The Action Plan for

Australian Bats

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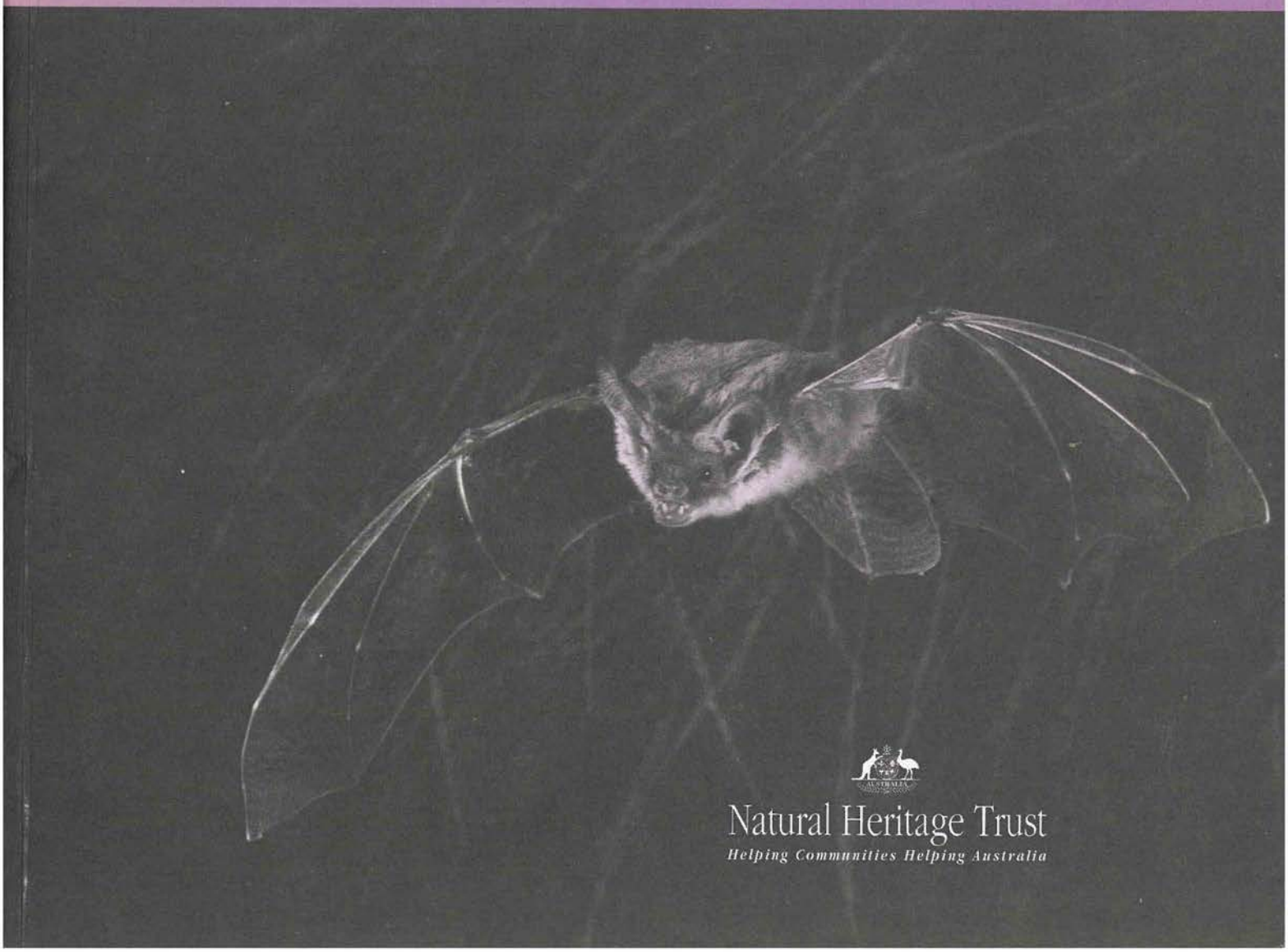
With assistance from the
Editorial Panel



Natural Heritage Trust
Helping Communities Helping Australia

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Edited by
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With assistance from the Editorial Panel
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Cover photograph of Eastern Long-eared Bat (*Nyctophilus timoriensis* south-eastern form) by Barry Baker, Environment Australia
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Foreword

Bats are one of the least known and most mysterious groups of mammals in the minds of the public. Traditionally they have been viewed as animals which belong in the realm of horror movies, with an appeal akin to spiders, snakes, creepy-crawlies and other much-maligned animals. They are gradually being given better press as scientific study reveals the wonderful intricacies of their biology and as public awareness of the role they play in plant pollination and regulation of insect numbers improves.

In recent times bats have been brought into the spotlight as their management has become an issue of community concern. Two flying-fox species, *Pteropus conspicillatus* and *Pteropus poliocephalus,* feed on fruit and have for a long time been regarded by commercial fruit growers as 'pest species' inflicting commercial damage on fruit crops in Eastern Australia. Traditionally, shooting has been the main method for crop protection. However, as this Action Plan demonstrates, conservation of both species has also become a concern as habitat clearance continues to increase. The development of effective non-lethal crop protection techniques is a challenge facing the community, which is essential to the long-term conservation of these species.

Another recently emerged issue of community concern is the danger posed by viral diseases carried by bats, Australian Bat Lyssavirus and Equine Morbillivirus (Hendra virus) and Menangle Pig Virus. Not only are potential effects on bats unknown, but the first two of these viral diseases have been transmitted to humans with fatal results. Management of public health issues wherever bats and humans interact has thus become a real necessity.

In terms of species numbers, bats are the second largest group of mammals in the world, the 950 or so bat species from 18 families comprising one fifth of all mammal species. In Australia there are 90 taxa from seven families, and these comprise 25% of the Australian terrestrial mammal fauna.

Bats appear to have survived European settlement of Australia better than other mammal groups, possibly because of their mobility. While there have been local extinctions of populations, no species has become extinct. However, the effects of human settlement are apparently creeping up on bats: the major threats identified in this Action Plan include habitat clearing, roost disturbance and forestry harvesting. Of the 90 bat taxa recognised in this Action Plan, one is extinct, nine are critically endangered, endangered or vulnerable, one is conservation dependent, 11 are considered to be 'near threatened' (close to being considered vulnerable), and 14 species are 'data deficient'. Thus, almost half of all bat species are of some conservation concern or the knowledge is lacking to determine their conservation status.

Development of this *Action Plan for Australian Bats* has been a long and arduous task, originally commencing in 1990. The process has been successful in bringing together and focussing Australian bat researchers on the conservation status of species and the actions necessary to conserve species. The Action Plan can now serve as a benchmark of knowledge from which conservation status can be better judged in the future. It will play a key role in determining priorities for conservation research and management necessary to conserve Australia's bat species.

Stephen Hunter
Head of Biodiversity Group
Environment Australia

Contents

Summary

This Action Plan, which was prepared for Environment Australia, reviews the conservation status of 90 taxa of Australian bats. Development commenced several years ago and builds upon comments arising from two workshops that were held in 1996 and 1997. Comments and advice were also sought from individuals with bat expertise and ANZECC agencies. An editorial panel was convened in 1998 to finalise listings against the IUCN criteria, make taxonomic decisions and finalise the text of the recovery outlines and taxon summaries.

This Action Plan lists one taxa as Extinct (EX), two taxa as Critically Endangered (CR), three as Endangered (EN), four as Vulnerable (VU), one as Lower Risk conservation dependent [LR(cd)], 11 as Lower Risk near threatened [LR(nt)], 14 as Data Deficient [DD], and 54 as Lower Risk least concern [LR(lc)]. Recovery outlines are presented for all taxa listed here as EX, CR, EN and VU. Briefer taxon summaries are presented for taxa listed as LR(cd), LR(nt) and DD.

This Action Plan highlights the high proportion of Australian bats that are threatened with extinction. The main causes of decline in bats have been identified and include habitat clearing, disturbance of roosts, forest harvesting and the collapse, closure or re-working of old mines.

This Action Plan, through the recovery outlines and taxon summaries, demonstrates what needs to be done to conserve Australia's bats. In most cases, what needs to be done is clear; what is required is the commitment and resources to carry out the necessary work.

Acknowledgements

The Editors and Editorial Panel wish to thank Environment Australia for funding the preparation of this Action Plan through the Endangered Species Program.

This Action Plan could not have been prepared without the assistance of many members of the Australasian bat research community, who generously contributed their knowledge and time. The Editors and Editorial Panel are extremely grateful to all those who helped and especially to those who responded to our many requests for extra information. A full list of people who contributed to preparation of this Action Plan can be found in Appendix B.

The considerable work of Greg Richards and Les Hall, who prepared earlier drafts of the Action Plan and provided access to their personal records, is also acknowledged. We are also grateful to Andrew Burbidge, Sally Bryant, Sue Churchill, Roger Coles, Peggy Eby, Murray Ellis, Les Hall, Greg Richards, Dick Schodde, Martin Schulz, Chris Tidemann, Jeremy Thompson, Bruce Thomson and Michael Vardon who provided detailed comment on the final draft.

1 Introduction

1.1 History of the Action Plan

This Action Plan for Australian Bats was commissioned by the Australian National Parks and Wildlife Service (now the Biodiversity Group of Environment Australia), through the Endangered Species Program (ESP).

Development of the Action Plan commenced in November 1990, when a contract for the Action Plan was awarded for its preparation to the University of Queensland. The team preparing the Plan was Mr Greg Richards, Dr Les Hall and Dr Chris Tidemann. A draft was subsequently completed by Greg Richards and Les Hall in March 1994. This draft was prepared prior to the International Union for Conservation of Nature and Natural Resources (IUCN) completing development of new criteria for allocating taxa to to Red List categories. In addition, data from Western Australia was not able to be included, necessitating a review of the document.

A second contract was awarded to the Commonwealth Scientific and Industrial Research Organisation in December 1994 to incorporate Western Australian data and to review the status of bat taxa using the revised IUCN (November 1994) criteria. This work was assigned by CSIRO to Greg Richards and Les Hall.

In April 1994 at an Australasian Bat Conference in Lismore, a questionnaire with proposed IUCN categories was circulated for comment. In March 1996 a workshop was held as part of the 7th Australasian Bat Conference in Naracoorte South Australia. At this workshop a draft list of the proposed conservation status (as determined by IUCN categories) for all recognised taxa was distributed to participants. Comments on the draft list were invited. In August 1996 a further draft of the Action Plan was completed and circulated to reviewers and State and Territory conservation agencies for comment. This draft served as an extremely important focus for the 'bat community' in concentrating their ideas on the status of species and conservation issues.

In response to comments from reviewers and conservation agencies, a workshop was convened by Environment Australia in June 1997 to resolve issues raised in comments and assist in finalising the Action Plan. At this workshop the national species list was revised, the allocation of species to IUCN categories was reviewed, and commitments to update the information content of recovery outlines were made by experts for each species. It was also agreed that Environment Australia would convene an editorial panel to edit the final document. Subsequently, Mr Barry Baker, Ms Anne Duncan, Ms Lindy Lumsden, Ms Narelle Montgomery, Dr John Nelson, Mr Terry Reardon and Dr Norm McKenzie agreed to join the editorial panel.

The Editorial Panel met in April 1998 to finalise taxonomic decisions, assignment of Red List Categories and recovery outlines and taxon summaries for the plan. The document was then edited by Environment Australia officers Anne Duncan, Barry Baker and Narelle Montgomery. Environment Australia circulated the final plan to ANZECC agencies for review and the draft was amended as appropriate.

1.2 Aim of the Action Plan

The aim of the Action Plan is to:

- provide a national overview of the conservation status of bats, including assessment of taxa using IUCN Categories, identification of threats and recommendation of actions;
- identify habitats or areas of particular importance for bat conservation including key areas or habitats for endangered and vulnerable taxa;
- identify processes threatening bats, in particular those taxa in endangered and vulnerable categories, and identify areas where these processes are a problem; and
- recommend conservation priorities including research and management actions with particular emphasis on endangered and vulnerable taxa.

1.3 Methods

Species were subjectively assessed against IUCN criteria (IUCN 1994, Appendix A), initially by Greg Richards and Les Hall. This initial assessment was circulated for comment at the 7th Australasian Bat Conference at Naracoorte in 1996 and these categories were revised for the 1996 draft plan.

The categories ascribed in the 1996 draft plan were revised at the Environment Australia workshop in June 1997. Invited workshop participants consisted of Australian bat experts and representatives of State and Territory conservation agencies. A list of participants is provided in Appendix B. One of the main aims of the workshop was to ensure that all people with knowledge about the conservation status and conservation needs of species had an opportunity to have input into the Action Plan. Subsequent to the workshop, the status of some species was further discussed by the workshop participants, primarily using electronic mail.

Recovery outlines from the 1996 draft were sent to workshop participants who volunteered to update them. Comments on each species were then compiled into a final draft recovery outline and circulated to all the contributors.

Some suggestions and comments received subsequent to the 1997 workshop, primarily on the taxonomic and conservation status of taxa, required resolution. These issues were referred to the Editorial Panel, which met in April 1998 to finalise the Plan. Decisions taken by the Panel, where they depart significantly from those made at the 1997 workshop, are discussed in Chapter 2 and in the recovery outlines and taxon summaries.

1.4 Categories of threat

A complete taxonomic list of Australian bats and the category of threat assigned in this Action Plan, using the IUCN Categories of Threat (IUCN 1994), and sorted on status, is shown in Table 1.1. The complete taxonomic list of Australian bats is shown in Appendix D.

It should be noted that, for many taxa, comprehensive data required for accurate assessment of conservation status were not available. For those taxa where some data was available but this was incomplete, the 1996 workshop and the Editorial Panel endeavoured to allocate categories based on the use of the precautionary principle, as recommended in the preamble to the IUCN Red List Categories of Threat (IUCN 1994). For fourteen taxa there was insufficient data to make a meaningful allocation and so these were placed in the Data Deficient category.

1.5 Disagreements about categories of threat

For some species the categories of threat assigned by the Editorial Panel will be considered contentious. These species and the reasons for decisions taken by the Editorial Panel are discussed below.

Macroderma gigas

Some discussion is warranted here of the special case of *Macroderma gigas*. Previously, both the IUCN and the Australian Nature Conservation Agency (now Environment Australia) had classified *M. gigas* as Vulnerable. This species has a high profile in Australia, partly because of its striking appearance and carnivorous habit.

The designation of conservation category for *M. gigas* has been the subject of some consideration in the Action Plan. Historical evidence shows unequivocally that *M. gigas* has suffered a major range contraction over the last 200 years or so. It appears also to be vulnerable because of its dependence on a small number of mines and caves for breeding. However, when the June workshop considered the available evidence, it could not match any of IUCN criteria to keep *M. gigas* in a threatened category.

The issue is complicated because *M. gigas* is the only Australian bat species which has been subjected to genetic analysis for the purpose of understanding its population structure (Worthington-Wilmer et al. 1994). The results of this study, which examined four of the major known maternity sites, showed that there was strong genetic differences between populations at each of these sites. The suggestion from this study was that each site or population would be considered as a separate management unit, and that each unit would most likely satisfy IUCN criteria to be placed in a threatened category.

One option open to the Editorial Panel was to treat each major population of *M. gigas* as a separate conservation unit and prepare a Recovery Outline for each. However, the study of Worthington-Wilmer et al. (1994) did not examine all known main maternity sites nor is it clear where the boundaries are for each population. The Panel has therefore decided that, at this stage, *M. gigas* should be treated as a single taxon, and in the Recovery Outline has

recommended that further genetic work be carried out to complete the work of Worthington-Wilmer et al. (1994). Following that work, the question of how to treat the populations should be reconsidered. The Panel also recognises that *M. gigas* will be classified in threatened categories at the State and Territory level.

Pteropus poliocephalus and *Pteropus conspicillatus*

The listings of two species of *Pteropus*, *P. poliocephalus* (VU A2c, A2d, A2e) and *P. conspicillatus* (LR nt) were carefully debated. In the case of *P. poliocephalus*, a strong case was presented for listing as Vulnerable and it was agreed by the Editorial Panel that the species meets the appropriate IUCN criteria. The basis of the listing is projected population decline in response to documented on-going reduction in critical habitat in north east New South Wales and south east Queensland. In the case of *P. conspicillatus*, a consensus could not be reached on its conservation status by those reviewing the evidence. It was decided there was not sufficient information available on past or projected population decline for the species to be listed as threatened under IUCN criteria.

1.6 Recovery Outlines and Taxon Summaries

Recovery outlines are provided for all taxa listed as Extinct, Critically Endangered, Endangered and Vulnerable. Briefer 'Taxon Summaries' are provided for taxa listed as Lower Risk (near threatened), Lower Risk (conservation dependent) and Data Deficient.

Recovery outlines provide estimated costs of staff and other resources for recovery of species. These are based on the best information provided to the authors, but should be considered as a guide only, rather than being definitive. It is envisaged that detailed costs will be worked out as Recovery Plans are developed. A summary of the estimated cost of implementing this Action Plan is provided at Appendix C.

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Table 1.1 Complete list and conservation status of Australian bat taxa, with IUCN Red List category allocated by this Action Plan, sorted by status.

CR critically endangered; EN endangered; VU vulnerable; LR (nt) lower risk near threatened; LR (cd) lower risk conservation dependent; LR (lc) lower risk least concern; DD data deficient. The criteria for allocating a status of CR, EN or VU to a taxon are shown in brackets (refer Appendix A for further detail).

Species	Common name	Status
Nyctophilus howensis	Lord Howe Long-eared Bat	EX
Saccolaimus saccolaimus nudicluniatus	Bare-rumped Sheathtail Bat	CR (A1a)
Taphozous troughtoni	Troughton's Sheathtail Bat	CR (B1, B2c)
Pipistrellus murrayi	Christmas Island Pipistrelle	EN (C1)
Rhinolophus philippinensis (large form)	Greater Large-eared Horseshoe Bat	EN (C2a)
Hipposideros semoni	Semon's Leaf-nosed Bat	EN (C2a, D)
Pteropus poliocephalus	Grey-headed Flying-fox	VU (A2c, A2d, A2e)
Rhinonicteris aurantius (Pilbara form)	Pilbara Leaf-nosed Bat	VU (A1c, B1, B2c)
Chalinolobus dwyeri	Large-eared Pied Bat	VU (A1a, C2a)
Nyctophilus timoriensis (South-eastern form)	Eastern Long-eared Bat	VU (A1c, A2c)

(Continued next page)

Species	Common name	Status
Pteropus conspicillatus	Spectacled Flying-fox	LR (nt)
Dobsonia moluccensis magna	Bare-backed Fruit Bat	LR (nt)
Macroderma gigas	Ghost Bat	LR (nt)
Taphozous australis	Coastal Sheathtail Bat	LR (nt)
Chalinolobus picatus	Little Pied Bat	LR (nt)
Falsistrellus mackenziei	Western False Pipistrelle	LR(nt)
Kerivoula papuensis	Golden-tipped Bat	LR (nt)
Murina florium	Tube-nosed Insectivorous Bat	LR (nt)
Myotis macropus	Southern Myotis	LR (nt)
Nyctophilus timoriensis (Central form)	Central Long-eared Bat	LR (nt)
Scoteanax rueppellii	Greater Broad-nosed Bat	LR(nt)
Miniopterus schreibersii (Southern form)	Southern Bent-wing Bat	LR (cd)
Pteropus sp. (Moa Island)	Torresian Flying-fox	DD
Pteropus brunneus	Percy Island Flying-fox	DD
Pteropus melanotus natalis	Christmas Island Flying-fox	DD
Nyctimene cephalotes	Torresian Tube-nosed Bat	DD
Rhinolophus philippinensis (small form)	Lesser Large-eared Horseshoe Bat	DD
Hipposideros diadema inornatus	Arnhem Leaf-nosed Bat	DD
Hipposideros stenotis	Northern Leaf-nosed Bat	DD
Taphozous kapalgensis	Arnhem Sheathtail Bat	DD
Saccolaimus mixtus	Papuan Sheathtail Bat	DD
Mormopterus loriae cobourgiana	Little North-western Freetail Bat	DD
Mormopterus norfolkensis	East Coast Freetail Bat	DD
Mormopterus sp. (form sp. 6 in Adams et al. 1988)	Hairy Rostrum Freetail Bat	DD
Scotorepens sp.	Central-eastern Broad-nosed Bat	DD
Vespadelus douglasorum	Yellow-lipped Cave Bat	DD
Pteropus scapulatus	Little Red Flying-fox	LR (lc)
Pteropus alecto gouldi	Black Flying-fox	LR (lc)
Pteropus macrotis epularius	Large-eared Flying-fox	LR (lc)
Nyctimene robinsoni	Eastern Tube-nosed Bat	LR (lc)
Syconycteris australis	Eastern Blossom Bat	LR (lc)
Macroglossus minimus nanus	Northern Blossom Bat	LR (lc)
Rhinolophus megaphyllus ignifer	Northern Horseshoe Bat	LR (lc)
Rhinolophus megaphyllus megaphyllus	Southern Horseshoe Bat	LR (lc)
Hipposideros ater aruensis	Eastern Dusky Leaf-nosed Bat	LR (lc)
Hipposideros ater gilberti	Western Dusky Leaf-nosed Bat	LR (lc)
Hipposideros cervinus	Fawn Leaf-nosed Bat	LR (lc)
Hipposideros diadema reginae	Diadem Leaf-nosed Bat	LR(lc)
Rhinonicteris aurantius	Orange Leaf-nosed Bat	LR (lc)
Taphozous georgianus	Common Sheathtail Bat	LR (lc)
Taphozous hilli	Hill's Sheathtail Bat	LR (lc)
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	LR (lc)
Tadarida australis	White-striped Freetail Bat	LR (lc)
Chaerephon jobensis plicatus	Northern Freetail Bat	LR (lc)

Species	Common name	Status
Mormopterus beccarii	Beccari's Freetail Bat	LR (lc)
Mormopterus loriae ridei	Little North-eastern Freetail Bat	LR (lc)
Mormopterus sp. * (form sp. 4, Populations P, Q and R, in Adams et al. 1988)	South-eastern Freetail Bat	LR (lc)
Mormopterus sp. * (form sp. 3 in Adams et al. 1988)	Inland Freetail Bat	LR (lc)
Mormopterus sp. * (form sp. 4, Population O, in Adams et al. 1988)	South-western Freetail Bat	LR (lc)
Mormopterus sp.* (form sp. 2 in Adams et al. 1988)	Eastern Freetail Bat	LR (lc)
Chalinolobus gouldii	Gould's Wattled Bat	LR (lc)
Chalinolobus morio	Chocolate Wattled Bat	LR (lc)
Chalinolobus nigrogriseus	Hoary Wattled Bat	LR (lc)
Falsistrellus tasmaniensis	Eastern False Pipistrelle	LR (lc)
Miniopterus australis	Little Bent-wing Bat	LR (lc)
Miniopterus schreibersii orianae	Northern Bent-wing Bat	LR (lc)
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	LR (lc)
Myotis moluccarum	Northern Myotis	LR (lc)
Nyctophilus arnhemensis	Arnhem Long-eared Bat	LR (lc)
Nyctophilus bifax bifax	Northern Long-eared Bat	LR (lc)
Nyctophilus bifax daedelus	Pallid Long-eared Bat	LR (lc)
Nyctophilus geoffroyi	Lesser Long-eared Bat	LR (lc)
Nyctophilus gouldi	Gould's Long-eared Bat	LR (lc)
Nyctophilus timoriensis sherrini	Tasmanian Long-eared Bat	LR (lc)
Nyctophilus timoriensis major	Western Long-eared Bat	LR (lc)
Nyctophilus walkeri	Pygmy Long-eared Bat	LR (lc)
Pipistrellus adamsi	Cape York Pipistrelle	LR (lc)
Pipistrellus westralis	Northern Pipistrelle	LR (lc)
Scotorepens balstoni	Inland Broad-nosed Bat	LR (lc)
Scotorepens greyii	Little Broad-nosed Bat	LR (lc)
Scotorepens orion	South-eastern Broad-nosed Bat	LR (lc)
Scotorepens sanborni	Northern Broad-nosed Bat	LR (lc)
Vespadelus baverstocki	Inland Forest Bat	LR (lc)
Vespadelus caurinus	Northern Cave Bat	LR (lc)
Vespadelus darlingtoni	Large Forest Bat	LR (lc)
Vespadelus finlaysoni	Finlayson's Cave Bat	LR (lc)
Vespadelus pumilus	Eastern Forest Bat	LR (lc)
Vespadelus regulus	Southern Forest Bat	LR (lc)
Vespadelus troughtoni	Eastern Cave Bat	LR (lc)
Vespadelus vulturnus	Little Forest Bat	LR (lc)

2 Taxonomy and selection of taxa for this action plan

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2.1 Aim

The purpose of this chapter is to:

- review the current state of Australian bat taxonomy;
- describe the decision making process for the selection of taxonomic units;
- summarise the justifications for the selection of taxonomic units where these selections were based on unpublished data; and
- list the known forms of Australian Chiroptera.

2.2 Current status of bat taxonomy in Australia

In the most recent published review of the state of Australian bat taxonomy, Parnaby (1991) argued that at least two thirds of the then recognised bat species were in need of taxonomic clarification. While several new taxonomic studies have since been completed or commenced (involving species of *Pteropus, Nyctimene, Miniopterus, Myotis, Hipposideros, Rhinolophus* and *Macroderma*) most have served only to elucidate further problems. Thus, if the same four criteria used by Parnaby (1991) are applied to the currently known species, then the proportion of species requiring taxonomic clarification has not significantly altered since 1991.

The current problems facing species level systematics within Australian Chiroptera are summarised in Table 2.1. The problems identified have been compiled from both published and unpublished studies, and from the considered opinions of experienced bat biologists familiar with the taxa in question.

Moreover, changes in generic level systematics in the following genera can be expected from comparisons of Australian representatives with supposed extra limital congenors: *Macroglossus, Nyctimene, Rhinolophus, Hipposideros, Saccolaimus, Taphozous, Chalinolobus, Kerivoula, Miniopterus, Myotis, Murina, Chaerephon* and *Tadarida*.

It is clear that Australian bat taxonomy is currently in an extremely parlous state, despite the fact that so many of the problems outlined above have been known to bat biologists for over a decade.

If the problems are so readily identifiable, why then has Australian bat taxonomy been so neglected? The answer appears to lie in a combination of lack of commitment to bat taxonomy by professional mammalian systematists, who at least have the institutional resources to undertake the necessary work, and lack of resources (both institutional and financial) available for those who are willing to undertake the necessary work but whose main profession is not taxonomy. The latter circumstance is exemplified by the current status of two major generic revisions, namely *Nyctophilus* and *Mormopterus*. These two genera account for 22% of all taxa listed in this Action Plan and comprise nine undescribed species. Both revisions were all but completed many years ago, but their publication has stalled through lack of financial support to the respective investigators involved.

One area of bat systematics which has burgeoned in recent years is that involving molecular biology. The molecular approach to taxonomy has already made an important contribution to resolving cryptic species problems in Australian bats, and will increasingly influence all hierarchical levels of bat systematics. Perhaps the most important role for molecular biology will be in defining 'Management Units' and 'Evolutionarily Significant Units' which can be used for prioritising conservation effort (Moritz 1994). Thus far, the only Australian bat species studied at this level is the ghost bat, *Macroderma gigas* (Worthington-Wilmer et al. 1994).

Table 2.1 Australian bat taxa requiring taxonomic clarification at the species-level.

Genus	Species	Problem summary	Current research status
Pteropus	sp.(Moa Island)	Torres Strait form recognised as a new species based on morphology (Richards and Hall in prep.). This has been disputed (Coles 1997, Tidemann 1997	Further taxonomic work in progress (Richards and Hall – University of Queensland).
Pteropus	*alecto*	Two distinct size classes in Australia (Vardon and Tidemann 1997).	unknown
Pteropus	*macrotis*	Suggested that the subspecies *epularius* will be elevated to full species (Richards and Hall pers. comm.).	unknown
Nyctimene	*robinsoni*	Genetic data failed to distinguish this taxon from New Guinea *albiventer* (Donnellan et al. 1995). Northern NSW specimens also need to be compared with Queensland specimens (Parnaby pers. comm.).	Genetic work in progress (Irwin, Hall and Moritz – University of Queensland).
Nyctimene	*cephalotes*	Specimens from Torres Strait and a specimen from Cape York designated *Nyctimene* sp. (*cepholotes* form) appear morphologically distinct (Hall and Richards pers. comm.).	Genetic work in progress (Irwin, Hall and Moritz – University of Queensland).
Hipposideros	*diadema*	Two subspecies are recognised and are expected to be elevated to species.	Genetic study in progress (Adams – SA Museum).
Saccolaimus	*saccolaimus*	Queensland and NT populations are allopatric and separated by a large distance – possibly two species.	unknown
Rhinolophus	all forms	Species boundaries remain unresolved – possibly four species present.	Genetic (Reardon and Cooper – SA Museum) and morphological and echolocation studies (Coles – University of Sydney, and Clague – University of Queensland) in progress.
Rhinonicteris	*aurantius*	Pilbara form differs in morphology and echolocation call (McKenzie and Start pers. comm.).	unknown
Myotis	*adversus* subsp. indet.	The validity of this species is questioned (Reardon).	Genetic studies in progress (Reardon, Cooper, Day – SA Museum).
Nyctophilus	*timoriensis*	Sibling species proposed (Parnaby).	Genetic and morphological studies mostly completed (Parnaby – Australian Museum, Adams – SA Museum); funding required to complete.
Nyctophilus	*bifax*	Sibling species proposed (Parnaby).	as above
Nyctophilus	*gouldi*	Two disjunct populations present, requires taxonomic resolution. There is also morphological variation amongst eastern forms (Parnaby pers. comm.).	Morphological studies mostly completed (Parnaby – Australian Museum); funding required to complete.

Table 2.1 (continued).

Genus	Species	Problem summary	Current research status
Pipistrellus	*murrayi*	Taxonomic affinities to *P. tenuis* requires clarification (Lumsden pers. comm.).	unknown
Miniopterus	*schreibersii* complex	Sibling species proposed (Reinhold, Reardon, Adams and Lara, in prep. – University of Queensland, S.A. Museum in prep.).	Further genetic and morphological studies in progress (Cardinal – University of Melbourne).
Murina	*florium*	The taxonomic relationship between the Iron Range specimen and Wet Tropics specimens is unresolved (Coles pers. comm.).	unknown
Scotorepens	sp. nov.	A morphologically distinct form recognised, taxonomic status unresolved (Parnaby 1992).	Genetic study in progress (Reardon – SA Museum).
Scotorepens	*balstoni*	Morphological and genetic variation may indicate cryptic species (Parnaby pers. comm., Baverstock et al. 1987).	unknown
Scotorepens	*greyii/sanborni*	Species boundaries in this group remain equivocal (Kitchener and Caputi 1985; Parnaby pers. comm.).	unknown
Vespadelus	*regulus*	Genetic discontinuity warrants further examination (Adams et al. 1987).	unknown
Vespadelus	*vulturnus*	Morphological variants suggestive of cryptic species (Parnaby, Hoye pers. comm.)	
Chalinolobus	*morio*	Morphological and roosting habitat variation suggests further investigation (Hall and Richards, Parnaby, Hoye pers. comm.).	unknown
Mormopterus	most species	Species boundaries unresolved formally.	Genetics published (Adams et al. 1988), morphology finished but requires examination of types, funding required for completion (McKenzie – WA CALM, and Reardon – SA Museum). Funding required to complete.

Taxonomic research is fundamental to the conservation of Australia's bat fauna because it is impossible to conserve a taxon until it has been described. The slow pace of resolution of taxonomic problems is recognised as a major impediment to bat conservation in Australia. As a result, support for taxonomic research has been set as a high priority in this Action Plan.

2.3 Decision process for defining taxa

The definition of taxa for the Action Plan has involved rigorous consultation with Australian bat researchers. Mr Greg Richards and Dr Les Hall initially compiled a 'List of Australian Bat Taxa' for the July 1996 Draft Action Plan, based primarily on Mahoney and Walton (1988), but modified to accommodate subsequently published accounts and their knowledge of unpublished data. This list formed the basis for discussion at the June 1997 workshop (refer Chapter 1, this volume). Several amendments (additions and deletions) were made to the list, again based on newly available and unpublished data. Inevitably, there was debate over some decisions and, while not all workshop participants supported all the decisions, a list was finally

agreed upon. Further debate on particular taxa ensued over the following 12 months. In April 1998 the Editorial Panel convened, considered arguments for defining taxa still in dispute, and determined a final list of taxa for the Action Plan.

2.4 Taxonomic decisions

2.4.1 Philosophy

The IUCN Red List Categories booklet explicitly states that criteria for listing of taxa can be applied to 'any taxonomic unit at or below the species level ... including forms that are not yet formally described' (IUCN 1994). The guiding principle adopted by Richards and Hall, the June workshop participants and the Editorial Panel was that for the Action Plan to be relevant for at least five years, it should take account of all data available, including unpublished data, when defining taxonomic units.

2.4.2 Nomenclature

In deciding to use unpublished taxonomic studies (those which propose the recognition of new species) and published genetic studies (which delineate species boundaries but have no formal diagnoses or nomenclature), the Editorial Panel has been careful to avoid pre-empting unpublished scientific taxonomic names. It has also been recognised that considerable time may pass before the backlog of species-level taxonomic problems are solved, and therefore the nomenclature used here may become widely adopted. The application of names for some taxonomic units proved to be challenging.

Common names have been given to each taxon, whether it be a formally described species or subspecies, anticipated new species or conservation unit. The common names used were derived either from Richards et al. (1993) or newly applied by the Editorial Panel.

Scientific names have been dealt with in the following manner. Since most of the proposed (unpublished) new species are elevations from subspecies, the taxa are simply referred to by their subspecific names (denoted in Table 2.2 with an asterisk). It should be noted that not all subspecies listed are proposed for elevation to full species. Where anticipated species complexes have been delineated, each taxon is referred to by the parent species name but distinguished as a geographic 'form'. For some proposed or suspected new species, the term 'sp.' is used with the corresponding generic name. The naming of taxa in the genus *Mormopterus* has been particularly difficult and it remains somewhat clumsily dealt with here. Four of the species have existing names which are considered to be correctly assigned, but the identities of the remaining five are uncertain and are therefore referred to as 'sp.' together with a reference to the population defined in the published genetic study of Adams et al. (1988).

2.4.3 Justification

Because the selection of taxa has relied so heavily upon unpublished data and opinion, and because some of the decisions to include or leave out specific taxa have been strongly debated, the rationale for the selection or omission of taxa are outlined below.

Pteropus sp. (Moa Island)

There has been considerable contention over the recognition of this taxon as being distinct from *P. alecto*, (both are sympatric on Moa Island, Torres Strait). This putative new species was first distinguished by Greg Richards and Les Hall based on morphology (it is smaller in many characters, significantly different in cranial characters and has a different shaped baculum). A paper describing the new species was submitted to the Australian Zoologist and was 'returned to the authors for revision' – this paper is currently being revised (Richards and Hall in prep.). The June workshop discussed this issue at length and finally agreed (but with dissenters) to include it on the list. Subsequently, the specimens used in the Richards et al. study were re-examined and those specimens previously assigned to the new 'species' were judged to be either juvenile or neotenous *P. alecto* (R. B. Coles 1997, C.R. Tidemann 1997). Richards and Hall (pers. comm.) reject these findings. This issue remains unresolved. The Editorial Panel, having considered the evidence, agreed to include this taxon as *Pteropus* sp. in the Action Plan, but to make taxonomic resolution a precursor to allocation of further funding for conservation.

Nyctimene cephalotes and *N. cf. vizcaccia*

Specimens referrable to *N. cephalotes* have been collected from Silver Plains, Cape York and from Moa Island, Torres Strait. The forms from each locality are morphologically distinct (Hall and Richards pers. comm.). The Moa Island specimens were previously identified as *N. vizcaccia* (Richards 1995), however Bonnacorso (1999) refers to the same specimens as being *N. cephalotes*.

The species level taxonomy of Australo-Papuan *Nyctimene* is not fully resolved (Donnellan et al.

1995). The Editorial Panel has accepted the opinion of Hall and Richards that the two forms are morphologically distinct but treat both forms under the name *N. cephalotes*.

Rhinolophus

The species-level taxonomy of Australian rhinolophids has been problematical. Two species are recognised formally, namely *R. megaphyllus* and *R. philippinensis*. For nearly two decades a third form, intermediate in size between the two named species, has been known. This form has a distinct echolocation call (Coles 1993) and, although morphologically distinct, has nose-leaf characters similar to *R. philippinensis* (Churchill 1998). Recent genetic analysis (at a level usually capable of distinguishing between individuals at the population level) has failed to distinguish between the intermediate size form and *R. philippinensis*. Most of the workshop panel who are familiar with these forms, agree on treating the intermediate size form as a separate taxon. They have both been named here as *R. philippinensis*, large and small form, although it is not resolved which of the two, or in fact if either, are referable to true *philippinensis*.

The recognition of two forms within *R. megaphyllus* is based on recent convincing DNA evidence (Cooper, Reardon and Skilins 1998). Although the distribution boundaries have not been well defined, the populations are essentially separated into north and south forms. To distinguish them, the earlier discarded subspecies names have been reapplied: *R. m. megaphyllus* for the southern form and *R. m. ignifer* for the northern form.

Rhinonicteris aurantius

Morphological characters of the Pilbara population reflect a functional requirement to forage efficiently in low productivity environments of the arid Pilbara region. On the basis of the differences listed below (N.L. McKenzie and A.N. Start pers. comm.), two taxa are recognised in this Action Plan.

Mormopterus species

Although the species level taxonomy of *Mormopterus* is now mostly resolved in an informal sense, the inconsistent use of common names has served to make this genus one of the most poorly known in Australia. Independently conducted revisions based on genetics (Adams et al. 1988) and morphology (McKenzie unpub.) are in agreement on species boundaries. Based on these taxonomic revisions, nine taxa are recognised. However, nomenclatural clarification is contingent upon examination of type material, which is held in overseas institutions.

Scotorepens sp.

Parnaby (1992) reported on a new form of *Scotorepens* from coastal eastern Australia. This form differs on skull, dental and external morphology from *S. balstoni* and *S. orion*, and differs from *S. greyii* on skull morphology (Parnaby unpub.). This taxon has been recognised as a distinct species, *Scotorepens* sp., for the purposes of the Action Plan.

Nyctophilus timoriensis

The 1997 workshop accepted the opinion of Parnaby (1988), based on his revision of the genus *Nyctophilus*, that *N. timoriensis* contained three morphologically distinct forms.

Myotis adversus complex

The most recently published taxonomic revision of *Myotis adversus* is by Kitchener et al. (1995). Based on morphological variation, *M. adversus* (*sensu lato*) was split into three species – *M. macropus*, *M. adversus* and *M. moluccarum*. Whilst there has been widespread acceptance of two of the species in Australia, there remains considerable scepticism over the third (*M. adversus*). The main arguments are that the evidence for recognising *M. adversus* in Australia was based on measurements of only a single specimen (from near Lismore New South Wales), and that the Lismore specimen was the only

Region	Echolocation Frequency for CF component (kHz) (range)	Wing Aspect Ratio (s.d.)	Wing Loading (g/cm^2) (s.d.)	N
Pilbara	125 (122–128)	6.54 (0.04)	0.066 (0.002)	6
Kimberley	112 (110–119)	6.29 (0.01)	0.058 (0.04)	4

New South Wales specimen included in the study – there was a large gap in sampling in New South Wales.

The nearest locality elsewhere for *M. adversus* (*sensu stricto*) is in Indonesia. Kitchener et al. (*op cit.*) were tentative about the placement of the New South Wales specimen in *adversus*, and inspection of the Discriminate Function Analysis (DFA) plots reveals that the placement of this specimen is speculative with respect to all three species. The reliability of the DFA analysis is further diminished because no other New South Wales specimens were included.

Analysis of mitochondrial DNA sequence data (Day, Cooper and Reardon unpub.), which used the same Lismore specimen included in the Kitchener et al. study, found:

- Indonesian *adversus* forms a distinct clade from the clade that includes all Australian *Myotis*;
- there are two clades within Australia but the genetic distance between them gives only weak support for the recognition of two species; and
- the Lismore specimen and one south-eastern Queensland specimen fall in the *macropus* clade.

On this evidence, *M. adversus* has been excluded from the list of Australian taxa.

Miniopterus schreibersii

In a taxonomic review of Australo-Papuan *Miniopterus*, Reinhold (1997) presented molecular and morphological evidence to support the recognition of at least two species within *M. schreibersii* within Australia. Although formal publication of these results will be some months away, it is expected that *M. s. orianae* will be elevated to full species status, leaving *M. s. oceanensis* as the form in eastern Australia. Reinhold did not examine the extreme southern populations of *M. schreibersii* (those from Naracoorte, South Australia and Warrnambool, Victoria) which have been considered as being distinct from eastern Australian forms based on morphology, genetics and breeding patterns (Hamilton-Smith 1972, Hand 1980, Maeda 1982, Wilson 1982, Cardinal 1997, Reardon unpub.). Indeed, Maeda (1982) formally recognised the southern forms as part of the *M. macrodens* group, which is otherwise widely distributed through Indonesia and Malaysia. However Maeda's work has not been widely accepted. The Editorial Panel felt there was sufficient evidence to recognise three forms of *M. schreibersii* in Australia, the two named subspecies, *orianae* and *oceanensis* , and the geographical variant based on the Naracoorte population (southern form).

2.5 List of Australian bat taxa

The list ultimately adopted by the Editorial Panel contains 90 taxa (Table 2.2).

Table 2.2 List of Australian bat taxa.

Pteropodidae (Fruit bats)	
Pteropus poliocephalus Temminck, 1825	Grey-headed Flying-fox
Pteropus scapulatus Peters, 1862	Little Red Flying-fox
Pteropus alecto gouldi Peters, 1867	Black Flying-fox
Pteropus sp.* (Moa Island)	Torresian Flying-fox
Pteropus brunneus Dobson, 1878	Percy Island Flying-fox
Pteropus conspicillatus Gould, 1850	Spectacled Flying-fox
Pteropus macrotis epularius * Ramsay, 1878	Large-eared Flying-fox
Pteropus melanotus natalis Thomas, 1887	Christmas Island Flying-fox
Dobsonia moluccensis magna Thomas, 1904	Bare-backed Fruit Bat
Nyctimene robinsoni Thomas, 1904	Eastern Tube-nosed Bat
Nyctimene cephalotes (Pallas, 1767)	Torresian Tube-nosed Bat
Syconycteris australis (Peters, 1867)	Eastern Blossom Bat
Macroglossus minimus nanus Matschie, 1899	Northern Blossom Bat
Megadermatidae (Ghost bats)	
Macroderma gigas (Dobson, 1880)	Ghost Bat
Rhinolophidae (Horseshoe bats)	
*Rhinolophus megaphyllus ignifer** Allen, 1933	Northern Horseshoe Bat
*Rhinolophus megaphyllus megaphyllus** Gray, 1834	Southern Horseshoe Bat
Rhinolophus philippinensis Waterhouse, 1843: (large form)	Greater Large-eared Horseshoe Bat
(small form)	Lesser Large-eared Horseshoe Bat

Table 2.2 (continued)

Hipposideridae (Leaf-nosed bats)	
Hipposideros ater aruensis Gray, 1858	Eastern Dusky Leaf-nosed Bat
Hipposideros ater gilberti Johnson, 1959	Western Dusky Leaf-nosed Bat
Hipposideros cervinus (Gould, 1854)	Fawn Leaf-nosed Bat
*Hipposideros diadema inornatus** McKean, 1970	Arnhem Leaf-nosed Bat
*Hipposideros diadema reginae** Troughton, 1937	Diadem Leaf-nosed Bat
Hipposideros semoni Matschie, 1903	Semon's Leaf-nosed Bat
Hipposideros stenotis Thomas, 1913	Northern Leaf-nosed Bat
Rhinonicteris aurantius (Gray, 1845)	Orange Leaf-nosed Bat
Rhinonicteris aurantius (Pilbara form)	Pilbara Leaf-nosed Bat
Emballonuridae (Sheathtail bats)	
Taphozous australis Gould, 1854	Coastal Sheathtail Bat
Taphozous georgianus Thomas, 1915	Common Sheathtail Bat
Taphozous hilli Kitchener, 1980	Hill's Sheathtail Bat
Taphozous kapalgensis McKean and Friend, 1979	Arnhem Sheathtail Bat
Taphozous troughtoni Tate, 1952	Troughton's Sheathtail Bat
Saccolaimus flaviventris (Peters, 1867)	Yellow-bellied Sheathtail Bat
Saccolaimus mixtus Troughton, 1925	Papuan Sheathtail Bat
Saccolaimus saccolaimus nudicluniatus (De Vis, 1905)	Bare-rumped Sheathtail Bat
Molossidae (Freetail bats)	
Tadarida australis (Gray, 1838)	White-striped Freetail Bat
Chaerephon jobensis plicatus (Thomas, 1906)	Northern Freetail Bat
Mormopterus beccarii Peters, 1881	Beccari's Freetail Bat
*Mormopterus loriae cobourgiana** Johnson, 1959	Little North-western Freetail Bat
*Mormopterus loriae ridei** Felten, 1964	Little North-eastern Freetail Bat
Mormopterus norfolkensis (Gray, 1839)	East Coast Freetail Bat
Mormopterus sp. * (form sp. 4, Populations P,Q and R, in Adams et al. 1988)	South-eastern Freetail Bat
Mormopterus sp. * (form sp. 3 in Adams et al. 1988)	Inland Freetail Bat
Mormopterus sp. * (form sp. 4, Population O, in Adams et al. 1988)	South-western Freetail Bat
Mormopterus sp.* (form sp. 2 in Adams et al. 1988)	Eastern Freetail Bat
Mormopterus sp.* (form sp. 6 in Adams et al. 1988)	Hairy Rostrum Freetail Bat
Vespertilionidae (Ordinary bats)	
Chalinolobus dwyeri Ryan, 1966	Large-eared Pied Bat
Chalinolobus gouldii (Gray, 1841)	Gould's Wattled Bat
Chalinolobus morio (Gray, 1841)	Chocolate Wattled Bat
Chalinolobus nigrogriseus (Gould, 1856)	Hoary Wattled Bat
Chalinolobus picatus (Gould, 1852)	Little Pied Bat
Falsistrellus mackenziei Kitchener, Caputi and Jones, 1986	Western False Pipistrelle
Falsistrellus tasmaniensis (Gould, 1858)	Eastern False Pipistrelle
Kerivoula papuensis Dobson, 1878	Golden-tipped Bat
Miniopterus australis (Tomes, 1858)	Little Bent-wing Bat
*Miniopterus schreibersii orianae** Thomas, 1922	Northern Bent-wing Bat
Miniopterus schreibersii oceanensis Maeda, 1982	Eastern Bent-wing Bat
Miniopterus schreibersii (Kuhl, 1819) (Southern form)	Southern Bent-wing Bat
Murina florium Thomas, 1908	Tube-nosed Insectivorous Bat
Myotis macropus Gould, 1855	Southern Myotis
Myotis moluccarum Thomas, 1915	Northern Myotis
Nyctophilus arnhemensis Johnson, 1959	Arnhem Long-eared Bat
*Nyctophilus bifax bifax** Thomas, 1915	Northern Long-eared Bat
*Nyctophilus bifax daedelus** Thomas, 1915	Pallid Long-eared Bat
Nyctophilus geoffroyi Leach, 1821	Lesser Long-eared Bat
Nyctophilus gouldi Tomes, 1858	Gould's Long-eared Bat
Nyctophilus howensis McKean, 1975	Lord Howe Long-eared Bat
*Nyctophilus timoriensis sherrini** Thomas, 1915	Tasmanian Long-eared Bat
*Nyctophilus timoriensis major** Gray, 1844	Western Long-eared Bat

Table 2.2 (continued)

Nyctophilus timoriensis (Geoffroy, 1806): (Central form)	Central Long-eared Bat
(South-eastern form)*	Eastern Long-eared Bat
Nyctophilus walkeri Thomas, 1892	Pygmy Long-eared Bat
Pipistrellus adamsi Kitchener, Caputi and Jones, 1986	Cape York Pipistrelle
Pipistrellus murrayi Andrews, 1900	Christmas Island Pipistrelle
Pipistrellus westralis Koopman, 1984	Northern Pipistrelle
Scoteanax rueppellii (Peters, 1866)	Greater Broad-nosed Bat
Scotorepens balstoni (Thomas, 1906)	Inland Broad-nosed Bat
Scotorepens greyii (Gray, 1843)	Little Broad-nosed Bat
Scotorepens orion (Troughton, 1937)	South-eastern Broad-nosed Bat
Scotorepens sanborni (Troughton, 1937)	Northern Broad-nosed Bat
Scotorepens sp.*	Central-eastern Broad-nosed Bat
Vespadelus baverstocki Kitchener, Jones and Caputi, 1987	Inland Forest Bat
Vespadelus caurinus (Thomas, 1914)	Northern Cave Bat
Vespadelus darlingtoni (Allen, 1933)	Large Forest Bat
Vespadelus douglasorum Kitchener, 1976	Yellow-lipped Cave Bat
Vespadelus finlaysoni Kitchener, Jones and Caputi, 1987	Finlayson's Cave Bat
Vespadelus pumilus (Gray, 1841)	Eastern Forest Bat
Vespadelus regulus (Thomas, 1906)	Southern Forest Bat
Vespadelus troughtoni Kitchener, Jones and Caputi, 1987	Eastern Cave Bat
Vespadelus vulturnus (Thomas, 1914)	Little Forest Bat

* taxa which are expected to be recognised as full species.

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3.1 RECOVERY OUTLINES

Lord Howe Long-eared Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Nyctophilus howensis* McKean, 1975
3	**Common name**	Lord Howe Long-eared Bat
4	**Conservation status**	Extinct

5 Intraspecific taxa

None.

6 Former distribution

Lord Howe Island.

7 Current distribution

None known.

8 Habitat

Not known. Skull of type specimen found on ledge in a small sink hole in palm forest.

9 Reasons for decline

Not known. Suspected to be introduced predators.

10 Conservation reserves on which species occurs

Lord Howe Island National Park (NSW).

11 Other public land on which species occurs

None.

12 Other land on which species occurs

None.

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

No. The species is known only from an incomplete skull collected inside Gooseberry Cave on Lord Howe Island, New South Wales, which was previously considered to be of subfossil age (McKean 1975). However, re-examination and aging by the Chemistry Department of the University of Queensland indicated that its age may only be 50-100 years (Richards and Hall unpublished). It is the largest of the Long-eared bats, and specifically distinct. The discoverer of the skull specimen, the late Dr G.F. Van Tets, advised that:

- the skull was found in Gooseberry Cave on North Head;
- the cave was small, about the size of a 3m x 3m office, with a mezzanine ledge upon which the skull was located and would be an ideal owl roost;
- he did not think that the skull was any different in age than the other bones (of birds) that he found further in the cave; and
- he felt that the skull was 100 years old at the most, and was most likely something that an owl had regurgitated sometime this century.

Since its description, mammalogists have searched Lord Howe Island unsuccessfully for this species. Les Hall carried out a search of all caves on North Head which did not reveal any live or skeletal material (Hall unpublished).

Glenn Hoye conducted a survey using bat traps and mistnets failed to find any *N. howensis* (Hoye unpublished). On this basis the species is now considered to be extinct.

14 Recovery objectives

- If found to be extant, increase understanding of the basic ecology of the species to determine:
  - —relative abundance;
  - —habitat requirements;
  - —roost and maternity site selection; and
  - —threatening processes.

15 Management and research actions completed

- Eradication of introduced masked owls completed.
- Rat management programs have been initiated as part of the management of Lord Howe Island National Park.

16 Management and research actions required

- If found to be extant, carry out ecological research to meet recovery objectives i.e. determine:
  - —population size and habitat requirements;
  - —threatening processes;
  - —roost and maternity site selection; and
  - —conservation status.

17 Organisation(s) responsible for conservation of species

New South Wales National Parks and Wildlife Service.

18 Other organisation(s)/individuals involved

None.

19 Bibliography

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Bare-rumped Sheathtail Bat

1	**Family**	Emballonuridae
2	**Scientific name**	*Saccolaimus saccolaimus nudicluniatus* (De Vis 1905)
3	**Common name**	Bare-rumped Sheathtail Bat
4	**Conservation status**	Critically Endangered (A1a)

5 Intraspecific taxa

Not known. This species was first described as *Taphozous nudicluniatus* [De Vis 1905] in Australia (see also Troughton 1925) but later it was synonymised with *T.* (= *Saccolaimus*) *saccolaimus* (Goodwin 1979). Four sub-species have been recognised (Koopman 1994) but Goodwin (1979) considered that there was too much variation in the form of this species to warrant identifying sub-species. The sub-species *S. saccolaimus nudicluniatus* has been referred to the north-east Queensland population (Koopman 1994) but the status of the discrete Northern Territory population has not been considered (McKean et al. 1981, Thomson 1991). The Northern Territory form appears to be distinct, as it is somewhat larger, with very dark brown (almost black) fur dorsally (McKean et al. 1981). This compares with the Queensland form that tends to be more uniformly brown to dark brown, and regularly flecked with white (Troughton 1925, Compton and Johnson 1983, Hall 1995). Unfortunately, individuals were not examined by Chimimba and Kitchener (1991) in their taxonomic revision of the Australian Emballonuridae, and so it is premature to describe the Northern Territory form as a sub-species.

6 Former distribution

Not well known. Historically, most specimens have been collected from quite a restricted and narrow coastal region (less than 40 km inland) between Ayr and Cooktown in Queensland (Ingram and Raven 1991), with one isolated specimen collected north of Coen on Cape York. Type locality for *Taphozous nudicluniatus* (= *S. saccolaimus*) is Babinda Creek near Cardwell (De Vis 1905). A quite separate population of this species, which was not discovered until relatively recently (McKean et al. 1981) appears to exist in the northern coastal regions of the Northern Territory (Thomson 1991). Extralimitally, this species has an extremely widespread distribution from India throughout south-east Asia (excluding The Philippines) to the Solomon Islands (Koopman 1994). Distribution is likely to extend, patchily perhaps, the length of Cape York, and possibly include some of the Torres Strait islands, as specimens of *S. nudicluniatus* (= *saccolaimus*) have been collected from the coastal plains of south-west Papua adjacent to Torres Strait (Waithman 1979).

7 Current distribution

Essentially unknown, as very few records exist (Ingram and Raven 1991). There have been no records in the past 16 years (as reported by McKean et al. 1981, Compton and Johnson 1983). It is not clear whether this species still exists in its former range, or whether the range has changed. It is possible that echolocation calls of *S. s.nudicluniatus* are being confused with *Tadarida australis*, as there are no specimens of *T. australis* collected in tropical Queensland, but many records based on echolocation calls.

8 Habitat

Open tropical woodland. Most specimens have been collected from coastal lowlands, at both eucalypt and rainforest dominated sites. Known to roost in tree hollows such as *Eucalyptus platyphylla* (= *alba*) as well as coastal caves. One confirmed maternity roosting site has been found in a *E. platyphylla* (Compton and Johnson 1983). This species may be critically dependent on suitable tree roosts in coastal, open eucalypt woodlands (Compton and Johnson 1983).

9 Reasons for decline

None can be confirmed, but the clearing of a significant proportion of coastal tropical woodland may pose a serious threat. Changes to the fire regime at the northern and southern limits along the east coast of north Queensland may also have caused decline.

10 Conservation reserves on which species occurs

Kakadu National Park, possibly Bowling Green Bay National Park. Edmund Kennedy National Park, Lakefield National Park Rokeby National Park, Jardine River National Park, Wet Tropics World Heritage Area (likely).

11 Other public land on which species occurs

Not known. Possibly mining and pastoral leases in Northern Territory and Queensland

12 Other land on which species occurs

Private land south of Townsville (Compton and Johnson 1983).

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

No.

14 Recovery objectives

- Clarify the current distribution and abundance of the species. In particular, determine if this species is still extant in Australia.
- Increase understanding of the basic ecology of the species to determine:
  - —habitat requirements;
  - —roost and maternity site selection; and
  - —threatening processes.
- Protect any habitats and roost sites where the species is found to occur.
- Assess whether there is a taxonomic distinction between Northern Territory and Queensland populations, and determine relationships to extralimital populations.

15 Management and research actions completed or underway

- Survey of c.1000 coastal caves in the Wet Tropics region (Clague, Coles and Whybird unpub.) has failed to locate this species, compared to the frequent presence of *Taphozous australis*, suggesting that it prefers woodland habitat for roosting and foraging.

16 Management and research actions required

- Intensive survey at known localities are required initially, followed by surveys to determine the distributional limits of the Northern Territory and Queensland populations.
- Carry out ecological research to meet recovery objectives i.e. determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —threatening processes; and
  - —whether populations of this species are viable.
- Clarify, if possible, the taxonomic status of populations in both the Northern Territory and Queensland by the use of existing (museum specimens) morphological material and molecular techniques.

17 Organisation(s) responsible for conservation of species

Environment Australia, Conservation Commission of the Northern Territory, Queensland Parks and Wildlife Service, Wet Tropics Management Authority.

18 Other organisation(s)/individuals involved

Local Shire/City councils.

19 Can recovery be carried out with existing resources?

No. The following is required:

Survey	$85,000
Ecological research	$100,000
Taxonomic studies	$ 10,000
	$210,000

(Survey costs based on 2 people for 6 months 50K plus expenses 18K, vehicle 12K and equipment 5K; research costs based on 1 person for 1 year 60K plus expenses 40K. To reduce costs this project could be combined with recovery actions for other species.)

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Authors for the species:

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Les Hall
Chris Clague

Troughton's Sheathtail Bat

1	**Family**	Emballonuridae
2	**Scientific name**	*Taphozous troughtoni* Tate, 1952
3	**Common name**	Troughton's Sheathtail Bat
4	**Conservation status**	Critically Endangered (B1, B2c)

5 Intraspecific taxa

Originally described as a 'new species' by Tate (1952), referring to 'the large species of north central Australia' and based on his own material collected from Mt. Isa. This view was taken despite being unable to resolve the taxonomic confusion over the real identity of *T. australis* and *T. georgianus* raised by Troughton (1925). McKean and Price (1967) retained the sub-species status of *T. g. troughtoni* as a 'race' of *T. georgianus*, a view also supported by Koopman (1984). Following these earlier taxonomic difficulties, the most recent revision of the Australian Emballonuridae by Chimimba and Kitchener (1991) recognises five species in the genus *Taphozous*, and clearly raises *T. troughtoni* to species level. As such, this species is the largest of the genus and, according to Chimimba and Kitchener (1991), does not belong to the *T. georgianus* size cline identified originally by McKean and Price (1967).

6 Former distribution

Unknown. Earlier taxonomic confusion included this species as part of the *georgianus* complex that is widely distributed over Australia (see Strahan 1983, 1995). In consideration of very meagre historical records, the former distribution is likely to be northern central Australia, in the southern Gulf region, as the first specimens were collected from Mt. Isa (Troughton 1925).

7 Current distribution

Very poorly known. Only six specimens have been collected (Tate 1952, Chimimba and Kitchener 1991) and it has only been recorded rarely in the last 34 years i.e. since McKean and Price (1967). This species has been collected from only three localities in the general Mt Isa — Mary Kathleen — Cloncurry area: a cave next to the Rifle Creek Dam (type locality of Tate 1952), the Native Bee Mine close to Mt. Isa, and a mine at Ballara. There is a recent record (measured and echolocation call recorded) from a rocky escarpment near Gunpowder, Queensland (Hall and De Oliveira unpub.). There are possible recent unconfirmed records from a disused railway tunnel at Ballara, and from a disused mine on Brightlands Station near Cloncurry.

8 Habitat

Roosting habitat open woodlands with spinifex *Triodia* spp., where it uses subterranean roosts such as caves and abandoned mines, as well as cracks and crevices in rocky escarpments. Roosting sites are similar to *T. georgianus*, and include entrances to caves and shallow overhangs which are not far from daylight. It is known to co-exist with *T. georgianus* as both species have been collected from the same (mine) roost (McKean and Price 1967, Chimimba and Kitchener 1991). No maternity sites have been located. Nothing is known of its foraging habitats.

9 Reasons for decline

From the limited data available, it is impossible to establish the size of the current population, whether it has declined and, if so, by how much. Destruction of one of the few known roost sites (the Native Bee Mine near Mt Isa), by mining activities in 1994, has been confirmed (Hall et al. 1998).

10 Conservation reserves on which species occurs

None known.

11 Other public land on which species occurs

Not known.

12 Other land on which species occurs

Mining leases in the Mary Kathleen area (leases held by Mt Isa Mines Pty Ltd). Freehold properties south of Mary Kathleen and Cloncurry if a record on Brightlands Station is confirmed.

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

No.

14 Recovery objectives

- Search for extra localities from re-examination of existing museum material.
- Clarify the taxonomic status of the species, from existing material if possible.
- If taxonomic status is confirmed:
  - —conduct field surveys to determine status and range;
  - —protect all known roost locations from disturbance and/or destruction; and
  - —increase understanding of the basic ecology of the species.

15 Management and research actions completed or underway

None.

16 Management and research actions required

- Examine all museum specimens of *T. georgianus* from west and north-west Queensland and the Northern Territory to determine if any are *T. troughtoni*. This action will help to clarify whether the distribution of *T. troughtoni* extends substantially further than is known at present.
- Clarify taxonomic status of this species using molecular techniques.
- Confirm if the species is present at the Ballara Railway tunnel. Prevent disturbance of roosting bats (if found) by erection of appropriately designed barriers or gates (tour operators drive through and cause disturbance to roosting bats at this location).
- Conduct targeted surveys in north-west Queensland i.e. the Mt Isa and Gulf of Carpentaria region, to obtain a better understanding of the distribution, status and roosting requirements of the species. In particular, locate maternity sites, roosts away from mining leases and identify key roost characteristics.
- Identify field characteristics that will assist in the identification of *T. troughtoni* from the closely related *T. georgianus*.
- Protect all known roosts from human visitation:
  - —by appropriate gating or signage (short term); and
  - —through conservation agreements with Queensland Department of Minerals and Energy (long term).
- Possible purchase of any land containing roost sites crucial to the survival of this species. This would be extremely important if it is found to be a good species and restricted to a few sites. Construction of alternative roosts in active mining areas might be feasible.

17 Organisation(s) responsible for conservation of species

Queensland Parks and Wildlife Service.

18 Other organisation(s)/individuals involved

Mt Isa Mines Pty Ltd, Queensland Department of Minerals and Energy, Brightlands Station.

19 Can recovery be carried out with existing resources?

No. The following is required:

Re-examination of museum specimens and taxonomic assessment	$5,000
Survey	$50,000
Protect known roosts	$20,000
Design suitable bat gate	$15,000
	$90,000

(Survey based on 2 people for 3 months 25K, expenses 9K, equipment 10K, vehicle 6K; design of bat gate based on employment of 1 person for 2 months 10K, equipment 5K; protect known roosts based on 1 person for 3 months 15K, equipment 5K. To reduce costs this project could be combined with recovery actions for other species).

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Authors for the species:

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Greater Large-eared Horseshoe Bat

1	**Family**	Rhinolophidae
2	**Scientific name**	*Rhinolophus philippinensis* Waterhouse, 1843
3	**Common name**	Greater Large-eared Horseshoe Bat
4	**Conservation status**	Endangered (C2a)

5 Intraspecific taxa

The taxonomy of this taxon at the species and subspecies level requires further clarification (see Taxonomy section for further discussion).

6 Former distribution

In Australia, distribution is confined to northern Queensland (eastern and coastal regions) from Paluma (near Townsville) to Iron Range on Cape York; and west to Chillagoe. *R. philippinensis* is common extralimitally, including south-east Asia (Flannery 1995a,b).

7 Current distribution

In Northern Queensland it is currently known from Malanda (Curtain Fig State Forest on the Atherton Tableland) to Iron Range on Cape York. There are recent western records from Chillagoe and Mitchell-Palmer Karsts.

8 Habitat

The species roosts in caves and mines. It forages mainly in open forest and wattle dominated ridges in rainforest. It has been observed foraging close to ground with possible gleaning behaviour (Pavey 1995a, b, Whybird 1996) and at canopy height (Whybird 1996). The largest known colony contains six individuals and day roosts often contain only one or two individuals. Will form colonies with *R. megaphyllus ignifer.*

9 Reasons for decline

The human disturbance of roost sites and collapse and intentional closure of old mines is also known to have occurred. For example, the Paluma mine was closed in 1994 as part of a program to 'Clean up the Wet Tropics World Heritage Area', destroying the site of the most southern record of *Rhinolophus philippinensis;* the Old Collingwood mine at Shipton's Flat was bulldozed to reduce the threat to public safety, however, this mine was illegally re-opened to allow a small entrance for bats, and has been successfully re-colonised by the species; gating of the Phoenician Mine on Mount Amos has forced *R. philippinensis* to utilise a ventilation shaft, potentially increasing the chance of predation. Over collection for museums from well-known colony sites may also have occurred and loss of habitat is also postulated.

10 Conservation reserves on which species occurs

Wet Tropics World Heritage Area (includes Black Mountain National Park, Cape Tribulation National Park, Crystal Creek — Mt. Spec National Park), Mitchell Palmer Goldfields Reserve, Chillagoe National Park, Iron Range National Park, Cape Melville National Park, Starke River National Park.

11 Other public land on which species occurs

Mt. Baldy State Forest, Goldsborough State Forest, Pine Creek State Forest, Curtain Fig State Forest, Danbulla State Forest, McIlwraith Range proposed National Park.

12 Other land on which species occurs

Old mines and caves on freehold/leasehold and aboriginal managed land on the east coast of Queensland from Cairns to Iron Range. Mining leases at Mt Molloy. May also occur on Silver Plains Station but roost sites have not been located. On Belle Vue and Palmer River Stations in the caves of the Mitchell / Palmer Karst area.

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

Partially. Resolution of taxonomy is required.

14 Recovery objectives

- Clarify the current distribution and abundance of the species.
- Protect all known roosts.
- Increase understanding of the basic ecology of the species for management purposes.
- Resolve taxonomy.

15 Management actions completed or underway

- Bat survey within Wet Tropics World Heritage Area as part of Project Gondwana, funded by Wet Tropics Management Agency.
- Current Queensland Parks and Wildlife Service action for the protection and gating of known mine roosts and caves (where necessary).
- Molecular taxonomy ongoing at the South Australian Museum (S. Cooper and T. Reardon).
- Survey of the bats of the Mitchell / Palmer Karst area by the Central Queensland Speleological Society, Les Hall and Lana Little (Queensland National Parks and Wildlife Service).

16 Management and research actions required

- Undertake targetted surveys for the species to clarify distribution and abundance.
- Carry out ecological research to meet recovery objectives i.e. determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —foraging strategy;
  - —population dynamics; and
  - —threatening processes.
- Protect and secure roost sites, including the design of a suitable bat gate.
- Clarify taxonomy.

17 Organisation(s) responsible for conservation of species

Queensland Parks and Wildlife Service, Wet Tropics Management Authority.

18 Other organisation(s)/individuals involved

Queensland Department of Natural Resources, Queensland Department of Mines and Energy.

19 Can recovery be carried out with existing resources?

No. The following is required:

Survey and ecological research	$90,000
Design and install suitable bat gates	$20,000
Resolve taxonomy (in combination with *R. philippinensis* — small form)	$19,000
	$129,000

(Survey based on 2 people for 6 months 51K, expenses 17K, vehicle 12K, equipment 10K; design of bat gate based on employment of 1 person for 3 months 15K, equipment 5K; taxonomy (molecular and morphological — 4 months Technical Officer 14K, consumables 5K. To reduce costs this project could be combined with recovery actions for other species on Cape York Peninsula).

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Authors for the species:

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Semon's Leaf-nosed Bat

1	**Family**	Hipposideridae
2	**Scientific name**	*Hipposideros semoni* Matschie, 1903
3	**Common name**	Semon's Leaf-nosed Bat
4	**Conservation status**	Endangered (C2a, D)

5 Intraspecific taxa

None.

6 Former distribution

Historical records include only a small number of opportunistic records from Cooktown, Iron Range, McIlwraith Range and Coen (Van Deusen 1975). Former distribution is restricted to Cape York as far south as Cooktown, mainly occurring in the east coastal or near coastal areas. Type locality is Cooktown, Queensland (Matschie 1903). Found extralimitally in Papua New Guinea but range may be restricted to southern regions and few records exist (Flannery 1995, Bonaccorso 1999). Apparent Queensland Museum record from Bramston Beach near Innisfail is actually *Hipposideros ater* (C. Clague and O. Whybird unpub). Apparent record of *H. semoni* from Townsville is also in error, as this specimen was collected from Cape Direction near Iron Range (Dixon and Huxley 1985).

7 Current distribution

In Australia, it occurs from Cape York south to the Cooktown region. Current distribution is similar to the former distribution, although the southern limit of the species is presently unclear. Recently, the species has been detected (by sonar call) south of Cooktown on the Mt. Windsor Tableland (Coles et al. 1996). The range extends much further than previously realised south to central and southern Queensland. There is an isolated roost capture record at Kroombit Tops, west of Gladstone (Schulz and de Oliveira 1995) and an unconfirmed sonar call detection record at St Mary's State Forest near Maryborough (de Oliveira and Pavey 1995).

8 Habitat

The species is known to roost in caves, rock fissures, boulder piles, abandoned mines and occasionally buildings. It is also possible that it roosts in tree hollows. Its foraging habitat is in rainforest (riparian, semi-evergreen notophyll vine forest, monsoon vine thickets) and open forest close to vine thickets or rainforest.

9 Reasons for decline

A decline is inferred through comparing the relative numbers which the Archbold Expeditions (Tate 1952) encountered during the 1940s/50s and the number of recent records obtained using more sophisticated survey techniques. Reasons for decline are unclear, although destruction of roosts eg. by collapse of old mines (either naturally or via reworking by mining companies), loss of habitat and frequent disturbance of roosts may have contributed (Hall et al. 1997).

10 Conservation reserves on which species occurs

Iron Range National Park, Black Mountain National Park, Starke National Park, Cape Melville National Park, Wet Tropics World Heritage Area.

11 Other public land on which species occurs

Kroombit Tops State Forest, St Mary's State Forest (possible), McIlwraith Range proposed National Park, Deed of Trust — Lockhart River community land, Iron Range National Park.

12 Other land on which species occurs

Old mines on private land near Coen (Stewart River), Lockhart River and Hopevale Community Managed Land, King Plains Pastoral Lease.

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

Partially.

14 Recovery objectives

- Increase understanding of the basic ecology of the species to determine:
  - — habitat requirements;
  - — roost and maternity site selection; and
  - — threatening processes.

- Determine the current distribution and abundance of the species, in particular whether any populations occur in the area between Cooktown and Kroombit Tops.
- Ensure that a selection of roost sites are protected across the range of the species.
- Clarify the genetic relationship between northern and southern sub-populations to determine the appropriate conservation unit.

15 Management actions already initiated

- Sites visited by Tate (1952) and Van Deusen (1975) were re-surveyed during a bat survey of Wet Tropics World Heritage Area, as part of Project Gondwana, funded by the Wet Tropics Management Agency.
- Bat gate considered suitable for this species was installed on Gordons No 2 Adit, Iron Range, a known roost for the species.
- Negotiations underway with the Queensland Department of Mines and Energy to resolve the mine closures and bat gates issue.

16 Management and research actions required

- Carry out ecological research to meet recovery objectives i.e. determine:
  - — habitat requirements;
  - — roost and maternity site selection;
  - — foraging strategy;
  - — population dynamics; and
  - — threatening processes.
- Undertake targetted surveys to determine the range of the species, in particular between Cooktown and Kroombit Tops. Survey should be based initially on predictive climatic models, such as BIOCLIM.
- Ensure that a selection of roost sites are protected across the range of the species.
- Review success of the bat gate installed on Gordons No 2 Adit and, if appropriate, develop protocols for future installation and monitoring at other sites.
- Undertake genetic studies to determine the genetic relationship between northern and southern sub-populations.

17 Organisation(s) responsible for conservation of species

Queensland Parks and Wildlife Service, Queensland Department of Natural Resources, Queensland Department of Mines and Energy, Wet Tropics Management Authority.

18 Other organisation(s)/individuals involved

Mining industry.

19 Can recovery be carried out with existing resources?

No. The following is required:

Survey and ecological research	$110,200
Protect known roosts	$20,000
Taxonomy	$5,000
	$135,200

To reduce costs this project could be combined with recovery plans for other species on Cape York Peninsula.

(Survey based on 2 people for 8 months 68K, expenses 22.7K, vehicle 16K, equipment 3.5K; protect known roosts based on 1 person for 3 months 15K, equipment 5K; taxonomy 2 months Technical Officer 3.5K, consumables 1.5K).

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Olivia Whybird

Christmas Island Pipistrelle

1	**Family**	Vespertilionidae
2	**Scientific name**	*Pipistrellus murrayi* Andrews, 1900
3	**Common name**	Christmas Island Pipistrelle
4	**Conservation status**	Endangered (C1)

5 Intraspecific taxa

Probably none; considered to be an endemic species by Kitchener et al. (1986) and Hill and Harrison (1987), but listed as conspecific with *P. tenuis* by Wilson and Reeder (1993). Given the small size of the species (3g), consequent low mobility and the distance to the nearest source population of *P. tenuis*, commonsense indicates that this should be treated as an isolated taxon.

6 Former distribution

Only known from Christmas Island, Indian Ocean.

7 Current distribution

Christmas Island, Indian Ocean.

8 Habitat

Occurs in the range of habitats found on the island: primary rainforest on both the plateau and terraces, secondary regrowth, old mining fields, and areas which have been rehabilitated. In 1984, animals were recorded foraging in many areas, particularly along the numerous tracks cleared through the forest and along forest edges over seral vegetation (Tidemann 1985). Nearly all of these tracks were blocked by treefalls during a cyclone in 1988 (Tidemann 1989) and in studies in 1994 and 1998 most foraging was observed in small clearings in primary and secondary rainforest (Lumsden and Cherry 1997, Lumsden et al. 1999). While old mined areas and recently rehabilitated areas may be used for foraging, there are no roosting opportunities in these areas. A limited number of non-breeding roosts have been located: all were in primary forest, in hollows in large live trees, under exfoliating bark on dead trees, and under dead pandanus and palm fronds (Lumsden et al. 1999). There is currently no information on the location of maternity roosts.

9 Reasons for decline

Approximately 25% of the island has been cleared of primary rainforest for phosphate mining. Although some of these areas now provide foraging habitat there are no roosting opportunities, and hence the area providing roosts has decreased since settlement late last century.

More recently, there has been a marked decline in numbers between studies conducted in 1984 (Tidemann 1985), 1994 (Lumsden and Cherry 1997) and 1998 (Lumsden et al. 1999). The distribution of this species has contracted westwards with most records now in the western section of the island. In 1984 it was located throughout the island. Despite extensive sampling of suitable habitat, it now appears to be no longer present in the north-eastern section of the island (Lumsden et al. 1999). Comparison of results from 22 sites sampled using Anabat detectors in both 1994 and 1998, showed a decline in abundance of bat activity of 33% within the last four years (Lumsden et al. 1999). Although this difference was not significant due to the high level of variability, it does, however, suggest that the decline is continuing, possibly at a rapid rate.

The reasons for the decline are currently unknown. Clearing of primary rainforest ceased in 1988, and hence roosting habitat is unlikely to have changed. Foraging habitat has, however, changed markedly with the regrowth of the extensive network of bulldozed drill lines that were constructed in the 1960s. There are a number of potential predators of *P. murrayi*, including the Wolf Snake (*Lycodon aulicus capucinus*) which was accidentally introduced to the island in 1987 (Smith 1988, Fritts 1993), and is currently expanding out from the settlement area into the centre of the island. The distribution of this species largely mirrors that of *P. murrayi* occurring through the north-east section where *P. murrayi* has recently disappeared. In the centre of the island where the

two species overlap *P. murrayi* is currently in decline. Another potentially serious threat to the species is the introduced ant *Anoplolepis gracilipes* (Lumsden et al. 1999). There has been a dramatic increase in population densities of this species in recent years, with the formation of supercolonies containing millions of individuals. These ants are currently having a catastrophic impact on the red crab populations on the island, killing thousands of individuals. The impact of these ants on *P. murrayi* is not yet known, however, individuals are vulnerable to ant attack, as evidenced by the death of an individual in a harp trap covered in ants. Large numbers of ants have been observed in the typical roost sites used by this species, which may result either in death or desertion of roosts. Other potential predators of *P. murrayi* include Nankeen kestrels, black rats and feral cats (Lumsden et al. 1999).

10 Conservation reserves on which species occurs

Christmas Island National Park.

11 Other public land on which species occurs

Christmas Island, outside the park.

12 Other land on which species occurs

None.

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

Partially. Knowledge is sufficient to set research objectives, however, lack of information on the causes of recent declines prevents the development of recovery management actions at this stage.

14 Recovery objectives

- Determine the causes of recent declines and formulate appropriate management actions.
- Undertake management actions to prevent further decline and to re-establish population numbers to former levels.
- Establish a long-term monitoring program to monitor the recovery.

15 Management and research actions completed or underway

- Gazettal of the Christmas Island National Park and preparation of management plan.
- A study of the status, habitat requirements and management was conducted in 1984 (Tidemann 1985).
- A brief follow-up study was conducted in 1994 (Lumsden and Cherry 1997).
- A study investigating the conservation status, distribution and abundance and habitat requirements for foraging and roosting was funded by Environment Australia in 1998 (Lumsden et al. 1999).

16 Management and research actions required

Research actions required:

- Determine roosting requirements, in particular maternity roosts, and locate and describe roosts in areas of low bat activity, especially at the current edge of the distribution. Investigate potential threatening processes affecting maternity roosts and dependent young which could account for the decline in the species.
- Determine whether the distribution and abundance are uniform throughout the year, or if different patterns emerge during the breeding season.
- Investigate the impact of the Wolf Snake on *P. murrayi*, in particular in relation to predation of roosting bats.
- Investigate the impact of the introduced ant *Anoplolepis gracilipes* on *P. murrayi*, particularly in relation to roosting bats.
- Investigate the impact of the other potential predators: the black rat, feral cat and Nankeen kestrel.
- Establish a long-term monitoring program. This should comprise two components: standardised driving detection technique to investigate changes in distribution (to be undertaken at 3-monthly intervals by Parks Australia North staff on Christmas Island), and a more extensive re-sampling of sites surveyed in the 1998 study, at 2 to 5 year intervals, to monitor changes in both distribution and abundance.
- Studies of this species should be linked to a re-assessment of the Christmas Island Flying-fox, *Pteropus melanotus natalis*, of which no appraisal has been made since 1984.

Management actions required:

- Actions will largely depend on the results of research aimed at determining the cause of the decline.
- Key areas have been identified in the western section of the island for this species (Lumsden et al. 1999), and management actions should focus on these areas.

17 Organisation(s) responsible for conservation of species

Environment Australia.

18 Other organisation(s)/individuals involved

Christmas Island Council, Territories Office, Christmas Island Phosphate.

19 Can recovery be carried out with existing resources?

No.

Research Actions:

Ecological studies and identification of threats:	$160,000
Monitoring program:	$30,000
	$190,000

Management Actions:

Currently unknown.

(Ecological studies based on: 2 people for 9 months 82K, 1 person extra 3 months for write-up, expenses 27K, vehicle 10K, airfares and freight 16K, equipment 10K; monitoring program: regular PAN monitoring 2K/year x 5 years, re-sampling sites 20K).

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Grey-headed Flying-fox

1	**Family**	Pteropodidae
2	**Scientific name**	*Pteropus poliocephalus* Temminck, 1825
3	**Common name**	Grey-headed Flying-fox
4	**Conservation status**	Vulnerable: (A2c, A2d, A2e) (See section 1.5 Disagreements about categories of threat)

5 Intraspecific taxa

Radio-tracking (Eby 1991), genetic (Webb and Tidemann 1996) and banding studies (Tidemann unpub.) indicate that the species is panmictic.

6 Former distribution

Collett (1887) and Andersen (1912) recorded specimens from far north Queensland. In 1929-30 camp-sites occupied permanently or regularly were found from Rockhampton in the north to Mallacoota in the south, from the coast to 100 km inland in Queensland and to the eastern edge of the escarpment in New South Wales (Ratcliffe 1931). By including areas used less consistently, a subsequent assessment extended the southern boundary to Warrnambool, Victoria and the inland boundary to the western slopes of New South Wales (Nelson 1965).

7 Current distribution

P. poliocephalus is no longer found in the Rockhampton area (D. Vavryn and G. Simmonds pers. comm.) and in 1997 *P. poliocephalus* was not found north of Hervey Bay, Queensland, a southerly contraction of about 300km since Ratcliffe's study; small numbers may be irregularly present in the Bundaberg region (P. Birt and L. Hall unpub.). The numbers of *P. poliocephalus* relative to *P. alecto* in Brisbane have declined markedly over the past ten years (H.E. Luckhoff pers. comm.). In contrast to the situation reported by Nelson (1965), camps in south-east Queensland now tend to be dominated by *P. alecto* (Birt and Hall unpub.), the range of which has extended south by about 500 km since Ratcliffe's study (Webb and Tidemann 1995). A permanent colony of *P. poliocephalus* is now present in Melbourne (Menkhorst 1995).

8 Habitat

P. poliocephalus requires foraging resources and roosting sites. It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, *Melaleuca* swamps and *Banksia* woodlands. It also feeds in introduced tree species in urban areas and in commercial fruit crops. The primary food source is blossom from *Eucalyptus* and related genera, but, in some areas it also utilises a wide range of rainforest fruits (Eby 1998). None of the vegetation communities used by *P. poliocephalus* produces continuous foraging resources throughout the year, and *P. poliocephalus* has adopted complex migration traits in response to ephemeral and patchy food resources (Nelson 1965, Spencer et al. 1991, Parry-Jones and Augee 1992, Eby 1996, 1998).

Temporally and spatially reliable resources are restricted to a small number of coastal vegetation communities in northern New South Wales and Queensland (Eby 1996), but these predictable food sources support relatively few animals. The majority of *P. poliocephalus* either additionally or exclusively feed on the flowers of *Eucalyptus* which are usually produced as superabundant pulses in seasonal, but annually irregular patterns. Patterns of use of eucalypts are complex and unpredictable and as a result, essential habitat for *P. poliocephalus* is difficult to define.

P. poliocephalus roosts in aggregations of various sizes on the exposed branches, commonly of emergent trees. Roost vegetation includes rainforest patches, stands of *Melaleuca*, mangroves and riparian vegetation (Ratcliffe 1931, Nelson 1965), but colonies also use highly modified vegetation in urban areas (Tidemann and Vardon 1997, Birt et al. 1998). *P. poliocephalus* can maintain fidelity to roost sites for extended periods (Lunney and Moon 1994) and, although new sites have been colonised in recent times (Tidemann and Vardon 1997), roost sites may be limiting over some of the species' range.

9 Reasons for decline

P. poliocephalus is affected by a number of threatening processes, the most serious of which is loss of foraging and roosting habitat.

Habitat loss

Ratcliffe (1931), on the basis of anecdotal evidence, believed that the species had declined by 50% since pre-European times as a result of clearing of native vegetation (and competition with *P. alecto*). Clearing of native vegetation for agriculture and forestry operations has accelerated since that time and has been particularly widespread over the range of *P. poliocephalus* in eastern Australia (State of the Environment Advisory Committee 1996). The loss of native habitat is assumed to have resulted in the destruction or disturbance of roosting and foraging habitats of the species.

The complexity of the habitat requirements of *P. poliocephalus*, particularly its requirement for multiple, geographically dispersed populations of food trees, mitigate against its conservation within a system of forest reserves leaving the species vulnerable to population declines from land use decisions and management strategies in unreserved forests of various tenures (Parry-Jones 1993, Pressey 1994, Eby 1996, Tidemann and Vardon 1997).

Annually reliable winter resources are limited in distribution to a narrow coastal strip in northern New South Wales and Queensland, and primarily occur on freehold land (Eby 1996, Pressey et al. 1996). These coastal areas are targeted for intensive residential development to cater for a projected 25% increase in the human population over the next ten years (NSW Department of Planning 1995). Substantial tracts of important winter flowering species, particularly *Melaleuca quinquenervia* and *E. robusta* have been zoned for urban and rural residential development. Approximately 40% of the extant *M. quinquenerviva* and 36% of the *E. robusta* within the City of Coffs Harbour, New South Wales are on land targeted for development by 2010 (Coffs Harbour City Council 1996). Seventy percent of the *M. quinquenervia* swamps between Noosa Heads and Tweed Heads have been lost to urban development (Hall unpublished).

Exploitation

P. poliocephalus destroys commercial fruit in Queensland and New South Wales (Jamieson 1988, Slack 1990, Tidemann et al. 1997). Direct killing of animals on orchards and harassment and destruction of roosts has almost certainly played a role in the species' decline. The exact number of animals destroyed is unknown, but estimates as high as 100,000 annually have been made (Vardon and Tidemann 1995). The impact is more substantial than direct deaths alone would indicate, for a large proportion of animals shot on orchards are pregnant and lactating females (Parry-Jones 1993, Tidemann et al. 1997). Permit systems in Queensland and New South Wales regulate pest destruction activities, but the impact of this destruction on both the size and structure of the population remains unquantified (although widely believed to be detrimental).

Roost sites have been legally protected since 1986 in New South Wales and 1994 in Queensland (Tidemann and Vardon 1997), but the recent discovery of lyssavirus in Australia may increase the persecution of flying-foxes and their colonies in places where they are known to roost in large numbers and are already regarded by some people as a nuisance (Tidemann et al. 1997).

Competition and hybridization

Competition with *P. alecto* (and perhaps *P. scapulatus*) may be a threat to *P. poliocephalus*. The distribution of *P. alecto* has undergone a substantial southerly shift since it was first described, extending further into coastal areas inhabited by *P. poliocephalus* (Webb and Tidemann 1995). The two species share roosts and diet plants, and increasing competition for resources in the northern part of the range of *P. poliocephalus* is assumed, although it has not been assessed. Hybrids between *P. poliocephalus* and *P. alecto* have occurred in captivity (Luckoff pers. comm.).

Pollutants and pathogens

Some urban-dwelling *P. poliocephalus* accumulate lethal levels of lead from the environment (Hariono et al. 1993) and they are also prone to electrocution which kills disproportionately high numbers of lactating females (Flying-fox Information and Conservation Network, Ku-ring-gai Bat Colony Committee, L.S. Hall unpub., Tidemann unpub.). The effects of the recently discovered pathogens, Australian Bat Lyssavirus, Bat Paramyxovirus and Menangle Pig Virus (Hoar et al. 1998) on *P. poliocephalus* are unknown, but may, in concert with other threatening processes, be expected to have an adverse impact on the population. Other miscellaneous threats are detailed by Eby (1995).

10 Conservation reserves on which species occurs

The species uses most national parks and other protected areas within its range, but none on its own provides the resources necessary to sustain a viable population in the long term.

11 Other public land on which species occurs

Roosts and foraging resources are contained in many areas including: forests under State ownership in Queensland; New South Wales and Victoria; Crown Lands; and some lands under control of local government.

12 Other land on which species occurs

Any land supporting food plants or roost habitat (occupied or potential).

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

A great deal is known about the biology of this species, but knowledge of the population status is inadequate. Two recent estimates have been made. In March 1989 the New South Wales population was estimated to be 570,000 (K. Parry-Jones, C. Palmer and P. Eby unpub.) and in July 1998 the total population was estimated to be 360,000 (P. Birt, G. Richards, P. Eby, K. Parry-Jones and J. Nelson unpub.). These figures, however, must be interpreted with caution because (1) the 1998 count was made at a time of year when the species is dispersed (Nelson 1965) and (2) the counting methodology needs to be validated. Further work needs to be done to (1) validate population estimates, (2) define habitat requirements in relation to the protected area system and (3) develop cost-effective methods of protecting fruit crops. Future counts need to be made during the breeding season when populations are aggregated.

14 Recovery objectives

- Stabilise the population at its current level.
- Define patterns of landscape use, and identify and protect essential habitat.
- Develop non-destructive methods for crop protection.
- Develop non-destructive methods for management of camps in problem areas
- Ensure consistent management of the species across all range states (Queensland, New South Wales and Victoria).

15 Management and research actions completed or underway

- Inclusion in Response to Disturbance projects within Regional Forest Agreements in New South Wales and south-east Queensland.
- Many published studies are relevant — see References.
- Many other ongoing studies are relevant — eg, Monash University (Nelson et al.); University of NSW (Augee et al.); University of New England (Eby); University of Queensland (Hall et al.); Australian National University (Tidemann et al.) plus activities of a number of independent researchers (eg, K. Parry-Jones, G. Richards).
- In Queensland the Department of Primary Industry, Department of Environment, orchardists and researchers have a formed a Flying Fox Consultative Committee to resolve problems of flying foxes in orchards.

16 Management and research actions required

- Validate methods for estimating population size and demographics.
- Develop and implement a population monitoring program.
- Document status of foraging habitat in space and time to:
  - identify high priority conservation areas;
  - guide forest management practices; and
  - provide information for revegetation programs which may enhance habitat (particularly winter resources).
- Seek funding from orchard industry and relevant government agencies to develop practical and cost effective non-destructive methods for on-crop control. Suggested scope of research could include:
  - testing of existing methodologies such as acoustic and other repellant methods, and exclosure netting;
  - evaluation of the cost and methods of containing damage; and
  - development of clear guidelines for implemention of mitigation methods by fruit growers.
- Facilitate protection of existing camp sites and foraging habitat on private land. Considerations could include:
  - identification of where camps occur and land tenure at these sites;

— development of conservation agreements with landowners; and

— identification of alternative camp sites and encouragement of relocation to these sites where necessary in problem situations.

- Develop a national recovery plan which coordinates management actions in range states (Queensland, New South Wales and Victoria).

17 Organisation(s) responsible for conservation of the species

Environment Australia (if species is listed), Queensland Parks and Wildlife Service, New South Wales National Parks and Wildlife Service, Victorian Department of Natural Resources and Environment. Conservation of habitat is additionally the responsibility of: Queensland Department of Natural Resources, New South Wales State Forests, State planning authorities and local government bodies throughout the range. Some habitat is in private ownership.

18 Other organisation(s)/individuals involved

Wildlife care groups in New South Wales, Queensland and Victoria; private landholders; orchard industry.

19 Can recovery be carried out with current resources?

No. Current and past levels of funding for research are poor and resources allocated to management by State government bodies is inadequate.

The following is required:

Validation of methods for estimating population size	$80,000
Implement monitoring programme (5 year total)	$125,000
Document/model foraging habitat in space and time	$150,000
Develop on-crop control methods	$305,000
Facilitate protection of existing camp sites on private land	$580,000
National recovery plan	$20,000
Total	$1,260,000

(Validation of methods for estimating population size based on based on 1 person for 12 months 60K plus materials 20K; implement monitoring programme based on 1 person for 3 months 15K plus expenses 10K per annum; document/model foraging habitat based on 1 person for 2 years 120K plus materials and expenses 30K ; develop on-crop control methods based on 2.5 persons for 2 years 175K, plus expenses 23K and materials 107K; facilitate protection of existing camp sites on private land based on 1 person for 12 months 60K plus expenses 20K, and 500K (nominal estimate) to identify camps and negotiate agreements with landowners / purchase land; National recovery plan 20K).

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Pilbara Leaf-nosed Bat

1	**Family**	Hipposideridae
2	**Scientific name**	*Rhinonicteris aurantius* (Pilbara form)
3	**Common name**	Pilbara Leaf-nosed Bat
4	**Conservation status**	Vulnerable (A1c, B1, B2c)

5 Intra-specific Taxa

The Pilbara population is geographically the most isolated population of *R. aurantius*, being separated from the northern Australian populations by nearly 400 km of sand-ridge desert. It differs from the Northern Australian population in terms of wing-shape indices and echolocation call frequency (N.L. McKenzie unpub. data, refer Section 2 on taxonomy; Coles and Guppy 1989).

6 Former distribution

Individual records scattered across Pilbara Region since 1925, and from a single locality in the north-western corner of the adjacent Gascoyne Region (first captured in Barlee Range Nature Reserve by P. Kendrick) in October in 1995.

No historical data on abundance, but 74 individuals were captured, and a colony-size of 350 was estimated, at Klondyke Queen Mine (eastern Pilbara) in 1981 by Churchill et al. (1988).

7 Current distribution

Known from less than 10 localities in the Pilbara and from one locality in the Gascoyne. In contrast to the Gascoyne region, no natural colony sites are known from the Pilbara.

Currently 2 to 20 individuals occupy each of the 5 known roost sites in the Pilbara, all of which are in the eastern Pilbara (K. Armstrong unpub.). The first Pilbara specimen was captured in the Red Hill copper mine in 1928. When this west Pilbara site was re-visited in 1997 the entire workings had collapsed, and there was no evidence of *R. aurantius* present. The five surveys of the Klondyke population since Churchill's 1981 visit, have failed to record more than 20 individuals.

8 Habitat

Hunts food during slow manoeuvrable flight. Hawks flying prey close to clutter, and gleans from foliage and the ground in riparian vegetation in gorges, and in open hummock grasslands and sparse tree and shrub savanna.

Known colonies in the Pilbara occupy abandoned, deep and partially flooded mines that trap pockets of warm, humid air in the mine's constant temperature zone (Hall et al. 1997). For at least part of the year, the species is thought to also occupy smaller, less complex mines nearby.

Two natural roosts have been located in the Gascoyne region (K. Armstrong unpub.). One is a cave more than 30m deep, and the other a horizontal fissure beneath an ephemeral waterfall. Both are in the Barlee Range National Park.

9 Reasons for decline

Unknown. However, roost loss through the collapse and flooding of old mines has been implicated. On current knowledge, the Klondyke and Comet Mines should be treated as important in maintaining the current population-levels in the region. Although both of these old gold mines are deep, complex and partially flooded, available data indicate a population decline in both mines (Hall et al. 1997).

In the Klondyke, Churchill recorded a population of 350 in 1981, whereas the five subsequent surveys have recorded no more than 20 individuals. Like most of the other old mines in the Pilbara, much of the Klondyke Queen has already collapsed, and the remaining areas are unstable.

Data from the Comet Mine also indicate a decline. While a 'large colony of orange bats' roosted over the pool in the base of the Comet Mine prior to a percussion-drilling program in 1992/3 (N. Dunlop pers. comm.), survey in July 1995 netted only a single *Rhinonicteris* male in

the entrance drive, and detected only two *R. aurantius* passes by ultrasound along the main incline immediately above the pool (N. McKenzie unpub.). When last surveyed (by Kyle Armstrong in May 1997), the lower portion of the Comet Mine where the *R. aurantius* were reported was completely flooded, and there was no indication that they were roosting in other parts of the mine.

Open-cut mining also presents a threat as recent drilling programs have revealed that there are extensions to the ore-bodies beneath both the Klondyke and Comet gold mines.

Recent roadkills near Tom Price (in 1995) and Fortescue Roadhouse (in 1990) suggest that colonies remain to be discovered elsewhere in the Pilbara.

10 Conservation reserves on which species occurs

Barlee Range Nature Reserve.

11 Other public land on which species occurs

None known.

12 Other land on which species occurs

Pastoral leases and mining leases in the Pilbara.

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

Yes.

14 Recovery objectives

- Protect known Pilbara colonies, and/or translocate them if necessary.
- Ascertain if colonies in natural roosts in the Barlee Range Nature Reserve are declining.
- Locate and protect natural breeding roost sites in the Pilbara region.

15 Management and research actions completed or underway

- Population genetics and morphological study on phylogenetic status of the Pilbara population – MSc project by Kyle Armstrong, University of WA.
- Determine environmental conditions of actual roost sites during the year, including the breeding season — MSc project by Kyle Armstrong, University of WA.
- Monitoring Pilbara mine colonies – Opportunistic by CALM (WA) scientists, and as part of a MSc project by Kyle Armstrong, University of WA.

16 Management and research actions required

- Seek cooperation of relevant mining companies to minimise effect of mining activities on the populations.
- Negotiate code of practice with mining industry at relevant sites to address:
  - —replacement of supports in old mine tunnels and chambers, and installation of additional re-inforcement as necessary;
  - —prevention of destruction of old workings during removal of remaining portions of the ore body; and
  - —installation and maintenance of drainage devices to control flooding.
- Inspect and re-condition/install supports in a selection of collapsing mines.
- Permanently cap any exploratory drill holes that intersect mine chambers so that the pockets of warm humid air required by colonies (Churchill 1991b) are not vented.
- Ensure any essential drilling programmes near occupied mines are designed to minimise disturbance.
- Design, test and install steel mesh gates on relevant mine entrances to minimise disturbance by visitors.
- Carry out surveys in the region for natural breeding roosts.
- Protect any natural breeding roosts found from disturbance.
- Monitor existing colonies in mines to ensure that populations are stabilised.
- Create reserves to protect several breeding roosts in mines.
- Identify and acquire vesting over a suitable, safe mine for translocation (two possibilities have already been identified).
- Begin translocation from the Klondyke Queen mine.
- Ensure that, as a last resort, opportunity to translocate a colony is provided in any plans to develop the relevant mines.

17 Organisation(s) responsible for conservation of species

Western Australian Department of Conservation and Land Management.

18 Other organisation(s)/individuals involved

Department of Zoology, University of Western Australia, mining companies

19 Can recovery be carried out with existing resources?

No. The following is required:

Replacement of supports in old mines	unknown
Develop code of practice	$10,000
Design and install gates	$35,000
Survey of natural breeding roosts	$85,000
	$130,000

(Code of practice based on 1 person for 2 months 10K; design and install gates based on 1 person for 3 months 15K plus materials 20K; survey and monitoring based on 2 people for 6 months 51K; vehicle 12K, equipment 5K, expenses 17K.)

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Authors for the species:

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Large-eared Pied Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Chalinolobus dwyeri* Ryan, 1966
3	**Common name**	Large-eared Pied Bat
4	**Conservation status**	Vulnerable (A1a, C2a)

5 Intraspecific taxa

None.

6 Former distribution

Poorly known. This species was first described in 1966 from Copeton in northern New South Wales (Ryan 1966, Dwyer 1966).

7 Current distribution

Inadequately known. The species appears to be uncommon in New South Wales and rare within its range in Queensland. It has been recorded from scattered localities as far south as Nowra in coastal New South Wales and on the Blackdown Tableland in central eastern Queensland in the north (Parnaby 1992, Hoye and Dwyer 1995). It appears to have localised distributions and be sparsely distributed within its range.

The majority of records exist in north-eastern and central northern and eastern New South Wales. However, recent fauna surveys conducted through the Comprehensive Regional Assessment process in both Queensland (Schulz et al. 1998) and New South Wales have failed to re-locate this species in north-eastern New South Wales. The majority of records in northern New South Wales are of single individuals although recently in central west New South Wales, it has been detected (sonar call surveys) sporadically over a widespread area (Coles 1995). Little is known about its western range limits, with records from as far inland as the Pilliga Nature Reserve and the (now flooded) type locality near Copeton. The only known recent records in Queensland are from the far south-eastern region, such as the Border Ranges, the Main Range, Gambubal State Forest, Wivenhoe Dam and Moogerah Dam. Currently there is a significant gap in the records between sites in far south-east Queensland and the known northern limit on the Blackdown Tableland (Coles unpub.).

8 Habitat

Poorly understood. In New South Wales this species has been recorded from a range of vegetation types, including dry and wet sclerophyll forest, *Callitris* dominated forest, tall open eucalypt forest with a rainforest sub-canopy, sub-alpine woodland and sandstone outcrop country. In south-eastern Queensland the species has primarily been recorded from higher altitude moist tall open forest adjacent to rainforest. Little is known about the roosting requirements of this species but natural roosts may depend heavily on sandstone outcrops. It has been found roosting in disused mine shafts, caves, overhangs and disused Fairy Martin nests (Schulz 1998). It also possibly roosts in tree hollows. Currently, no maternity sites are known.

9 Reasons for decline

Lack of knowledge on the roosting requirements, foraging habits and other aspects of its biology make it difficult to accurately determine current threats to the species.

Destruction or interference of subterranean roosts is a confirmed threat. The type locality at Copeton (Dwyer 1966) was flooded by the Copeton Dam (Hall et al. 1997, Hall and Richards 1998). The cave roost in the Pilliga Scrub Nature Reserve appears to have been deserted. In the dissected sandstone escarpments of New South Wales underground coal mining is a potential threat, since mining induced subsidence would appear to affect availability of roost sites. Other possible threats include habitat clearance for agriculture, urban developments, impact of forestry operations (direct mortality of individuals from tree felling, reduction in the availability of suitable hollows, forest fragmentation) and predation by feral animals.

10 Conservation reserves on which species occurs

NSW: Bouddi National Park, Big Scrub Flora Reserve, Bungonia Nature Reserve, Coolah Tops National Park, Goulburn River National Park, Munghorn Gap Nature Reserve, Pilliga Scrub Nature Reserve, Richmond Range National Park, Royal National Park, Warrumbungle National Park, Wollemi National Park, Yengo National Park.
Queensland: Carnarvon Gorge National Park, Lamington National Park, Main Range National Park, Blackdown Tableland National Park.

11 Other public lands on which species occurs

NSW: Bingara State Forest, Bourbah State Forest, Giro State Forest, Irrigapa State Forest, Kerringle State Forest, Montrose State Forest, Olney State Forest, Pilliga State Forest, Pilliga East State Forest, Pilliga West State Forest, Ruttley State Forest, Yarrigan State Forest, Watagan State Forest, Yalcogrin State Forest.
Queensland: Blackdown Tableland State Forest, Gambubal State Forest, road reserves in the Wivenhoe Dam, Lake Moogerah and west of Mt Barney areas.

12 Other land on which species occurs

NSW: Crown Land near Ulan.
Queensland: Private land adjacent to Mt Mistake.

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

Partially.

14 Recovery objectives

- Protect all known roost sites (including the Pilliga Scrub Reserve roost) and adjacent habitat.
- Clarify the current distribution and abundance of the species.
- Increase understanding of the basic ecology of the species to determine:
  - — habitat requirements;
  - — roost and maternity site selection; and
  - — threatening processes.

15 Management and research actions completed or underway

- None, apart from non-targeted surveys in parts of its range and qualitative roost selection and behavioural observations.

16 Management and research actions required

- Protection of known roosts and associated foraging habitats.
- Undertake targetted surveys for the species to clarify distribution and status.
- Carry out ecological research to determine:
  - — habitat requirements, in particular factors responsible for the patchy distribution of the species;
  - — roost and maternity site selection;
  - — foraging strategy;
  - — population dynamics; and
  - — threatening processes.
- Encourage active management actions such as:
  - — installation of 'Fairy Martin friendly structures' in road culverts and bridges (as a means to promote bat roost sites, see Schulz 1998); and
  - — inspection of bridges/culverts prior to demolition or major capital works to reduce impact on colonies already utilising these structures

  by State and local government authorities with responsibility for construction and maintenance of roads.

17 Organisation(s) responsible for conservation of species

Queensland Parks and Wildlife Service, Queensland Department of Natural Resources, New South Wales National Parks and Wildlife Service, State Forests of New South Wales.

18 Other organisation(s)/individuals involved

New South Wales Department of Land and Water Conservation, New South Wales Department of Urbans Affairs and Planning, Private land holders, local government and road construction authorities.

19 Can recovery be carried out with existing resources?

No. The following is required:

Protection of known roosts	unknown
Ecological research	$100,000
Surveys (western NSW and Qld.)	$ 61,000
Total	$161,000

(Surveys based on 2 people for 3 months 25K, expenses 20K, equipment 10K, vehicle 6K. Ecological research based on 1 person for 1 year 60K, radio tracking equipment 16K, expenses 24K.)

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Authors for the species:

Martin Schulz
Roger Coles
Glenn Hoye
Les Hall

Eastern Long-eared Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Nyctophilus timoriensis* Geoffroy, 1806 (South eastern form)
3	**Common name**	Eastern Long-eared Bat
4	**Conservation status**	Vulnerable (A1c, A2c)

5 Intraspecific taxa

None.

6 Former distribution

Possibly unchanged. Previously considered to be distributed throughout temperate southern Australia, but as this taxon has recently been shown to be comprised of three species with allopatric distributions (H. Parnaby pers. comm.), the former distribution is therefore unclear.

7 Current distribution

Southern central Queensland, central western New South Wales, north-western Victoria and South Australia. There are only four records of this species from Victoria, all from the north-west of the state (Lumsden 1994). There have been no records from central western Victoria since 1888 (a single specimen). In South Australia records are confined to north of the Murray River, east of Canegrass Station and south of the Barrier Highway, but the northern range limit in this state remains unclear.

8 Habitat

River Red Gum forest, semi-arid woodlands and savannahs. It also occurs in box/ironbark/*Callitris* open forests and Buloke woodland in northern New South Wales and inland south-east Queensland. In South Australia it is confined to tall mallee shrublands north of the Murray River and is known to roost in hollows in *Eucalyptus gracilis*. Victorian records are from *E. gracilis* mallee, Buloke and Black Box woodlands (Lumsden 1994).

9 Reasons for decline

Extensive loss of habitat. Clearing for agriculture and, in the remaining uncleared areas, timber harvesting, grazing and altered fire regimes are suspected threats. In New South Wales 75% of the eastern part of the species range has been cleared.

10 Conservation reserves on which species occurs

Vic.: Hattah-Kulkyne National Park, Murray Sunset National Park; NSW: Goulburn River National Park, Monabalai Nature Reserve, Yathong Nature Reserve Budigower Nature Reserve, Woggon Nature Reserve, Mungo National Park, Cocoparra National Park, Ben Halls Gap National Park, Pilliga Nature Reserve, Goobang National Park, Warrumbungle National Park, The Rock Nature Reserve; SA: Danggali Conservation Park; Commonwealth (Environment Australia): Calperum pastoral lease.

11 Other public land on which species occurs

NSW: Crown Land near Ulan, Binya State Forest, Benambra State Forest, Warraderry State Forest, Leard State Forest; Victoria: remnant vegetation in a streamside reserve along Bullock Ck, south-west of Echuca; Queensland: Eena State Forest, Bracker State Forest, Barakula State Forest.

12 Other land on which species occurs

Recorded from Canegrass Station in South Australia and probably occurs on other private land containing mallee between Canegrass Station and Danggali Conservation Park.

13 Is knowledge about species adequate for objectives and actions to be defined accurately?

Partially.

14 Recovery objectives

- Increase understanding of the basic ecology of the species to determine:
  - —habitat requirements;
  - —roost and maternity site selection; and
  - —threatening processes.
- Clarify the current distribution and abundance of the species.

15 Management and research actions completed or underway

- Survey and radiotracking studies have commenced in Bookmark Biosphere Reserve (Sonia Dominelli, Bookmark Biosphere).
- North-west Victoria has been surveyed for bats, including this species, during two major studies, in the mallee region (Lumsden and Bennett 1995b) and the Northern Plains (Lumsden et al. 1995).

16 Management and research actions required

- Carry out ecological research to meet recovery objectives i.e. determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —foraging strategy;
  - —population dynamics; and
  - —threatening processes.
- Undertake targetted surveys for the species, particularly in areas where clearing is imminent.
- Assess the impact of timber harvesting and related activities such as grazing on the viability of populations.

17 Organisation(s) responsible for conservation of species

New South Wales National Parks and Wildlife Service, Department of Natural Resources and Environment (Victoria), Queensland Parks and Wildlife Service, Queensland Department of Natural Resources, Queensland Department of Primary Industries (Forestry), South Australian Department of Environment, Heritage and Aboriginal Affairs, Environment Australia.

18 Other organisation(s)/individuals involved

State Forests of New South Wales, Department of Land and Water Conservation (NSW), Parks Victoria, Bookmark Biosphere Trust.

19 Can recovery be carried out with existing resources?

No. The following is required:

Ecological research and survey	$127,000

(Costs based on 1 person for 12 months 60K, with technical assistance for 6 months 21K, vehicle for 6 months 12K, expenses 24K and equipment 10K.)

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Authors for the species:

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Terry Reardon
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Spectacled Flying-fox

1	**Family**	Pteropodidae
2	**Scientific name**	*Pteropus conspicillatus* Gould, 1850
3	**Common name**	Spectacled Flying-fox
4	**Conservation status**	Lower Risk (near threatened) (See section 1.5 Disagreements about categories of threat)

5 Past range and abundance

Not known for certain but was thought to occur within and in the vicinity of the major rainforest tracts from Ingham to Cooktown in north-east Queensland, at Iron and McIlwraith Ranges on Cape York Peninsula and in Torres Strait. Extralimitally occurs in Papua New Guinea and Solomon Islands. Outliers at Chillagoe and Brisbane (Hall and Richards 1985, Richards 1990a). Anecdotal records of large camps but no documented overall count.

6 Present range and abundance

As above but no recent records from Ingham District and may also have declined between Cardwell and Tully (Richards 1990a). Census in April 1998 between Russell River and Rossville found about 153,000 individuals, including newly-independent juveniles (Garnett, Whybird and Spencer (1999)).

7 Habitat

Primarily rainforest, wet sclerophyll margins, coastal swamps, monsoon vine thickets and mangrove areas. Roosts are always found within 6 km of rainforest (Richards 1990b).

8 Current threats

These include: habitat loss through large scale clearing of both coastal and upland habitats for sugar, grazing and urban development; electrocution and shooting of large numbers in orchards and at colonies; mortality due to paralysis tick (*Ixodes holocyclus*); disturbance at maternity colonies; death of unknown numbers on barbed-wire fences and powerlines; and high incidence of genetic disorders (cleft palate) (Les Hall pers. comm.).

9 Recommended actions

- Validate methods for estimating population size and demographics.
- Develop and implement a population monitoring program.
- Seek funding from orchard industry and relevant government agencies to develop practical and cost effective non-destructive methods for on-crop control. (See also Recovery Outline for *Pteropus poliocephalus*).
- Contingent on the success of the above action, negotiate phasing out of lethal crop protection techniques.
- Determine the cause of the paralysis tick problem and develop control techniques.
- Determine efficacy of the care of orphans and their release to the wild as a technique for conservation management.
- Negotiate conservation agreements for regularly used colonies on private land.

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Authors for the species:

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Stephen Garnett
Hugh Spencer
Olivia Whybird
Greg Richards

Bare-backed Fruit Bat

1	**Family**	Pteropodidae
2	**Scientific name**	*Dobsonia moluccensis magna* Thomas, 1904
3	**Common name**	Bare-backed Fruit Bat
4	**Conservation status**	Lower Risk (near threatened)

5 Past range and abundance

Not known. Most of north, north-central and east Cape York, possibly as far south as Chillagoe (see below). First collected in Australia at Coen (Allen 1935).

6 Present range and abundance

The distribution of this species possibly remained stable as there has not been any large scale habitat modification within its range. Survey records indicate that the species is common in Iron Range and Lockerbie Scrub (L. Leung unpub.). Confirmed distribution is from Silver Plains (McIlwraith Range), northwards to the tip of Cape York and includes Moa Is. in Torres Strait (Hall 1995). A southern record from Black Mountain is most likely anomalous (based on a cave in the Black Mountain National Park being known as 'Flying Fox', and based on a totem held in the vicinity). However there appears to be a reliable sight record from Chillagoe (Robson 1986). This species occurs extralimitally in Papua New Guinea where it is very widespread (Flannery 1995, Bonaccorso 1999).

7 Habitat

Roosts in small numbers in vegetation and in larger numbers (up to thirty) in caves or boulder piles. Forages at night in open forest as well as rainforest and monsoon vine thickets and is noted to feed regularly on native figs. It is also known to feed in cultivated fruit gardens when the natural food supply is low (in the late wet season to early dry season).

8 Current threats

No large scale decline has been observed, although shooting has caused small losses of numbers and the species has been regularly killed on barbed wire at King Ranch and Silver Plains. There has also been some loss of habitat through clearing. Inferred threats include changes to vegetation through historical changes to fire regime.

9 Recommended actions

- Protection of known roosts and associated foraging habitats.
- Undertake targetted surveys for the species to clarify distribution and status. In particular, survey roost sites on Cape York Peninsula and the Torres Strait islands and determine the southern limit of distribution.
- Carry out ecological research to determine:
  - — habitat requirements;
  - — roost and maternity site selection;
  - — foraging strategy;
  - — population dynamics; and
  - — threatening processes.

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Authors for the species:

Luke Leung
Chris Clague
Roger Coles
Frank Bonnacorso
Greg Richards
Les Hall

Ghost Bat

1	**Family**	Megadermatidae
2	**Scientific name**	*Macroderma gigas* Dobson, 1880
3	**Common name**	Ghost Bat
4	**Conservation status**	Lower Risk (near threatened) (See section 1.5 Disagreement about categories of threat)

5 Former distribution

All of mainland Australia except Victoria, south-west Western Australia and eastern New South Wales (Finlayson 1958, Douglas 1967, Molnar et al. 1984).

6 Current distribution

Coastal and up to 400 km inland, throughout northern Australia, generally north of the Tropic of Capricorn, with the exception of the Pilbara in Western Australia (Richards and Hand 1995). The range appears to have contracted northwards in relatively recent times, especially in Central Australia (Churchill and Helman 1990).

Regional populations of this species are centred on maternity roosts that are genetically isolated from each other (Worthington-Wilmer et al. 1994). The persisting arid zone regional population in the Pilbara is also geographically isolated, being separated from extant northern Australian populations and the historical central Australian populations by extensive sandy deserts, and should be further assessed to determine its specific status. The central Australian population is considered to be extinct and the Pilbara population is considered vulnerable (A2c).

7 Habitat

A wide range from rainforest, monsoon and vine scrub in the tropics to open woodlands and arid areas. Forages by gleaning and is carnivorous (Toop 1985, Schulz 1986). Obligate troglodyte, and survival is critically dependent on finding natural roosts in caves, crevices, deep overhangs, and artifical roosts such as abandoned mines (Hall et al. 1997). Each population appears to have a regionally centralised maternity site and only 10 such sites are known to exist (Worthington-Wilmer et al. 1994). Populations are known to disperse in the non-breeding (dry) season (Toop 1979, 1985).

8 Reasons for decline

Disturbance and loss of roosting sites due to mining, tourism and internal dereliction of mines through aging of timber supports are known threats (Hall et al. 1997). In recent times population declines could be attributable to competition for prey with foxes, feral cats, and prey lost through habitat modification by fire and livestock.

9 Recommended actions

- Genetic studies to complete the work of Worthington-Wilmer et al. (1994) and better determine the status of the regional populations, the Pilbara population in particular. The question of conservation status of the regional populations can then be reconsidered.
- Determine the extent to which the Pilbara population is dependent upon old mines for its persistence in the region.
- Monitor regional populations to enable early detection of declines.

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Authors for the species:

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Coastal Sheathtail Bat

1	**Family**	Emballonuridae
2	**Scientific name**	*Taphozous australis* Gould, 1854
3	**Common name**	Coastal Sheathtail Bat
4	**Conservation status**	Lower Risk (near threatened)

5 Past range and abundance

Unknown but probably similar to present range (for general distribution see Hall 1983, Richards 1995). Type locality is Albany Island off Cape York (for details see Troughton 1925 and Tate 1952). This species is apparently endemic to Australia, as the origin of a single specimen from 'New Guinea' (Dobson 1878) has been queried by Troughton (1925).

6 Present range and abundance

The species occurs along a very narrow but extended coastal zone from Shoalwater Bay in Queensland (Catling et al. 1994), as far north as Moa Island in the Torres Strait (Conder 1994). Also occurs on numerous off shore islands throughout the range (Grimes 1973, Schulz 1991, Hall 1997, Churchill pers. comm.). The dependence on coastal roosts results in the range of this species extending no more than a few kilometres inland (Richards 1995). As such, this species may be unevenly distributed throughout its range. In the northern part of its range this species is in caves on off-shore islands (Hall 1997). In the central part of its range between Townsville and Cooktown, it has been frequently found roosting in sea caves e.g. in more than 100 sea caves from a total of 600 caves searched (Clague unpub.). However, in a search of the coastline from Cooktown to Cape York (1996-98) only a small number of caves were found to be inhabited by this species (Hall unpub.). In the southern part of its range e.g. at Shoalwater Bay in central Queensland, it is has been regarded as 'abundant' to 'uncommon' (Catling et al. 1994). Colony sizes have been found to be small (generally less than 20 individuals) and current estimates of population size varies from 1200 (Richards unpub.) to more than 2500 (Clague and Coles unpub.).

7 Habitat

This species apparently prefers to roost in sea caves and rocky clefts although it is also known to roost in boulder piles (e.g. at Cape Melville, Little and Hall 1996), buildings (such as the CSR Sugar mill in Cairns), mines (e.g. Possession Is., Noble Is.) and old WWII bunkers (e.g. at Portland Roads and on several Torres Strait islands, Richards and Hall unpub.). Details of its roosting requirements are not well known but most roosts are shallow and partially lighted. It forages only a few kilometres inland from the coast and populations may be localised due to the uneven distribution of roosts along the coastline (including off shore islands).

8 Current threats

There is no documented widespread decline of the species. However, at one site in the Cape Hillsborough National Park (Hoye 1985), an observed decline may be due to human visitation. The negative effects of human disturbance on roosts have also been observed at a colony near Townsville, and are thought to have caused a 50% decline in numbers (Hall unpub.). The loss of foraging habitat through coastal development and sand mining, and roost disturbance (with increasing human access to the coast) may pose threats to this species in the central and southern parts of its distribution.

9 Recommended actions

- Carry out ecological research to determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —foraging strategy;
  - —population dynamics; and
  - —threatening processes.
- Protect a selection of known roosts from disturbance, especially if confirmed as maternity sites.
- Establish a long term monitoring program to assess population changes.

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Little Pied Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Chalinolobus picatus* Gould, 1852
3	**Common name**	Little Pied Bat
4	**Conservation status**	Lower Risk (near threatened)

5 Past range and abundance

No historical data on abundance is available.

6 Present range and abundance

Coastal and south-eastern Queensland from the Greenvale region (north of Ingham) to the Maryborough-Childers-Miriam Vale area, extending across south-western Queensland, western New South Wales and far north-eastern South Australia. Despite a commonly held view that the species has an inland distribution, there are a number of records from south-eastern Queensland within 50 km of the coast (Cordalba State Forest and Eurimbula National Park), and a recent record from a sea cave north of Townsville.

No evidence exists that the range has contracted. This species was originally thought to be an obligate cave-dwelling species and therefore rare due to the scattered and infrequent occurrence of suitable roosting and maternity sites across its range. However, colonies are now known from tree hollows and disused buildings (particularly those with open timber frames). Surveys have indicated that in arid and semi-arid environments the species may be locally common near permanent or semi-permanent water.

7 Habitat

Occurs most frequently in dry, open woodland communities throughout its range but has also been recorded in dry sclerophyll forests and Araucarian notophyll vine forests in south-east Queensland. Dry sclerophyll forests inhabited in south-east and central coastal Queensland include types dominated by *Corymbia citriodora, Eucalyptus moluccana, E. tereticornis* and ironbark species. In the central and western Darling Downs area of Queensland it has been predominantly recorded from *Callitris/Allocasuarina* dominated forests with scattered eucalypt emergents such as *E. dealbata* and *E. fibrosa*. In the more arid parts of its range in Queensland, New South Wales and South Australia it has been recorded from mulga (*Acacia aneura*) woodlands, from patches of *Eucalyptus largiflorens* woodlands (New South Wales) and riverine *E. camaldulensis* dominated communities.

8 Current threats

In south-east Queensland there is only one documented record from a National Park and this species has predominantly been recorded from timber production forests within State forest lands. It is therefore likely that the continuing loss of hollow-bearing trees in production forests will impact on the species, particularly in heavily utilized forests such as those in the Maryborough region, where relatively few hollow-bearing trees are present. The possible development of a woodchip industry in south-east Queensland may increase the likely impact of forestry practices on the species. In other areas of Queensland such as in the Childers area, clearing due to expansion of sugar cane plantations is a current threat. All Queensland State forest localities are also subject to various levels of grazing pressure from leaseholders and frequent fire regimes, which may impact on the species.

Across the rest of its range the species may be under threat from large scale clearing of native vegetation for grazing or agriculture. Loss of mature roost trees in inland areas, particularly in riverine environments, and removal of old buildings or damage to them, may result in loss of roost sites in some areas.

9 Recommended actions

- Further survey work is required to establish the true conservation status of the species, particularly in inland areas and in production forests of south-east and central Queensland and north-western New South Wales.
- Critical habitat requirements require further intensive study in order to formulate appropriate conservation management regimes. This is required particularly in relation to hollow requirements for roosting and nursery purposes in production forest areas (south-east and central Queensland and possibly north-western New South Wales).
- Protection and maintenance of known roosts.

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Western False Pipistrelle

1	**Family**	Vespertilionidae
2	**Scientific name**	*Falsistrellus mackenziei* Kitchener, Caputi and Jones, 1986
3	**Common name**	Western False Pipistrelle
4	**Conservation status**	Lower Risk (near threatened)

5 Past range and abundance

First recorded capture was in 1961. All available records are from the forested areas in mesic parts of the Darling Phytogeographic District of south-western Australia. Its range extends northward almost to Perth and eastward to the western margin of the wheatbelt. No historical data on abundance. No island populations known.

6 Present range and abundance

Since 1961, the species has been collected at 33 locations in south-west Australia. It is known from 27 operational forest 'blocks'. Records with habitat data were in or adjacent to stands of mature forest (usually pre-senescent types of old growth). It is estimated that 12 — 15% of the south-western forests remain as old growth, so a substantial decline in area of occupancy is indicated. At four sites it was locally common.

7 Habitat

It occurs in wet sclerophyll forest dominated by Karri (*Eucalyptus diversicolor*), and in the high rainfall zones of the Jarrah (*E. marginata*) and Tuart (*E. gomphocephala*) forests. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (*E. calophylla*), Sheoak (*Casuarina heugeliana*) and Peppermint (*Agonis flexuosa*) trees are often co-dominant at its collection localities.

A specialist whose foraging niche centres on the 'inside stand /open' foraging microhabitat found under the canopy of mature forests. *Chalinolobus gouldii*, its aerodynamically less specialised competitor, occupies the 'beside stand /open' foraging microhabitat that becomes more common as trees are removed.

8 Current threats

Stands of mature, pre-senescent forest are still subject to logging. Some in private ownership are being cleared. However, more than 60% of the remaining 'old growth' in the three main south-western forest types is now under some form of reservation.

9 Recommended actions

- Field survey to establish status.
- Monitor presence/absence at selected sites across range.
- Locate and characterise roost sites, determine conservation implications of sexual segregation in roosting and foraging.
- Protect roosts from disturbance.

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Golden-tipped Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Kerivoula papuensis* Dobson, 1878
3	**Common name**	Golden-tipped Bat
4	**Conservation status**	Lower Risk (near threatened)

5 Past range and abundance

Not known. There are few records of the species before the 1980's (Hall and Richards 1979). First recorded from Coomooboolaroo Station, south of Duaringa in central Queensland in 1884, although the exact locality is doubted (Schulz 1995a). This species was not recorded from 1897 until 1981, when it was 're-discovered', with the capture of a single individual at Crystal Cascades on the hinterland of Cairns (Churchill 1998); for historical review see Schulz 1995a). Extralimitally, this species is found in Papua New Guinea and the type locality is Port Moresby (Flannery 1995, Bonaccorso 1999).

6 Present range and abundance

Not well known. Since the 1980's this species has been captured with increasing regularity in regional fauna surveys with the refinement of trapping techniques and improvement of sonar detection systems (Walton et al. 1992, Clague et al. 1995, Schulz and Wainer 1997). The species has been recorded from sea level to over 1200m altitude in scattered localities ranging from Mumbulla State Forest, east of Bega in southern New South Wales north to Cape York Peninsula (Lunney and Barker 1986, Parnaby and Mills 1994, Clague et al. 1995, Schulz 1995a). It appears to have localised distributions and/or sparsely distributed within its range. The species is reasonably common in the north Queensland wet tropics region (Clague et al. 1995, Clague et al. 1995, Schulz 1995a). The majority of records have been collected in the north-east New South Wales and south-east Queensland biogeographical regions (New South Wales National Parks and Wildlife Service 1994, Schulz and Wainer 1997). The western limit of this species is poorly understood (Walton et al. 1992). While it is known from semi-evergreen vine thickets in the Tarong-Yarraman area of inland south-east Queensland, it has not been located in dry vine forests west of the Atherton Tablelands.

7 Habitat

This species has been recorded predominantly from a variety of rainforest types, ranging from tropical mesophyll vine forest to semi-evergreen vine thickets, and rainforest ecotone areas, where it feeds on a range of both gleaned and aerially acquired dietary items (Clague et al. 1995, Schulz 1995a, Schulz and Wainer 1997). There are a small number of records from dry and wet sclerophyll forests lacking a rainforest subcanopy, riparian *Casuarina cunninghamiana* dominated forest, coastal Melaleuca forests, and several individuals have been recorded inside houses on the edge of residential areas (Schulz 1995a). However the majority of such records are situated within 1 km of rainforest patches.

Roosts have predominantly been recorded from the disused suspended nests of the Yellow-throated Scrubwren *Sericornis citreogularis* and the Brown Gerygone *Gerygone mouki* (Schulz 1995b, 1998). Individuals have also been recorded roosting in tree hollows and on the side of branches, and in suspended dead foliage of treeferns (Schulz 1995b). Outside Australia, this species has been recorded roosting in caves and in buildings (Flannery 1995).

8 Current threats

Threats to this species are not well understood. However, clearing of drier rainforest types and lowland rainforest areas for agricultural and pastoral purposes, particularly in the western and coastal parts of its range, are likely to have caused decline of the species. Current potential threats include: continued clearing and fragmentation of forest, forest harvesting operations; the effect of prescribed fire regimes and *ad hoc* fires from leaseholders in production forests on foraging habitat; and predation by domestic and feral cats (known species roosts are within 5m of the ground). As the majority of roosts located so far, have been in the nests of the Yellow-throated Scrubwren and Brown Gerygone, it may be important to identify current threats facing these two rainforest bird species.

9 Recommended actions

- Conduct surveys to clarify distribution (western range limits in Queensland, drier sections of coastal and sub-coastal Queensland e.g. between Rockhampton and Mackay).
- Conduct DNA analysis of collected material to identify whether the species is isolated in sections of its range.
- Continue ecological research to determine:
  - —habitat requirements;
  - —roost and maternity site selection, particularly where the Yellow-throated Scrubwren and Brown Gerygone are uncommon or absent;
  - —population dynamics; and
  - —threatening processes, particularly the impact of forestry practices in New South Wales and Queensland.
- Ensure protection of representative populations across the distributional range.

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Tube-nosed Insectivorous Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Murina florium* Thomas, 1908
3	**Common name**	Tube-nosed Insectivorous Bat
4	**Conservation status**	Lower Risk (near threatened)

5 Past range and abundance

Unknown. Only discovered in Australia in 1981.

6 Present range and abundance

Poorly known. Has been recorded from approximately twenty localities in the Wet Tropics region extending from Mt Zero near Paluma in the south (Schulz et al. 1999) north to the Shiptons Flat / Cedar Bay area (Spencer et al. 1992), and at elevations from near sea level to 1200 metres. The southern and northern limits of the species distribution are not well known. The species has also been recorded from further north at Iron Range but it has also been suggested that this may represent a second, as yet undescribed, species. Available information indicates that the species is not uncommon in its currently recognised range and that this range is continuing to expand with increased survey work in the Wet Tropics region.

7 Habitat

This species forages in the canopy and sub-canopy of rainforest, (varying from lowland mesophyll rainforest to upland simple microphyll vine fern forest and simple notophyll vine forest) and in the ecotone between wet sclerophyll and rainforest (Whybird 1996). In some localities it has been found in rainforest with a eucalypt overstorey, and recently has been found in both wet and dry sclerophyll forest without a rainforest sub canopy (Schulz unpub.). Observation of free flying, released and radio tracked individuals suggests that they avoid cleared areas. This species uses a variety of external roosts in rainforest including the hanging nests of yellow-throated scrubwrens (*Sericornis citreogularis*) and fernwrens (*Oreoscopus gutteralis*), vertically suspended dead leaf clusters and epiphytic ferns (Schulz and Hannah 1996, 1998).

This species has been difficult to capture or record in the past using conventional techniques of trapping or ultrasonic detection. New techniques in trapping (including the use of lures) and recent advances in ultrasonic detection have improved the ability of surveys to detect the species (Whybird 1996, Clague et al. 1995).

8 Current threats

Threats to this species are not well understood. However potential threats include clearing and fragmentation of forest, forest harvesting operations and predation by domestic and feral cats (known species roosts are within 5m of the ground). A large proportion of the range of the species is contained within the Wet Tropics World Heritage Area (WTWHA) or National Parks and thus the species should be sufficiently protected in these areas. However there are important sites in the Moomin and Mt Baldy State Forests which are currently not reserved land tenure or included in the WTWHA. Logging still continues in part of the species range, leading to an inferred decline in numbers and fragmentation of populations.

9 Recommended actions

- Protection of the species in Mt Baldy State Forest from forest harvesting activities.
- Monitor populations within the WTWHA.
- Undertake targetted surveys for the species at Iron Range and clarify the taxonomic status of this population.
- Conduct targetted surveys to the south and north of the presently known range to clarify the limits of distribution.
- Encourage habitat retention and restoration where possible to provide corridors linking existing fragmented rainforest and wet sclerophyll habitats.

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Southern Myotis

1	**Family**	Vespertilionidae
2	**Scientific name**	*Myotis macropus* Gould, 1855
3	**Common name**	Southern Myotis
4	**Conservation status**	Lower Risk (near threatened)

5 Past range and abundance

Unknown. Taxonomic revision and confusion makes definitive statements about this species extremely difficult. However, in light of taxonomic revision by Kitchener et al. (1995) and recent genetic studies (T. Reardon unpub.) the species is thought to have occurred from the south of south-east Queensland along coastal Australia, with populations in Victoria and eastern South Australia and along the inland waterways of Murray and possibly Darling River systems. Thus the distribution of this species is much more restricted than shown earlier for the *M. adversus* complex (see McKean and Hall 1965, Strahan 1983, 1995) but consistent with that shown by Parnaby (1992). There is no historical data on abundance.

6 Present range and abundance

This species is generally uncommon to rare throughout most of its range. It occurs disjunctly along the coast from Victoria to south east Queensland and inland along waterways (for general distribution see Parnaby 1992). There has possibly been a decline along inland waterways (Law and Anderson unpub.), especially in southern New South Wales. In Victoria this species has been recorded from a relatively small number of localities scattered across lowland areas of the state, associated with large inland rivers (e.g. Murray River), coastal rivers and estuaries (e.g. Glenelg River, Wingan Inlet), lakes (e.g. Gippsland Lakes) and small creeks. Although widespread it is considered to be relatively rare and is only patchily distributed within areas of apparently suitable habitat (Lumsden and Menkhorst 1995). In South Australia it is known only from small colonies near Nildottie on the River Murray but probably extends along the river where there are cliffs. In south east Queensland, where in some areas it is locally common, the range of this species extends north to Gladstone.

7 Habitat

Preferred habitat is riparian. Roosts in caves, mines, tree hollows, aqueduct tunnels and under bridges and in dense vegetation in the vicinity of bodies of slow-flowing or still water (including estuaries). A recent study of the roosting ecology of this species at three localities in Victoria found it roosted exclusively in tree hollows (Caddle 1998). Roosts were located in partly submerged dead trees at Lake Eildon, while live trees close to the water were used at the other two localities. In South Australia, small colonies have been found in small vertical avens in overhangs in limestone cliffs along the Murray River. Almost exclusively forages over water (rivers, streams, dams) for aquatic prey in a variety of forest types (McKean and Hall 1965, Dwyer 1970, Lumsden and Coles 1989, Jones and Rayner 1991).

8 Current threats

Not certain. Is likely to be susceptible to changes in water quality, which may result from vegetation clearing and logging (sedimentation), sewage and fertilizer run-off (eutrophication), pesticide/herbicide leakage (chemical pollution) and altered flow regimes (changes to river ecology). Where populations concentrate in roosts which are susceptible to disturbance, human activities such as recreational use of caves and removal of old wooden bridges would also be a threat. The species may have been subject of over-collection in the past.

9 Recommended actions

- Complete the review of taxonomy and distribution of this species and its congeners. In particular confirm the placement of northern New South Wales specimens. Morphological parameters of New South Wales specimens should be incorporated into the study of Kitchener et al. (1995). Genetic studies are currently underway at the South Australian Museum.

- Conduct targetted surveys to clarify the status of the inland populations along the Murray River and in northern New South Wales.
- Assess whether this species is adequately represented in conservation reserves and ensure the security of known maternity sites.
- Carry out ecological research to determine:
  - —habitat requirements;
  - —roost and maternity site selection, particularly the relative dependence on caves versus tree hollows;
  - —sensitivity to changes in water quality;
  - —population dynamics; and
  - —threatening processes.
- Encourage State and local government authorities with responsibility for construction and maintenance of roads to inspect bridges/ culverts prior to demolition to reduce impact on colonies utilising these structures.

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Authors for the species:

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Andy Spate

Central Longed-eared Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Nyctophilus timoriensis* Geoffroy, 1806 (Central form)
3	**Common name**	Central Long-eared Bat
4	**Conservation status**	Lower Risk (near threatened)

5 Past range and abundance

Coolgardie, Hampton and northern Avon Bioregions in Western Australia, Gawler Bioregion and western part of the 'Eyre and York Blocks' Bioregion in South Australia. A specimen from Ooldea in the Great Victoria Desert Bioregion of South Australia. One other specimen from a car grill after a night-time drive from Marla (Stony Plains Bioregion of SA) to Alice Springs in the Northern Territory via the Stuart Highway in c.1985. No historical data on abundance.

6 Present range and abundance

Known from 15 localities in Western Australia and 19 in South Australia. No evidence that range has contracted, but it is apparently rare in Great Victoria Desert, Nullarbor and Stony Plains Bioregions while it is locally common in Coolgardie, Hampton, Gawler and western Eyre-York Block Bioregions.

7 Habitat

Gleans ground, bark and foliage surfaces; forages in and against cluttered airspaces. The species is often netted, and sometimes caught in pit traps, in heavy eucalypt woodlands and tall woodlands of the Coolgardie Bioregion of Western Australia with a tall shrub understorey of *Melaleuca lanceolata*, *M. pauperiflora*, *M. quadrifaria*, *Eremophila* spp. etc. Less common in open woodlands. Has been netted at dams in the Coolgardie and Hampton Bioregions of Western Australia while in South Australia has been associated with a range of mallee (*Eucalyptus*) species, *Acacia papyrocarpa*, *A. ramulosa*, *Casuarina cristata* and found to the fringes of the treeless Nullarbor Plain.

8 Current threats

Too little is known of its ecology and distribution to identify threats. Extensive clearing of mallee for grain crops in the 'Eyre and York Blocks' Bioregion, and grazing in the Gawler Bioregion, may have diminished local populations. Populations occur in the Dundas, Jilbadji and Mt Manning Nature Reserves in Western Australia, and on several Conservation Parks in South Australia.

9 Recommended actions

- Investigate taxonomic status by quantifying the morphological and sexual dimorphism differences between the Coolgardie and south-western populations.
- Extend genetic studies to include DNA sequence comparisons with eastern, western and Tasmanian forms.
- Monitor persistence of known populations.
- Carry out ecological research to determine:
  - —roost and maternity site selection; and
  - —population-density and dispersal of populations.

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Authors for the species:

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Terry Reardon
Bruce Thomson

Greater Broad-nosed Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Scoteanax rueppellii* (Peters, 1866)
3	**Common name**	Greater Broad-nosed Bat
4	**Conservation status**	Lower Risk (near threatened)

5 Past range and abundance

Poorly known but probably similar to its present distribution i.e. east coastal regions of Australia and typically less than 100 km inland (for general distribution see Hall and Richards 1979, Parnaby 1992, Hoye and Richards 1995). Likely to have been more widespread and less patchily distributed within its range.

6 Present range and abundance

The species distribution is widespread but sparse and patchy in coastal and near coastal east Australia, ranging from the extreme south-east of New South Wales (Parnaby 1992), as far north as the Atherton and Mt. Carbine Tablelands in north Queensland (Schulz 1995, Clague 1998). In southern New South Wales it appears to be restricted to lower altitude forests (McKean 1966, Woodside and Long 1984) while in the central part of its range it occurs from near sea level to upland areas (Calaby 1966). In the northern part of its range appears restricted to high altitude areas (Schulz 1995, Clague 1998). In some localities within its range, populations appears to be numerous: in south-east Queensland e.g. Ravensbourne State Forest, Main Range, and in north-east New South Wales e.g. Richmond Range National Park (Schulz unpub.). However, elsewhere in the same region, the species appears to be absent or present in low densities, despite similar vegetation type and topography.

7 Habitat

This species occurs in a variety of habitats including rainforest, dry and wet sclerophyll forest and eucalypt woodland (Parnaby 1984). In north-east Queensland it appears to be restricted to upland tall open forest and associated ecotones (Schulz 1995, Clague 1998). Its roosting requirements are poorly known. Individuals have been recorded roosting in tree hollows, cracks and fissures in the trunk and boughs of stags, and under exfoliating bark. Maternity sites have not been documented for this species.

8 Current threats

Little known. Suspected threats include: extensive clearing and fragmentation of forests in coastal and lowland areas; forest harvesting and associated activities. Impacts of forestry activities may include direct mortality of individuals (through tree felling), reduction in the availability of suitable hollows (including maternity sites) from logging and alteration in the availability of prey.

9 Recommended actions

- Ensure protection of populations throughout the range of the species. For such a strategy to be successful, minimum viable population sizes and the area required for such populations need to be calculated.
- Carry out ecological research to determine:
  - habitat requirements;
  - roost and maternity site selection, particularly winter and maternity roosts in the northern, central and southern sections of its distribution;
  - the sensitivity of roosts to disturbance;
  - key foraging areas and to ascertain the effectiveness of current forestry management practices in protecting these areas.
  - population dynamics; and
  - threatening processes.

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Authors for the species:

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Southern Bent-wing Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Miniopterus schreibersii* (Kuhl, 1819) (Southern form)
3	**Common name**	Southern Bent-wing Bat
4	**Conservation status**	Lower Risk (conservation dependent)

5 Past range and abundance

This form, which occurs in eastern South Australia and western Victoria, is considered separately from *Miniopterus schreibersii oceanensis* (see Chapter 2, p 11).

In South Australia, the Southern Bent-wing Bat has been recorded from Melrose (Flinders Ranges), Mount Lofty and Port Adelaide, Brentwood (Yorke Peninsula) and the far south-east from Naracoorte to the lower Glenelg River. They were considered to be 'by no means uncommon' in South Australia by Wood Jones (1925), although this comment was almost certainly referring to the abundance in the south east of the state. The records from the northern areas are few, with some proving difficult to verify. It is doubtful whether the natural distribution of Southern Bent-wing Bat extended very far north of Naracoorte. In south-east South Australia, the population is centered upon Naracoorte Bat Cave, the major maternity cave for this form. Well over twenty caves in the region have been identified as wintering caves (Hamilton-Smith 1972).

The past distribution of this form in Victoria was based around the cave systems in the south-west of the state. An immense maternity site recorded at Mt. Widderin Cave near Skipton in 1866 disappeared soon after discovery (Simpson and Smith 1964, Hamilton-Smith 1968). Thunder Point Blowhole, at Warrnambool, was used as a maternity site until its partial collapse in the last couple of years. Lake Gillear Guano Cave, also near Warrnambool, is currently used as a maternity site but its former status is unclear — in the past it may have served mainly as a temporary or transient site.

6 Current range and abundance

In South Australia, the range and abundance does not appear to have changed in the southern part of its range. However, there have been no records in the last 30 years of the species from north of the Naracoorte region. The number of bats currently using the Naracoorte Bat Cave (100,000 — 200,000 in December) is similar to estimates from the 1960s. This colony is protected by reservation and managed by the South Australian National Parks and Wildlife Service. This reservation has been put in place to manage cave visitation, without which the maternity site would be at risk. Other wintering and staging caves have come under increasing pressure through recreational caving activities but there is no evidence yet that such activity has resulted in any adverse effects on the bats.

In Victoria, the range and abundance has altered significantly over time, particularly through the loss of the maternity sites at Mt Widderin Cave and Thunder Point Blowhole. The Lake Gillear Guano Cave now appears to be the only maternity site remaining for the Victorian population, and its somewhat limited suitability (artificial roof holes serve to generate powerful drafts) makes the status of the population less secure. The numbers of individuals using Lake Gillear Guano Cave (less than 10,000) is considerably smaller than Naracoorte Bat Cave. Other caves near Warrnambool, along the south coast, and at Portland and Byaduk have been recorded as wintering and staging sites. The eastern limit of the distribution of this form is currently being resolved by genetic studies (B. Cardinal pers. comm.). Individuals located in mines in the Ballarat-Castlemaine area of central Victoria and from sea caves south-west of Geelong are being sampled to determine whether they belong to this form or to *M. schreibersii oceanensis* (for which the closest maternity roost is Nargun Cave in East Gippsland). If the individuals using mines in central Victoria belong to this form, the distribution is likely to have expanded into this region since European settlement as all known roosts are in man-made structures.

7 Habitat

The species is an obligate cave dweller (although some individuals occasionally roost in human constructed tunnels and buildings) and is likely to be dependent for its survival upon the only three known maternity caves (Naracoorte Bat Cave, Lake Gillear Guano Cave and the recently collapsed Thunder Point Blowhole). Every year

in spring, adult females accumulate in these caves to give birth and nurse their young. Each cave has structural characteristics which allow heat and humidity to build up so that conditions are suitable for the nursing of young bats. In mid to late summer, the bats begin to disperse to several caves which they will use to over-winter. Banding studies show that individuals can move considerable distances — one female flew from Naracoorte to Wombeyan in New South Wales (a distance of 870km) in a little over two months. Where the age of individuals making these exceptional flights is known, they have each been juveniles. The distribution of the Southern Bent-wing Bat is essentially coastal and its foraging areas are associated with major drainage systems.

8 Current threats

The recent partial collapse of Thunder Point Blowhole and its subsequent desertion by bats may have a deleterious effect upon the breeding potential of the Warrnambool region population. The current maternity site at the Lake Gillear Cave receives a relatively high level of human visitation, although the impact of this on the reproductive success of the colony is not known. The human disturbance to wintering bats and the widespread use of pesticides are potential threats, although these threats have not yet been shown to have caused a decline in population sizes.

The future of this taxon is dependent upon the protection of the major maternity caves.

9 Recommended actions

- Current plans to repair the collapse damage in Thunder Point Blowhole and to have the Lake Gillear Guano Cave repaired and placed under the care of Parks, Victoria should be encouraged.
- Develop methods for population monitoring at the maternity sites. Method/s should be non-intrusive and provide annual estimates with defined levels of precision and accuracy. When methods are developed, monitor numbers at the two currently used maternity sites, and undertake regular assessments at Thunder Point Blowhole to monitor any recolonisation of this site subsequent to restoration.
- Re-assess known wintering caves to document:
  - — current state of preservation;
  - — land tenure/ownership; and
  - — land owners attitudes conditions on cave access.
- Continue education programs for cave visitors to inform them of bat conservation issues, particularly the effect of cave disturbance.
- Complete genetic studies to determine the eastern limits of the distribution of this form.

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Torresian Flying-fox

1	**Family**	Pteropodidae
2	**Scientific name**	*Pteropus* sp. (Moa Island)
3	**Common name**	Torresian Flying-fox
4	**Conservation status**	Data Deficient

5 Comments

There has been considerable contention over the recognition of this taxon as being distinct from *P. alecto* (both are seasonally sympatric on Moa Island, Torres Strait). This putative new species was first distinguished by G.C. Richards and L.S. Hall based on morphology, being smaller in many characters, significantly different in cranial characters and having a different shaped baculum. Preliminary DNA analysis shows the closest affinity to *P. alecto* compared to the other *Pteropus* species (J.Pettigrew pers. comm.). A paper describing the new species has been prepared and is currently being revised (Richards and Hall in prep.). The June 1996 workshop discussed this issue at length and finally agreed, by majority, to include it on the list. Subsequently, the specimens used in the Richards and Hall study were re-examined and those specimens previously assigned to the new 'species' were judged to be either juvenile or neotenous *P. alecto* (Coles 1997, Tidemann 1997). Richards and Hall (pers. comm.) reject these findings on the basis that one of the holotypes was a lactating adult female with a large young. This issue remains unresolved. Resolution of the taxonomic status of this species is a precursor to allocation of further funding for conservation.

6 Recommended actions

- Resolve taxonomic status.
- If a valid taxon, determine conservation status.

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Authors for the species:

The Editorial Panel

Percy Island Flying-fox

1	**Family**	Pteropodidae
2	**Scientific name**	*Pteropus brunneus* Dobson, 1878
3	**Common name**	Percy Island Flying-fox
4	**Conservation status**	Data Deficient

5 Past range and abundance

Percy Islands (south-east of Mackay), Queensland.

6 Present range and abundance

None known. This species is known from a single specimen collected in 1859, and described in 1878 (Andersen 1912). There have been no further records of this species at the type locality, despite recent fauna surveys in the Percy Islands, nor anywhere else in Australia and the Pacific. After examination of the type specimen in the British Museum (Natural History) it is possible to conclude that this species may be confused with the ostensibly similar *Pteropus scapulatus*, especially at a distance. If *P. brunneus* is extant it may be represented by a small population that is intermixed and unnoticed in larger colonies of other *Pteropus* spp., although this possibility is doubtful.

The validity of the species was recently confirmed by both Pam Conder and Greg Richards, who examined the type specimen lodged in the British Museum of Natural History (see also Conder 1995). However, the accuracy of the type locality may be in doubt, and this requires further investigation. An unconfirmed report of a possible extant colony on nearby Akens Island was received in late 1991 and was investigated by by foot and helicopter survey in early 1992, without result (Hall and Richards unpub.).

7 Habitat

Not known.

8 Current threats

Unknown.

9 Recommended actions

- Verify the validity of the type locality by examination of historical documents. If the type locality can be proved to be non-Australian, then this species will not need further consideration.

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Authors for the species:

Les Hall
Greg Richards
Pam Conder

Christmas Island Flying-fox

1	**Family**	Pteropodidae
2	**Scientific name**	*Pteropus melanotus natalis* Thomas, 1887
3	**Common name**	Christmas Island Flying-fox
4	**Conservation status**	Data Deficient

5 Past range and abundance

According to Wilson and Reeder (1993) *P. melanotus* contains six subspecies, each restricted to an island: *P. m. satyrus* (North Andaman Islands); *P. m. tytleri* (South Andaman Islands); *P. m. niadicus* (Nias); *P. m. modiglianii* (Enggano); *P. m. melanotus* (Nicobar Islands) and *P. m. natalis* on Christmas Island. The correctness of this opinion has not been tested with modern taxonomic methods.

6 Present range and abundance

The most recent assessment of *P. melanotus natalis* was made in 1984 (Tidemann 1985). In 1984 the population was estimated to be less than 10,000 animals, but apparently stable. Much of Christmas Island (63%) is now contained within the Christmas Island National Park. No information is available on range and abundance of any of the other five subspecies (Mickleburgh et al. 1992). Assuming the opinion of Wilson and Reeder (1993) to be correct, the nearest source population to that on Christmas Island is Enggano, more than 600 km distant over water.

7 Habitat

P. melanotus natalis feeds in most of the vegetation types present on Christmas Island, including previously mined areas and camps were located in many different vegetation associations (Tidemann 1985).

8 Current threats

Small scale hunting by local people was observed in 1984, but firearms are prohibited and low technology methods are used. Consequently, bats are not hunted in camps (Tidemann 1987). Predation by feral cats causes some mortality, but the situation appears stable (Tidemann et al. 1994). The accidental introduction and establishment of the Wolf Snake (*Lycodon aulicus capucinus*) to the island (Fritts 1993) was thought initially to pose a potential risk to *P. melanotus* (Tidemann 1992), but subsequent consideration of the size of this snake suggests that it is an unlikely predator of the species (C. Tidemann unpub.).

9 Recommended actions

- Carry out population assessment. None has been carried out since 1984 and it would be prudent to do so, given the small size of the population and its extreme isolation.
- Carry out taxonomic study. This may well show that this species is an endemic species, rather than a subspecies of a widely distributed taxon.
- Review status based on knowledge gained through the above actions.

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Author for the species:

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Torresian Tube-nosed Bat

1	**Family**	Pteropodidae
2	**Scientific name**	*Nyctimene cephalotes* Pallas, 1767
3	**Common name**	Torresian Tube-nosed Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

Unknown.

6 Present range and abundance

Only known from Torres Strait on the basis of 3 specimens from Moa Is. (ANWC M13889, M5002, M19012). It should be noted that specimens M5002 and M19012 were previously mistakenly identified as *N. vizcaccia* (Bonaccorso unpub.). This species is possibly confined to Torres Strait islands within Australia, but extralimital distribution is widespread in Papua New Guinea and Indonesia where the species has been variously regarded as rare or common (Flannery 1990, Bonaccorso 1999). In New Guinea, specimens are known from Mari and Bula on the coast immediately adjacent to Torres Strait (Waithman 1979). The species may occur also on the far northern end of Cape York Peninsula; a single specimen *Nyctimene* sp. [*cephalotes* form] has been collected from central east Cape York at Silver Plains (ANWC M16259).

7 Habitat

Uncertain. Probably rainforest — it has been caught on the edge of rainforest and open grassy woodland on Moa Island, and is found in lowland rainforest in Papua New Guinea (Bonaccorso 1999). It may also inhabit mangrove as there are records from south coastal New Guinea (Waithman 1979).

8 Current threats

None known at present, but removal of rainforest or mangrove habitat would pose a serious threat if the distribution of this species is limited to Torres Strait and tip of Cape York Peninsula.

9 Recommended actions

- Taxonomic studies including:
  - — re-examination of specimens of *N. robinsoni* collected from Torres Strait islands and Cape York Peninsula to establish possible earlier collection of *N. cephalotes*; and
  - — confirm identity of Australian *N. cephalotes* in comparison with other species in the genus *Nyctimene*.
- Undertake targetted surveys of Torres Strait islands and adjacent mainland of Cape York to determine extent of distribution.
- Carry out ecological research to determine:
  - — habitat requirements;
  - — roost site selection;
  - — foraging strategy;
  - — threatening processes; and
  - — appropriate measures for conservation.
- Review status based on knowledge gained through the above actions.

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Authors for the species:

Frank Bonaccorso
Roger Coles
Les Hall
Greg Richards

Lesser Large-eared Horseshoe Bat

1	**Family**	Rhinolophidae
2	**Scientific name**	*Rhinolophus philippinensis* Waterhouse, 1843
3	**Common name**	Lesser Large-eared Horseshoe Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

Not known but was inadvertently included in the general distribution for *R. philippinensis* on Cape York Peninsula (Hall and Richards 1979, Strahan 1983). The taxonomic relationship of this taxon to *R. philippinensis* (large form) is unclear (see Chapter 2, p 10 for further discussion).

6 Present range and abundance

Now recognised from collection records as distributed in eastern central Cape York Peninsula, from Iron Range to McIlwraith Range (Churchill 1998). Current records of this form are localised and it is not known of further north than Iron Range or further south than McIlwraith Range (Peach Creek headwaters).

7 Habitat

Presumably rainforest/monsoonal vine forest. Foraging behaviour has not been observed and diet is unknown. No roosts are known but these are likely to be subterranean (mines and caves).

8 Current threats

None confirmed. This species is likely to be restricted to subterranean roosts and therefore presumably susceptible to the same type of disturbance that would affect other Rhinolophid and Hipposiderid species. May be affected by rainforest logging also.

9 Recommended actions

- Undertake targetted surveys for the species to clarify distribution and abundance.
- Carry out ecological research to meet recovery objectives i.e. determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —foraging strategy;
  - —population dynamics; and
  - —threatening processes.
- Protect and secure roost sites, including the design of a suitable bat gate.
- Clarification of taxonomy.

10 Bibliography

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Waterhouse G.R. 1843. Various species of bats from the Philippine Islands, collected by H.Cuming Esq. *Proceedings of the Zoological Society of London* **1843,** 66-69.

Authors for the species:

Sue Churchill
Chris Clague
Roger Coles
Terry Reardon

Arnhem Leaf-nosed Bat

1	**Family**	Hipposideridae
2	**Scientific name**	*Hipposideros diadema inornatus* McKean, 1970
3	**Common name**	Arnhem Leaf-nosed Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

Unknown.

6 Present range and abundance

Known from only 11 localities from Top End of the Northern Territory, although it may be distributed more widely. The species has previously been recorded in Kakadu National Park and Litchfield National Park (McKean and Hertog 1979). However it was not recorded in a recent survey of Litchfield National Park (Griffiths et al. 1997), although the survey was not intensive with neither bat trapping nor echolocation recording undertaken.

7 Habitat

The species is known to roost in caves of the sandstone escarpment of the western Arnhem Land and Tolmer Falls (McKean 1970, McKean and Hertog 1979, Thomson 1991). These areas are surrounded by tropical savanna with patches of monsoon forest. The north Queensland subspecies, *H. diadema reginae*, is known to feed on a wide variety of invertebrates and may occasionally eat small birds (Pavey and Burwell 1997).

8 Current threats

Not known.

9 Recommended actions

- Conduct taxonomic studies (morphology and genetics) to resolve whether a different species from *H. diadema reginae*.
- Conduct targetted surveys to determine the distribution and abundance of the species and in particular to locate maternity sites.
- Carry out ecological research to determine:
  - — roost and maternity site selection;
  - — population dynamics; and
  - — threatening processes.
- Ensure effective protection and management of maternity sites.
- Review status based on knowledge gained through the above actions.

10 Bibliography

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Authors for the species:

Michael Vardon
John Woinarski

Northern Leaf-nosed Bat

1	**Family**	Hipposideridae
2	**Scientific name**	*Hipposideros stenotis* Thomas, 1913
3	**Common name**	Northern Leaf-nosed Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

The species was first recorded by Knut Dahl in 1895 from the Mary River in the Northern Territory: he reported that it was 'not uncommon' in caves of the western escarpment of Arnhem Land. It has occurred in parts of the Kimberley and the Top End of Northern Territory which receive annual rainfall of greater than 700mm. Records from north-western Queensland (Mt Isa) are in the semi-arid (400mm annual rainfall) zone and are therefore not typical. There is no historical data on abundance.

6 Present range and abundance

There is no evidence that the range of the species has contracted. Although the mine localities on Koolan Island have now been 'open-cut', pairs were found in natural roosts elsewhere on the island (McKenzie et al. 1995). In the Pine Creek area of the Northern Territory, Schulz and Menkhorst (1984, 1986) found this species only in abandoned mines, some of which have since been open-cut.

They do not roost with other cave-dwelling bat species, and are usually very sensitive to the approach of an observer, darting away before identification can be made. Thus their presence is easily overlooked. Nevertheless, only twenty-one localities are known. Since it roosts alone, in pairs or in small colonies (maternity colonies of 6–12 individuals observed), this bat may be rare, localised and/or sparse within its range.

7 Habitat

The species generally roosts in the low humidity parts of caves. It frequently roosts in the twilight zone of small caves, tight overhangs or semi-shaded sites along cliff lines, and mine adits. It occurs in rugged range country supporting savanna woodlands to open forests of species such as *Eucalyptus miniata, E. tectifica, E. tetradonta, E. latifolia* with grassland or shrubland understories. Lithologies include Warton, Yampi and King Leopold sandstones, and Devonian limestone. In the Kimberley, it is usually captured along creeks and pools fringed by stands of *Melaleuca leucadendron, M. argentia, Pandanus* spp. and *Ficus platypoda*. The species has been observed in the Northern Territory feeding within centimetres of the ground surface along grass-lined vehicle tracks. It is a surface gleaner with very low wing loading, that forages against and in clutter.

8 Current threats

Little is known about threatening processes that may be affecting this species. It is considered to be sensitive to disturbance, and is less common now in the Pine Creek area of the Northern Territory than it was in 1983. There are populations in the Prince Regent River Nature Reserve, Kakadu National Park, Katherine Gorge National Park and Litchfield National Park. Three island populations are known.

9 Recommended actions

- Check identification of Mt Isa specimens.
- Carry out targetted surveys to establish conservation status and range limits.
- Carry out ecological research to determine:
  - — roost and maternity site selection;
  - — foraging strategy;
  - — population dynamics; and
  - — threatening processes.
- Review status based on knowledge gained through the above actions.

10 Bibliography

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Authors for the species:

Norm McKenzie
Martin Schulz
Bruce Thomson

Arnhem Sheathtail Bat

1	**Family**	Emballonuridae
2	**Scientific name**	*Taphozous kapalgensis* McKean and Friend, 1979
3	**Common name**	Arnhem Sheathtail Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

Unknown

6 Present range and abundance

Known only from a few specimens collected from Kakadu National Park (McKean and Friend 1979). However, Aboriginal people believe it occurs in south-east Arnhem Land (McKean and Thomson 1995), and because of limited survey activity in the Top End of the Northern Territory, it could be much more widespread than the current information suggests. Three nights of surveying in August 1996 at the type locality did not find/detect this species (L.Hall and G.Richards pers. comm.).

7 Habitat

Savannah Woodland dominated by *Eucalyptus papuana* and *Pandanus spiralis*. Aboriginal people say the species roosts at the base of Pandanus leaves (McKean and Thomson 1995).

8 Current threats:

None known. No decline has been detected nor is it likely that the habitat in which the species has been found will be greatly altered in the forseeable future. The weed species *Mimosa pigra* can detrimentally impact on floodplain vegetation, which may have implications for the species if it is dependent on *Pandanus*.

The Kapalga Research Station, where the species was first found, has been incorporated into Kakadu National Park. Access to Arnhem Land is by permit only, thereby limiting activities in this area which is likely to contain the species. *Mimosa* control has been undertaken in Kakadu National Park, and research into new or improved ways of control is continuing.

9 Recommended actions

- Undertake targetted surveys to clarify distribution and conservation status.
- Carry out ecological research to determine:
  - — habitat requirements;
  - — roost and maternity site selection, particularly the potential use of *Pandanus* as roosting places;
  - — population dynamics; and
  - — threatening processes.
- Review status based on knowledge gained through the above actions.

10 Bibliography

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Authors for the species:

Michael Vardon
John Woinarski

Papuan Sheathtail Bat

1	**Family**	Emballonuridae
2	**Scientific name**	*Saccolaimus mixtus* Troughton, 1925
3	**Common name**	Papuan Sheathtail Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

Unknown.

6 Present range and abundance

Northern Cape York Peninsula, with 3 specimens from Brown's Creek on the Pascoe River in 1948, 10 specimens from near Weipa in 1980-2, and one specimen from Heathlands in 1992 . The most southern known locality is Aurukun but the full extent of range has not been determined. The species is possibly present on some of the islands of Torres Strait as it occurs extralimitally in Papua New Guinea (Flannery 1990); the type locality is Port Moresby (Troughton 1925). Known from five specimens in southern New Guinea e.g. Dogwa, Oriomo River (Tate 1941).

7 Habitat

The three earliest Australian specimens were shot 'flying over open forest near a gully filled with fringe forest', while those collected in 1982 were caught along a track in closed *Eucalyptus tetrodonta* forest. The Heathlands specimen was taken around buildings in a clearing, surrounded by heaths and woodlands. The New Guinea specimens were mostly from monsoonal woodland, with one specimen taken from a limestone cave. Some Australian specimens were collected considerable distances from caves, and it is thought that roosts may be in tree hollows. The species typically forages in the open, above the canopy.

8 Current threats

Not known. If the species does live in tree hollows, the clearing of woodland, especially where hollow bearing eucalypts occur, for example, would pose a threat.

The species possibly occurs in several National Parks e.g. Jardine River National Park (as the Heathlands collecting locality (Coles and Lumsden 1993) is immediately adjacent to the National Park), Iron Range National Park, Archer Bend National Park and Rokeby National Park.

9 Recommended actions

- Undertake targetted surveys to clarify distribution and conservation status. Surveys should utilise ultrasonic bat detection techniques.
- Carry out ecological research to determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —foraging strategy;
  - —population dynamics; and
  - —threatening processes.
- Review status based on knowledge gained through the above actions.

10 Bibliography

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Authors for the species:

Lindy Lumsden
Roger Coles

Little North-western Freetail Bat

1	**Family**	Molossidae
2	**Scientific name**	*Mormopterus loriae cobourgiana* Johnson, 1959
3	**Common name**	Little North-western Freetail Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

Coastal and sub-coastal areas of the top-end of the Northern Territory and the semi-arid part of the tropical coastline of WA. No historical data on abundance.

6 Present range and abundance

Known from 12 localities in Western Australia and four in the Northern Territory (NT Biological Records System, Thomson 1991). There is no evidence that the range has contracted. Within its range, it is restricted to a few localised habitats, and can appear to be locally common because it aggregates. In the dry season, swarms of up to one hundred have been seen rising from *Avicennia marina* stands in Exmouth Gulf and Cape Keraudren at dusk, before dispersing to forage singly or in pairs.

7 Habitat

Rainforest and mangroves in the Northern Territory (Thomson 1991) and mangroves in Western Australia. Preys upon flying insects in the open air above and beside the forest canopy. Roosts in small spouts.

8 Current threats

Too little is known of its ecology and distribution to identify threats. A population occurs in the Gurig National Park in the Northern Territory. No island populations are known.

9 Recommended actions

- Investigate taxonomic status by quantifying the substantial morphological differences between the Western Australia and Northern Territory populations.
- Carry out ecological research to determine:
  - —roost and maternity site selection;
  - —foraging strategy;
  - —movement patterns between the mangrove stands along the Western Australian coast;
  - —persistence of known populations;
  - —population size and dynamics; and
  - —threatening processes.
- Review status based on knowledge gained through the above actions.

10 Bibliography

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Authors for the species:

Norm McKenzie
Michael Vardon

East Coast Freetail Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Mormopterus norfolkensis* (Gray, 1839)
3	**Common name**	East Coast Freetail Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

Unclear due to taxonomic confusion in this genus, especially from the east and coastal regions of Australia, and in New South Wales particularly (Allison 1989, 1996). Historically, specimens variously have been thought to either all belong to *M. norfolkensis* e.g. Iredale and Troughton (1934), to be part of the *M. planiceps* species complex (see Parnaby 1992, 1995 and Gilmore and Parnaby 1994), or to be part of *M. loriae* (see Allison 1989). The name *norfolkensis* is considered a misnomer, as the species is not known from Norfolk Island. It was most likely originally collected from the central coast of New South Wales in the vicinity of Sydney (Allison 1983, 1989). Therefore, the former distribution is likely to have been coastal mainland Australia only, restricted to central and north-east New South Wales, probably extending into south-east Queensland.

6 Present range and abundance

At present, Parnaby (1992) considers that *M. norfolkensis* can be distinguished readily from *M. planiceps* (both forms) and his *Mormopterus* sp.1. Parnaby does not recognise *M. loriae* as being sympatric with *M. norfolkensis* (Parnaby 1995), as now both sub-species of *M. loriae* are recognised to have restricted distributions over several regions in north and north-west Australia (McKenzie 1995). The sub-species *M. l. ridei* was originally considered sympatric with *M. norfolkensis* (Allison 1983) but now this range is occupied by the coastal species *Mormopterus* sp. 1 of Parnaby (1992). On this basis, *M. norfolkensis* is thought to be 'uncommon' and distributed east of the Great Dividing range to the coastline, and ranging in latitude from Picton (New South Wales) in the south, as far north as south-east Queensland. Most recent records come from north-eastern New South Wales (Parnaby 1992, Gilmore and Parnaby 1994).

7 Habitat

Poorly known. Habitat can be inferred from the few collecting localities, represented by about 12 confirmed records in New South Wales (Parnaby 1995). Such habitats include dry eucalypt forest and coastal woodlands but individuals have been captured in riparian zones in rainforest and wet sclerophyll forest (Allison and Hoye 1995). Forages above the forest canopy or at forest edges (Allison 1983). Known to roost in tree hollows but occasionally found in buildings (Gilmore and Parnaby 1994, Allison and Hoye 1995).

8 Current threats

None confirmed but it is likely that habitat modification, such as clearing for development and logging, could pose a serious threat. This is because the known distribution is limited to coastal New South Wales, and south-east Queensland where population growth is concentrated.

9 Recommended actions

- Taxonomic clarification through the re-examination of museum material and additional collection of specimens for genetic and morphological identification.
- Improve field criteria for positive identification of this species based on external morphology.
- Undertake targetted surveys to clarify distribution and conservation status.
- Carry out ecological research to determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —foraging strategy;
  - —population dynamics; and
  - —threatening processes.
- Review status based on knowledge gained through the above actions.

10 Bibliography

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Authors for the species:

Harry Parnaby
Roger Coles
Glenn Hoye

Hairy Rostrum Freetail Bat

1	**Family**	Molossidae
2	**Scientific name**	*Mormopterus* sp.(form sp. 6 in Adams et al. 1988)
3	**Common name**	Hairy Rostrum Freetail Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

Unknown.

6 Present range and abundance

Only a small number of specimens are known and these require confirmation of identification. It is understood to be widely distributed from southern Northern Territory to central Queensland, but is common nowhere. Current knowledge of this taxon is very poor, and its rarity may reflect that the species is under threat.

Based on allozyme characters (Adams et al. 1988) and morphology (McKenzie unpub., Allison 1996, and Peterson 1985) this taxon is a good species and is distantly related to other Australian *Mormopterus*.

7 Habitat

Dry open woodland. Presumed to roost in tree hollows as do other small *Mormopterus* spp.

8 Current threats

None identified.

9 Recommended actions

- Complete and publish taxonomic studies.
- Undertake targetted surveys to clarify distribution and conservation status.
- Carry out ecological research to determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —foraging strategy;
  - —population dynamics; and
  - —threatening processes.
- Review status based on knowledge gained through the above actions.

10 Bibliography

Adams M., Reardon T.R., Baverstock P.R. and Watts C.H.S. 1988. Electrophoretic Resolution of Species Boundaries in Australian Microchiroptera. IV. The Molossidae (Chiroptera). *Australian Journal of Biological Sciences* **40,** 417-433.

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Author for the species:

Terry Reardon

Central-eastern Broad-nosed Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Scotorepens* sp.
3	**Common name**	Central-eastern Broad-nosed Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

Unknown, as only recently recognised as a separate species (Parnaby 1992). The former range was probably similar to its present distribution i.e. central and north-east New South Wales coast, extending into south-east Queensland. Likely to have been more widespread and less patchily distributed within its range pre-colonisation. A re-examination of the collections of *Scotorepens* species in museums may reveal the former distribution, but only if its taxonomic identification is stabilised (see Parnaby 1995).

6 Current distribution

Poorly known. The only description of the range is to be found in Parnaby (1992, 1995). This species has some affinity to *S. greyii* (Parnaby 1992, 1995) and it may be part of the *S. greyii/S. sanborni* species complex. The uncertainty of identification (due in part to the difficulty in separating this species from *S. greyii* and *S. sanborni* in the field) has resulted in a number of records of this species being questionable (e.g. in the New South Wales National Parks and Wildlife Service Wildlife Atlas and the faunal database of the Department of Natural Resources, Queensland). Nevertheless, *S. greyii* is not considered to occur east of the Great Divide (compare Parnaby 1992, 1995, Gilmore and Parnaby 1994 and Strahan 1995, with Strahan 1983), and therefore there may be no range overlap with this species (or *S. orion*).

Current information indicates that this species is patchily distributed along a quite narrow coastal strip in eastern Australia, extending from central New South Wales to south-east Queensland (Parnaby 1992). The northern and southern limits of its range are unknown at present, and all reliable records are east of the Great Dividing Range (Parnaby 1992). Recent survey work reveals that in some localities, it appears to be well represented. For example, in Bundjalung National Park in north-eastern New South Wales, it was the most commonly captured species in harp traps (Schulz unpub.).

7 Habitat

This species occurs predominantly in dry sclerophyll forest, coastal eucalypt woodland and heathland. It appears to be sympatric with *S. orion* for most of its range (see Parnaby 1992, Tidemann 1995), but it is not clear whether it shares a similar lifestyle. For example, *S. orion* has been found in tall, wet sclerophyll forest and rainforest, but it has been caught foraging in open forest as well (Tidemann 1995). There is no information on the roosting requirements of this species and no maternity sites have been located. However, like *S. orion*, *S. greyii* and *S. sanborni*, it is likely to roost predominantly in tree hollows.

8 Current threats

Not clearly known. Suspected threats may include extensive clearing and fragmentation of suitable habitat in coastal and sub-coastal areas for residential development and agricultural purposes. Forest harvesting and associated activities may be threats through direct mortality of individuals (tree felling) reduction in the availability of suitable hollows as roosts and maternity sites, and the alteration in prey availability. Forest fragmentation may be a threat depending on the roosting and foraging requirements of this species.

9 Recommended actions

- Conduct genetic studies to determine the validity of *Scotorepens* sp. (sensu Parnaby 1992).
- Resolve difficulties in the field identification of this species and the closely related species *S. greyii*, *S. sanborni* and *S. orion*.
- Review all *Scotorepens* museum specimens and undertake targetted surveys to clarify distribution and conservation status.
- Carry out ecological research to determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —colony size;

— foraging behaviour;

— population dynamics; and

— threatening processes, particularly the impact of forestry practices in New South Wales and Queensland.

- Ensure protection of representative populations across the distributional range.
- Review status based on knowledge gained through the above actions.

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Yellow-lipped Cave Bat

1	**Family**	Vespertilionidae
2	**Scientific name**	*Vespadelus douglasorum* (Kitchener, 1976)
3	**Common name**	Yellow-lipped Cave Bat
4	**Conservation status**	Data Deficient

5 Past range and abundance

The species occurs in the parts of the north-western, south-western and north-eastern Kimberley which receive more than 600mm annual rainfall. There is no historical data on abundance. No island populations are known.

6 Present range and abundance

The first recorded capture was in 1958, and less than 15 localities have been reported since. A colony of about 12 individuals occupied the old school house at Mount Hart Homestead until 1993, when the building was knocked down. A colony of up to 50 individuals occurs in the Tunnel Creek cavern, Napier Range, and a small colony in a cave at Geikie Gorge.

The single individual known from the north-eastern Kimberley may be a different taxa [WAM19653 from Tanmurra Bore in the Ninbing Range: shorter ear with a flap at corner of mouth; shorter, wider tragus; short radius (33.9mm); for digit-3, a longer proximal phalynx to metacarpal ratio (14.9/34.0 = 0.44); no upper pre-molars; head not blended to shoulders and back].

7 Habitat

Captured along creeks and pools in Warton and King Leopold sandstone and in Devonian limestone range country. Species such as *Melaleuca leucadendron, M. argentia, Pandanus* spp., *Ficus platypoda* and *Barringtonia acutangula* are typically present.

8 Current threats

Too little is known of its ecology and distribution to identify threats. The Prince Regent River, Drysdale River and Tunnel Creek populations are protected by reservation. However, Tunnel Creek Cave is regularly disturbed by tourists.

9 Recommended actions

- Undertake targetted surveys to clarify distribution and conservation status.
- Carry out ecological research to determine:
  - —habitat requirements;
  - —roost and maternity site selection;
  - —foraging strategy;
  - —population dynamics; and
  - —threatening processes.
- Assess taxonomic status of north-east Kimberley specimen with a view to its description.
- Review status based on knowledge gained through the above actions.

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4 Threatening processes and conservation priorities

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4.1 Introduction

Identification of threats and the development of methods and actions to mitigate these is essential before successful management programs can be applied to threatened species. One of the aims of the Action Plan is therefore to identify threatening processes affecting Australian bats and recommend national priorities for conservation action.

Threatening processes are any natural or anthropogenic processes which either have a direct negative impact on individual animals or which change the habitat in such a way that the continued existence of a species is jeopardised. Natural processes which affect individual animals or taxa are part of evolutionary processes and are not considered here.

Threatening processes affecting Australian bats operate at many levels and include both factors that cause the death or reproductive failure of individuals as well as those which affect populations, whole species or many species simultaneously. Understanding threats may be complicated since many bat species could be affected by several threatening processes and these may interact in complex ways. Examples include broadscale habitat destruction and modification; roost destruction and disturbance; shooting and electrocution to protect crops; pesticide poisoning; mortality caused by collision with powerlines, fences and cars; and infection with parasites or diseases. Adverse social and cultural attitudes towards bats within the human community may also be considered a threat to some species.

In some species the effects of threatening processes may be readily apparent e.g. species which form large roosts where population size can be easily measured. However, in other species where roosts are dispersed, population size can be more difficult to define or measure due to lack of historical information and/or difficulty of survey.

4.2 Methods

Each species outline and taxon summary in this Action Plan addresses what is known about threats to each species. A broader national picture of threatening processes affecting Australian bats can be obtained by examining the numbers of species affected by similar threats. Table 4.1 summarises the confirmed and potential threats which have been identified in each species recovery outline and taxon summary (i.e. for threatened, near threatened and data deficient bats, hereafter referred to as 'threatened'), and shows the numbers of species affected by each threat.

In a similar way, a broad picture of the national priorities for conservation actions for Australian bats can be obtained by examining the numbers of species with similar types of actions identified. Table 4.2 is a summary of the types of actions identified in each species recovery outline and taxon summary. The table shows the numbers of species for which each action has been identified.

4.3 Overview of threatening processes for Australian threatened bat species

The review of Table 4.1 highlighted that the following processes were major threats affecting many Australian bats:

- habitat loss (affecting 21 of 36 species);
- roost disturbance (affecting 13 of 36 species); and
- forest harvesting (affecting 11 of 36 species).

A suite of other threats affecting small numbers of species is also identified: collapse, closure and re-working of old mines; crop protection activities; pathogens and pollutants; introduced predators; changes to fire regimes; over-collection; and collision with human infrastructure.

Also highlighted by this review is the general lack of knowledge about Australian bats. It is of great concern that for many bat species knowledge is insufficient to confidently identify reasons for decline or current threats. For seven species, no threats, confirmed or potential, can be identified.

4.3.1 Habitat loss (including clearing, fragmentation and modification)

Habitat loss is a major threat affecting more than half (21 out of 36 species) of the threatened species in Australia. While bats are not necessarily dependent on large areas of uncleared habitat for their roosting habitat, they range over relatively large areas and thus require large areas of habitat for foraging (Lunney et al. 1988, Lumsden et al. 1994, Pavey 1995). Habitat loss has resulted from activities such as agricultural clearing, urban settlement, industrial development, forestry activities, development of transport and utility corridors and tourism and recreation developments. In addition to the direct loss of habitat there are additional threats which can be associated with agricultural clearing and urban and industrial development: disturbance/ destruction of roosts, mortality associated with structures such as powerlines and barbed wire fences, and the expansion of range of introduced predators.

Using satellite imagery Graetz et al. (1995) estimate that 20% of the Australian continent has been cleared or thinned since European settlement. Contrary to common belief, broadscale clearing has actually increased in the last fifty years, with as much land cleared in the last fifty years as was cleared in the 150 years before 1945. Serious concern remains about continuing patterns of clearance (Department of Environment, Sport and Territories 1995, State of the Environment Advisory Council 1996).

As a response to concern about clearing of native vegetation, there are currently national programs under the Natural Heritage Trust e.g. the Bushcare progam, which aim to expand revegetation activities, conserve and improve the management of remnant bush and reverse the long term decline in the quality and extent of Australia's native vegetation. The protection of highly significant native vegetation is also pursued through the National Reserve System Program. State agencies also have legislation and funding programs which encourage retention of habitat and protection of wildlife on private land (e.g. Land for Wildlife (Victoria)).

4.3.2 Roost Disturbance

Roost disturbance affects 13 out of the 36 threatened species. Disturbance is usually in the form of regular human visitation, or visitation at inappropriate times such as during the maternity season or hibernation. Most susceptible species are cave dwellers or species which roost and breed in abandoned mines. The funding of management actions to protect roosts and prevent disturbance could be extremely effective in improving the conservation of bats in Australia.

4.3.3 Forest harvesting

This threat affects 11 of the 36 threatened species. Of the area of Australia covered by forests at the time of European settlement 40% has been modified by logging (State of the Environment Advisory Council 1996). The mechanisms through which logging can cause impact on bats can be summarised as:

- direct mortality;
- destruction of roost sites;
- reduced feeding opportunities through clearing of habitat;
- direct reduction in food abundance through effects on insect populations; and
- alteration of habitat structure which may impact on foraging abilities and affect chance of predation (Law 1996).

Despite the number of studies on the impact of forestry activities (relative to other threatening processes), the question of the extent of impact remains unanswered, partly because of the methodological problems associated with study of these highly mobile animals. In addition, management practices for mitigation of the effect of logging on wildlife, including bats, are presently being implemented by most State forestry agencies, but there are few studies of their efficacy. Such research is essential to ensure

Table 4.1 Confirmed and potential threats to threatened and data deficient bat species (based on species recovery outlines and taxon summaries in this Action Plan).

Threats / Species	Habitat clearing, (includes fragmentation and modification)	Roost disturbance	Forest harvesting	Collapse closure and/or reworking of mines	Change to fire regimes	Introduced predators	Pollutants	Over-collection	Crop protection activities (includes shooting, electrocution and roost harassment)	Pathogens (includes diseases and tick infestation)	Collision with human infrastructure (fences and powerlines)
Extinct											
Nyctophilus howensis						P					
Critically endangered											
Saccolaimus saccolaimus nudicluniatus	P				P						
Taphozous troughtoni				C							
Endangered											
Rhinolophus philippinensis (large form)	P	C		C				P			
Hipposideros semoni	P	P		P							
Pipistrellus murrayi	C					P					
Vulnerable											
Pteropus poliocephalus	C	C					C		C	C	C
Rhinonicteris aurantius (Pilbara form)				P							
Chalinolobus dwyeri	P	C	P	C							
Nyctophilus timoriensis (South-eastern form)	C		P		P						
Lower risk (nt and cd)											
Pteropus conspicillatus	C	C							C	C	C
Dobsonia moluccensis magna	P				P						
Macroderma gigas		C		C	P						
Taphozous australis	P	P									
Chalinolobus picatus	P	P	P		P						
Falsistrellus mackenziei			C								
Kerivoula papuensis	P		P		P						
Murina florium	P		P								
Myotis macropus	P	P	P				P	P			

Table 4.1 (continued)

Species / Threats	Habitat clearing, (includes fragmentation and modification)	Roost disturbance	Forest harvesting	Collapse closure and/or reworking of mines	Change to fire regimes	Introduced predators	Pollutants	Over-collection	Crop protection activities (includes shooting, electrocution and roost harassment)	Pathogens (includes diseases and tick infestation)	Collision with human infrastructure (fences and powerlines)
Lower risk (nt and cd) cont.											
Nyctophilus timoriensis (Central form)	P										
Scoteanax rueppellii	P		P								
Miniopterus schreibersii (Southern form)		P				P	P				
Data deficient											
Pteropus brunneus											
Pteropus sp. (Moa Island)	P										
Pteropus melanotus natalis		P				P					
Nyctimene cephalotes	P										
Rhinolophus philippinensis (small form)		P	P	P							
Hipposideros diadema inornatus				P							
Taphozous kapalgensis											
Hipposideros stenotis		P		P							
Saccolaimus mixtus	P										
Mormopterus loriae cobourgiana											
Mormopterus norfolkensis	P		P								
Mormopterus sp.(form sp 6. in Adams et al. 1988)											
Scotorepens sp.	P		P								
Vespadelus douglasorum											
C	4	5	1	4	–	–	1	–	2	2	2
P	17	8	10	5	6	4	2	2	–	–	–
TOTAL NUMBER	21	13	11	9	6	4	3	2	2	2	2

Notes: C = confirmed threat or cause of decline; P = likely/suspected/inferred/possible threat or cause of decline

management regimes can be adapted as necessary to meet the requirements of forests-dependent fauna.

4.3.4 Collapse, closure or re-working of old mines

This is a particular type of roost disturbance/ destruction which has been identified as a threat for 9 threatened bat species. A total of 29 species of Australian bats are known to use abandoned mines as daytime roosts, and 21 of these use them as maternity sites. Bats also use abandoned mines as dispersal stopover points and in a few cases the range of species has been extended (Hall et al. 1997, Hall and Richards 1998). Many of the bat species which use abandoned mines are rare and threatened and often there are large congregations of animals at these sites. The closure of mines for public safety considerations, or the collapse, destruction or re-working of abandoned mines can thus threaten the population viability of bat species now dependent on these sites following the destruction of natural roosts or because their range has now been extended to include them. On-ground management actions to protect roosts of threatened bat species are needed by mining companies, State conservation and other land management agencies.

4.3.5 Crop protection activities

'Crop protection activities' refers to a group of threats which apply specifically to two species, *Pteropus poliocephalus* (VU) and *Pteropus conspicillatus* (LR nt). These bats are well known for the damage they inflict on commercial fruit crops and have often been regarded as 'pest species' in the past. Losses to the fruit industry have been estimated by commercial growers at 20 million dollars per annum (Tidemann et al. 1997). As a result, these species have long been the subject of crop damage mitigation activities, primarily culling, by commercial fruit growers. Crop damage mitigation techniques also include harassment and disturbance of roosts, and use of crop protection devices such as 'Fyre Foxes' (networks of electric wires above orchards used to stun or kill flying foxes) and exclusion netting. Little research into the effectiveness of these techniques or their impact on bat populations.

The need to develop non-lethal techniques to protect fruit crops from *Pteropus poliocephalus* and *Pteropus conspicillatus* has been identified in this Action Plan. These should be developed and implemented in conjunction with the fruit growing industry. Further research on effective exclusion techniques (such as netting) and use of non-lethal electric currents and olfactory deterrents are suggested approaches. Incentives for encouraging the use of non-lethal techniques may also need to be considered. Queensland Department of Primary Industries are currently reviewing exclusion techniques for protection of fruit crops.

4.3.6 Diseases

All animals, bats and humans included, host an enormous range of micro-organisms, most of which usually have little effect on their hosts. If, however, animals are already stressed by starvation or some other factor, serious disease or death may result. Only a few animals will be affected in wild populations most of the time, but during unusual climatic events (eg, reduced food supply in El Nino years), localised or widespread outbreaks of disease may occur. Many diseases which are generally non-fatal in their usual hosts, may have serious consequences if transmitted to or through another species.

In the past decade three viral diseases have been traced to Australian bats — two have caused fatalities to humans and the other has caused illness. All three viruses have been fatal to domestic animals:

1. Hendra Virus (also known as equine morbillivirus, bat paramyxovirus no.1) caused the deaths of two people after they caught the disease from horses that were suspected to have caught it from bats;
2. Ballina Virus (also known as Australian Bat Lyssavirus) killed two people via bat-bites; and
3. Menangle Virus (also known as bat paramyxovirus no. 2) caused deaths of pigs and illness in humans.

In Australia very little is known about bat diseases, simply because the research has not been done. Preventive vaccination is only available currently for Ballina Virus (because of its very close affinity to classic rabies). The infectivity of Australian bat diseases to people is unknown, although probably low. Many people have been bitten by many bats over many years and contamination with faeces and urine is constant for people who work with these animals. Although only recently discovered, it is likely that these diseases have been present in the Australian bat population for some time and it is highly likely that more remain to be discovered.

Proper diagnostic testing is the only way to ascertain the cause of an animal's malaise. Accurate identification of species, age etc. are also very important if a complete epidemiological picture is to be obtained. People who wish to avoid any risk of disease should avoid contact with bats and their roosts altogether. Few people

have died from bat diseases in Australia but the health risk should be taken seriously by all concerned with bat conservation.

The threat of bat diseases is not just of a disease affecting individual animals or humans, but of the perception of personal risk by the public, leading to a reduced concern for the conservation of bats. Bats living in close proximity to humans may be at risk of persecution by people concerned about health risks. The issue of public health has now become a real issue to be addressed wherever there is likely to be contact between bats and humans. It should be noted that the Health Departments in Queensland and New South Wales consider that bats and the viruses that some of them carry are an extremely low public health risk. Well-targeted education programs are needed to convey this message to the public, together with information on the ecosystem benefits of bats.

4.4 Overview of conservation priorities for Australian threatened bat species

The review of the taxon summaries and recovery outlines (Table 4.2) highlighted that the following actions were of high national priority for Australian threatened bats:

- Survey (recommended for 31 out of 36 species);
- Ecological research (30 out of 36 species);
- Assessment of threats (23 out of 36 species);
- Taxonomy (21 out of 36 species); and
- Roost protection (18 out of 36 species).

4.4.1 Survey and ecological research

Survey of distribution and abundance of bats has been identified as an important action to assist the recovery of threatened species. It needs to be carried out in a strategic way to ensure effective conservation of bat species and efficiency of effort. Action could perhaps be taken on a regional and/or taxonomic basis or on the basis of common threats or management problems and priorities could be determined by a national advisory group. Data from surveys could be aggregated into a national bat atlas held by an appropriate national organisation such as the Environmental Resources Information Network (ERIN) or the Australian Biological Resources Study (ABRS). This would greatly assist in future reviews of the Action Plan.

Geographic information systems and modelling techniques should be used to 'fine tune' the target areas for survey and associated ecological studies. Surveys should employ a wide range of technology and be carried out with appropriate standardised methodologies. A national library of echolocation calls held by ERIN or ABRS would also assist surveys, which are increasingly relying on this method to identify species.

Possible regional groups for surveys and ecological research include:

Far North Queensland and Cape York Peninsula: this appears to be the highest priority region in terms of both numbers of species and numbers of threatened species. Species include:

Dobsonia moluccensis magna (LR[nt]),
Nyctimene cephalotes (DD),
Rhinolophus philippinensis (large form)(EN),
Rhinolophus philippinensis (small form)(DD),
Hipposideros semoni (EN),
Saccolaimus mixtus (DD),
Saccolaimus saccolaimus nudicluniatus (CR), and
Murina florium (LR[nt]).

Arid inland eastern Australia:
Taphozous troughtoni (CR),
Mormopterus sp. (form sp. 6 in Adams et al. 1988) (DD),
Chalinolobus dwyeri (VU),
Chalinolobus picatus (LR[nt]), and
Nyctophilus timoriensis (Central form) (LR[nt]).

Christmas Island:
Pteropus melanotus natalis (DD) and
Pipistrellus murrayi (EN).

Northern Territory:
Macroderma gigas (LR[nt]),
Hipposideros diadema inornatus (DD),
Hipposideros stenotis (DD),
Taphozous kapalgensis (DD), and
Saccolaimus saccolaimus nudicluniatus (CR).

Western Australia:
Macroderma gigas (LR[nt]),
Hipposideros stenotis (DD),
Rhinonicteris aurantius (Pilbara form) (VU) and
Vespadelus douglasorum (DD).

Table 4.2 Actions identified for threatened, near threatened and data deficient species (based on species recovery outlines and taxon summaries in this Action Plan).

Actions / Species	Survey	Ecological research	Assess threats	Taxonomy (including genetics and examination)	Protect roosts from disturbance	Long term monitoring	Habitat management protection	Management of roosts in man-made structures	Develop species identification	Develop survey techniques	Develop non destructive deterrents	Research into pathogens	Develop National recovery Plan
Nyctophilus howensis	Y	Y											
Saccolaimus saccolaimus nudicluniatus	Y	Y	Y	Y									
Taphozous troughtoni	Y	Y		Y	Y		Y	Y	Y				
Rhinolophus philippinensis (large form)	Y	Y	Y	Y	Y								
Hipposideros semoni	Y	Y	Y	Y	Y			Y					
Pipistrellus murrayi	Y	Y	Y			Y							
Pteropus poliocephalus		Y	Y		Y	Y	Y			Y	Y		Y
Rhinonicteris aurantius (Pilbara form)	Y				Y	Y		Y					
Chalinolobus dwyeri	Y	Y	Y		Y			Y					
Nyctophilus timoriensis (South-eastern form)	Y	Y	Y										
Pteropus conspicillatus		Y			Y	Y	Y			Y	Y	Y	
Dobsonia moluccensis magna	Y	Y	Y		Y								
Macroderma gigas	Y	Y		Y									
Taphozous australis		Y	Y		Y	Y							
Chalinolobus picatus	Y	Y	Y		Y								
Falsistrellus mackenziei	Y	Y			Y	Y							
Kerivoula papuensis	Y	Y	Y	Y	Y		Y						
Murina florium	Y			Y	Y	Y	Y						
Myotis macropus	Y	Y	Y	Y	Y	Y		Y					
Nyctophilus timoriensis (Central form)	Y	Y		Y		Y							
Scoteanax rueppellii	Y	Y	Y		Y		Y						
Miniopterus schreibersii (Southern form)				Y	Y	Y				Y			
Pteropus sp. (Moa Island)				Y									
Pteropus brunneus	Y												
Pteropus melanotus natalis	Y			Y									
Nyctimene cephalotes	Y	Y	Y	Y									
Rhinolophus philippinensis (small form)	Y	Y	Y	Y	Y								

Table 4.2 (continued)

Actions / Species	Survey	Ecological research	Assess threats	Taxonomy (including genetics and examination)	Protect roosts from disturbance	Long term monitoring	Habitat management protection	Management of roosts in man-made structures	Develop species identification	Develop survey techniques	Develop non destructive deterrents	Research into pathogens	Develop National recovery Plan
Hipposideros diadema inornatus	Y	Y	Y	Y	Y								
Hipposideros stenotis	Y	Y	Y	Y									
Taphozous kapalgensis	Y	Y	Y										
Saccolaimus mixtus	Y	Y	Y										
Mormopterus loriae cobourgiana	Y	Y	Y	Y									
Mormopterus norfolkensis	Y	Y	Y	Y					Y				
Mormopterus sp.(form sp 6. in Adams et al. 1988)	Y	Y	Y	Y									
Scotorepens sp.	Y	Y	Y	Y			Y		Y				
Vespadelus douglasorum	Y	Y		Y									
TOTAL NUMBERS OF SPECIES	**31**	**30**	**23**	**21**	**18**	**10**	**7**	**5**	**3**	**3**	**2**	**1**	**1**

Y = action identified for this species

Other groups based on similar threats and possible management approaches include:

Species which roost in abandoned mines, where collapse, closure and re-working is a threat. This group includes:

Macroderma gigas (LR[nt]),
Rhinolophus philippinensis (large form) (EN),
Rhinolophus philippinensis (small form) (DD),
Hipposideros semoni (EN),
Rhinonicteris aurantius (Pilbara form) (VU) and
Taphozous troughtoni (CR).

'Forest' species of eastern Australia. This group includes:

Mormopterus norfolkensis (DD),
Chalinolobus dwyeri (VU),
Chalinolobus picatus (LR[nt]),
Kerivoula papuensis (LR[nt]),
Murina florium (LR[nt]),
Myotis macropus (LR[nt]),
Nyctophilus timoriensis (South-eastern form)(VU),
Scoteanax ruepellii (LR[nt]) and
Scotorepens sp.(DD).

Flying foxes with similar management problems. This group includes:

Pteropus conspicillatus (LR[nt]) and
Pteropus poliocephalus (VU).

4.4.2 Assessment of threats

Assessment of threats has been identified as an action for 23 out of 36 threatened species, reinforcing the concern that little or nothing is known about threatening processes for many Australian bats. Assessment of threats should be an integral part of all ecological studies carried out on threatened species, including development of management actions to mitigate threats.

4.4.3 Taxonomy

Resolution of taxonomic problems is an action required for 21 out of 36 threatened bat species. Further, Chapter 2 (Table 2.1) identified at least 25 bat taxa requiring taxonomic clarification at the species level. It is a real possibility that such taxonomic research may identify further species which are threatened. Identification of taxonomic units is thus an integral part of ensuring the effective conservation of bats in Australia and there is a need for this to be recognised by conservation agencies and for adequate resources to be provided to rectify the problem.

4.4.4 Roost protection

Protection of roosts from disturbance has been recommended as an action for 18 out of 36 species. It is important to note that many of these species are in high categories of risk (CR, EN, VU), which indicates that despite the priority for information gathering actions such as survey, research and taxonomy, there are management actions which can be undertaken immediately to protect threatened species. Priority for funding such management actions, however, should not be overshadowed by the priority for these other actions.

4.5 Recommendations

4.5.1 Habitat clearance

The loss of habitat is probably the most serious issue affecting long-term conservation of Australian bats. The problem of habitat clearance however is a nationwide problem and its effect is obviously not restricted to bats.

- Funding for programs such as Bushcare, which are designed to halt the clearance of land and revegetate cleared land, should be maintained at current levels as a minimum and, ideally, be increased.

4.5.2 Survey and Research

- High priority should be given to survey and ecological research necessary to clarify the distribution, abundance and conservation status of Australian bats, in particular threatened, near threatened and data deficient species.
- Identification of threats and development of management prescriptions for their mitigation should be an integral part of all ecological studies.
- Forestry agencies should be encouraged to carry out further research on the impact of logging on tree-dwelling bats. In particular, studies should identify:
  - — the sensitivity of bat species to different intensities of logging (e.g. clearfelling vs selective logging);
  - — the impact of forest fragmentation on bats at a landscape scale;
  - — which species are affected by current forestry practices;
  - — the effectiveness of current management prescriptions; and
  - — improvement or modification to existing management actions if required.
- A national atlas of Australian bats should be developed and maintained, using existing and incoming data.

- A national library of echolocation calls should be established to assist in ecological research and survey.

4.5.3 Taxonomy

- High priority should be given to providing adequate resources to resolve taxonomic problems of Australian bats. This needs to be recognised by conservation agencies with fauna management responsibilities as an integral part of ensuring the effective conservation of bats in Australia.

4.5.4 Protection of roost sites

- On-ground management actions to protect roosts of threatened, near threatened and data deficient bats species should be given high priority for funding by State conservation and other land management agencies.

4.5.5 Development of non-lethal techniques for protection of fruit crops

- Non-lethal techniques to protect fruit crops from *Pteropus poliocephalus* and *Pteropus conspicillatus*, should be developed and implemented in conjunction with the fruit growing industry. This will require further research on effective exclusion techniques (such as netting) and use of non-lethal electric currents and olfactory deterrents. Incentives for encouraging the use of non-lethal techniques may also need to be considered.

4.5.6 Diseases

- A national education program should be developed to address the public health risks associated with contact with bats as well as the important ecological role of bats and the need to ensure their conservation.

4.5.7 Conservation of bat fauna in mines proposed for closure, destruction or re-working

- Guidelines for management and conservation of bat fauna in mines proposed for closure, destruction or re-working should be developed by State conservation agencies in consultation with the mining industry and government departments responsible for mining and workplace health and safety. Such guidelines could identify potential species in different areas and include options for protection of roosts and prevention of roost disturbance, such as the installation of bat gates and erection of fencing to prevent human access.

4.5.8 National coordination

In many cases the distribution of bat species, and hence responsibility for their management, extends across Commonwealth, State and Territory jurisdictions. Achievement of recovery of threatened species and management of other species would be facilitated by the existence of a national advisory group.

A national bat advisory group should be established to advise on the implementation of this Action Plan. In particular:

- advise on priorities for survey, research and taxonomy;
- set standards for survey and monitoring;
- facilitate establishment of an Australian bat atlas and call library;
- facilitate communication between researchers and managers;
- advise on/coordinate national issues eg. handling protocols required due to Australian Bat Lyssavirus and other emerging viral diseases; and
- identify and facilitate projects of broader national significance (e.g. education, public awareness).

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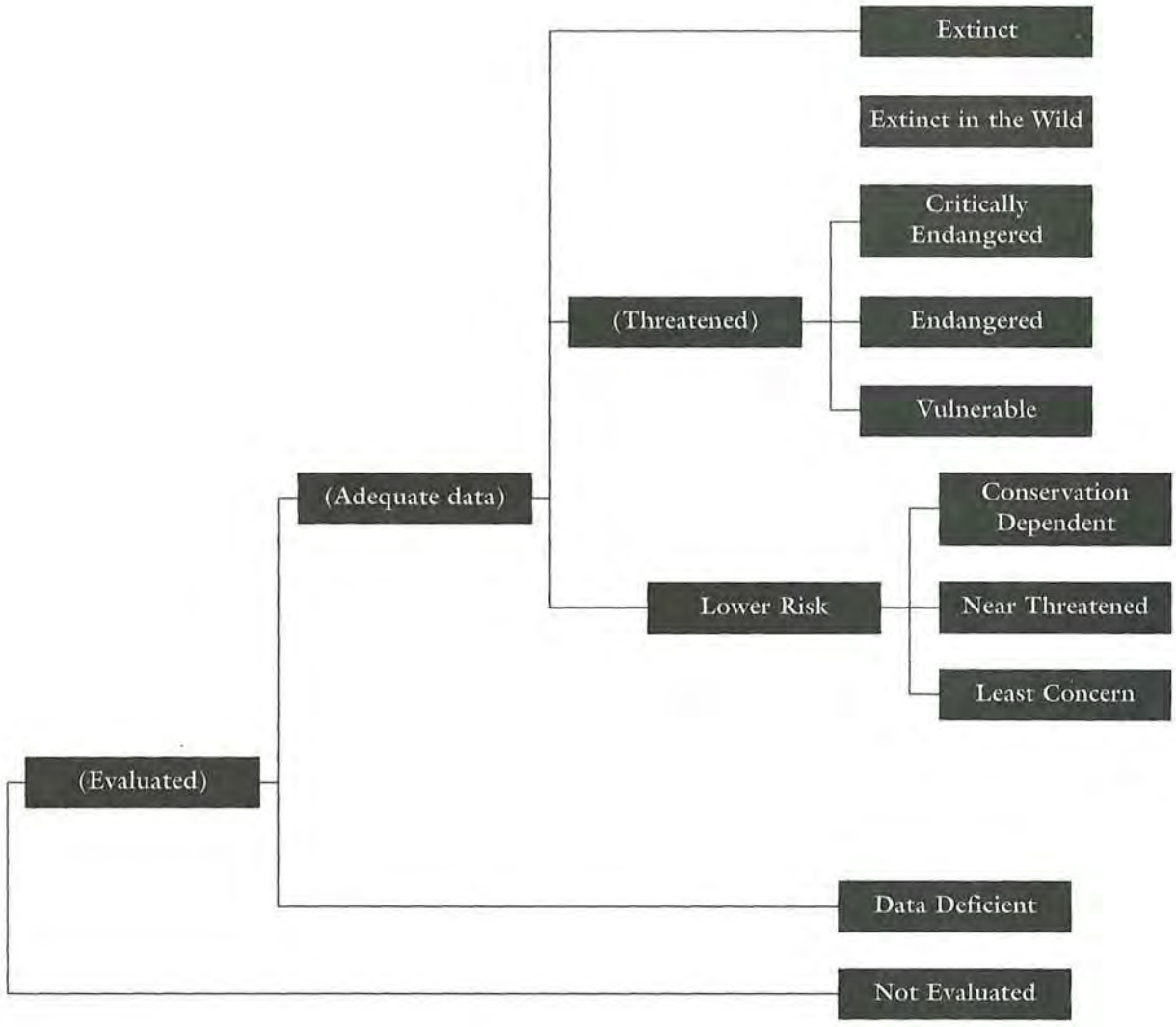
Appendix A

IUCN red list categories

Structure and Definitions of the IUCN (1994) Red List Categories.



Extinct (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died.

Extinct in the Wild (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

Critically Endangered (CR)
A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria A to E in the table below.

Endangered (EN)
A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria A to E in the table below.

Vulnerable (VU)
A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria A to E in the table below.

Lower Risk (LR)
A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

- **Conservation Dependent** (cd). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
- **Near Threatened** (nt). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable. *This Action Plan outlines four criteria for allocation of taxa to this category which were agreed upon by participants at the December 1995 workshop.*
- **Least Concern** (lc). Taxa which do not qualify for Conservation Dependent or Near Threatened.

Data Deficient (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of the taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Not Evaluated (NE)
A taxon is Not Evaluated when it has not yet been assessed against the criteria.

	CRITICALLY ENDANGERED	ENDANGERED	VULNERABLE
A) POPULATION REDUCTION IN THE FORM OF **EITHER** 1) Observed, estimated, inferred or suspected reduction of at least _____, based on (and specifying) ANY OF the following: **a)** direct observation, **b)** an index of abundance appropriate for the taxon, **c)** a decline in area of occupancy, extent of occurrence and/or quality of habitat, **d)** actual or potential levels of exploitation, **e)** the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites. **OR** 2) A reduction of at least the rate specified in A1, projected or suspected to be met, based on (and specifying) and of (b), (c), (d) or (e) above.	...80% during the last 10 years or three generations, whichever is the longer...	...50% during the last 10 years or three generations, whichever is the longer...	...20% during the last 10 years or three generations, whichever is the longer...
B) EXTENT OF OCCURRENCE ESTIMATED TO BE LESS THAN _____ **OR** AREA OF OCCUPANCY ESTIMATED TO BE LESS THAN _____ **AND ESTIMATES INDICATING ANY TWO OF** 1) Severely fragmented OR known to exist at _____ location(s). 2) Continuing decline, observed, inferred or projected, in ANY OF the following: **a)** extent of occurrence, **b)** area of occupancy, **c)** area, extent and/or quality of habitat, **d)** number of locations or subpopulations, **e)** number of mature individuals. 3) Extreme fluctuations in ANY OF the following: **a)** extent of occurrence, **b)** area of occupancy, **c)** number of locations or subpopulations, **d)** number of mature individuals.	...100 km^2 ...10 km^2 ...only a single location	...5000 km^2 ...500 km^2 ...no more than five locations	...20 000 km^2 ..2000 km^2 ...no more than ten locations
C) POPULATION ESTIMATED TO NUMBER LESS THAN _____ MATURE INDIVIDUALS **AND EITHER** 1) An estimated continuing decline of at least _____, whichever is longer **OR** 2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND population structure in the form of EITHER **a)** severely fragmented (ie. no population estimated to contain more than _____ mature individuals) OR **b)** all individuals are in a single sub-population	...250... ...25% within three years or one generation... ...50...	...2500... ...20% within five years or two generations... ...250...	...10 000... ...10% within ten years or three generations... ...1000...

	CRITICALLY ENDANGERED	ENDANGERED	VULNERABLE
D) POPULATION ESTIMATED TO NUMBER LESS THAN _____ MATURE INDIVIDUALS. **OR** **(VU only)** POPULATION IS CHARACTERISED BY AN ACUTE RESTRICTION IN ITS AREA OF OCCUPANCY (typically less than 100 km^2) OR IN THE NUMBER OF LOCATIONS (typically less than five). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.	...50... not applicable	...250... not applicable	...1000... applies
E) QUANTITATIVE ANALYSIS SHOWING PROBABILITY OF EXTINCTION IN THE WILD IS AT LEAST _____	...50% within ten years or three generations, whichever is the longer	...20% within 20 years or five generations, whichever is the longer	...10% within 100 years

Appendix B

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Appendix C

Summary of expenditure required to recover threatened taxa.

Critically Endangered	
Saccolaimus saccolaimus nudicluniatus, **Bare-rumped Sheathtail Bat**	$210 000
Taphozous troughtoni, **Troughton's Sheathtail Bat**	$90 000
Total for Critically Endangered taxa	**$300 000**
Endangered	
Rhinolophus philippinensis (large form), **Greater Large-eared Horseshoe Bat**	$129 000
Hipposideros semoni, **Semon's Leaf-nosed Bat**	$135 200
Pipistrellus murrayi, **Christmas Island Pipistrelle**	$190 000
Total for Endangered taxa	**$454 200**
Vulnerable	
Pteropus poliocephalus, **Grey-headed Flying Fox**	$1 260 000
Rhinonicteris aurantius (Pilbara form), **Pilbara Leaf-nosed Bat**	$130 000
Chalinolobus dwyeri, **Large-eared Pied Bat**	$161 000
Nyctophilus timoriensis (South-eastern form), **Eastern Long-eared Bat**	$127 000
Total for Vulnerable taxa	**$1 678 000**
TOTAL FOR ALL THREATENED TAXA	**$2 432 200**

Appendix D

Complete list and conservation status of Australian bat taxa, with IUCN red list category allocated by this Action Plan.

Species	Common name	Status
Pteropodidae (Fruit bats)		
Pteropus poliocephalus	Grey-headed Flying-fox	VU (A2c, A2d, A2e)
Pteropus scapulatus	Little Red Flying-fox	LR (lc)
Pteropus alecto gouldi	Black Flying-fox	LR (lc)
Pteropus sp. (Moa Island)	Torresian Flying-fox	DD
Pteropus brunneus	Percy Island Flying-fox	DD
Pteropus conspicillatus	Spectacled Flying-fox	LR (nt)
Pteropus macrotis epularius	Large-eared Flying-fox	LR (lc)
Pteropus melanotus natalis	Christmas Island Flying-fox	DD
Dobsonia moluccensis magna	Bare-backed Fruit Bat	LR (nt)
Nyctimene robinsoni	Eastern Tube-nosed Bat	LR (lc)
Nyctimene cephalotes	Torresian Tube-nosed Bat	DD
Syconycteris australis	Eastern Blossom Bat	LR (lc)
Macroglossus minimus nanus	Northern Blossom Bat	LR (lc)
Megadermatidae (Ghost bats)		
Macroderma gigas	Ghost Bat	LR (nt)
Rhinolophidae (Horseshoe bats)		
Rhinolophus megaphyllus ignifer	Northern Horseshoe Bat	LR (lc)
Rhinolophus megaphyllus megaphyllus	Southern Horseshoe Bat	LR (lc)
Rhinolophus philippinensis (large form)	Greater Large-eared Horseshoe Bat	EN (C2a)
Rhinolophus philippinensis (small form)	Lesser Large-eared Horseshoe Bat	DD
Hipposideridae (Leaf-nosed bats)		
Hipposideros ater aruensis	Eastern Dusky Leaf-nosed Bat	LR (lc)
Hipposideros ater gilberti	Western Dusky Leaf-nosed Bat	LR (lc)
Hipposideros cervinus	Fawn Leaf-nosed Bat	LR (lc)
Hipposideros diadema inornatus	Arnhem Leaf-nosed Bat	DD
Hipposideros diadema reginae	Diadem Leaf-nosed Bat	LR (lc)
Hipposideros semoni	Semon's Leaf-nosed Bat	EN (C2a, D)
Hipposideros stenotis	Northern Leaf-nosed Bat	DD
Rhinonicteris aurantius	Orange Leaf-nosed Bat	LR (lc)
Rhinonicteris aurantius (Pilbara form)	Pilbara Leaf-nosed Bat	VU (A1c, B1, B2c)
Emballonuridae (Sheathtail bats)		
Taphozous australis	Coastal Sheathtail Bat	LR (nt)
Taphozous georgianus	Common Sheathtail Bat	LR (lc)
Taphozous hilli	Hill's Sheathtail Bat	LR (lc)
Taphozous kapalgensis	Arnhem Sheathtail Bat	DD
Taphozous troughtoni	Troughton's Sheathtail Bat	CR (B1, B2c)
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	LR (lc)
Saccolaimus mixtus	Papuan Sheathtail Bat	DD
Saccolaimus saccolaimus nudicluniatus	Bare-rumped Sheathtail Bat	CR (A1a)

Species	Common name	Status
Molossidae (Freetail bats)		
Tadarida australis	White-striped Freetail Bat	LR (lc)
Chaerephon jobensis plicatus	Northern Freetail Bat	LR (lc)
Mormopterus beccarii	Beccari's Freetail Bat	LR (lc)
Mormopterus loriae cobourgiana	Little North-western Freetail Bat	DD
Mormopterus loriae ridei	Little North-eastern Freetail Bat	LR (lc)
Mormopterus norfolkensis	East Coast Freetail Bat	DD
Mormopterus sp.* (form sp. 4 Populations P, Q and R, in Adams et al. 1988)	South-eastern Freetail Bat	LR (lc)
Mormopterus sp.* (form sp. 3 in Adams et al. 1988)	Inland Freetail Bat	LR (lc)
Mormopterus sp.* (form sp. 4 Population O, in Adams et al. 1988)	South-western Freetail Bat	LR (lc)
Mormopterus sp.* (form sp. 2 in Adams et al. 1988)	Eastern Freetail Bat	LR (lc)
Mormopterus sp.* (form sp. 6 in Adams et al. 1988)	Hairy Rostrum Freetail Bat	DD
Vespertilionidae (Ordinary bats)		
Chalinolobus dwyeri	Large-eared Pied Bat	VU (A1a, C2a)
Chalinolobus gouldii	Gould's Wattled Bat	LR (lc)
Chalinolobus morio	Chocolate Wattled Bat	LR (lc)
Chalinolobus nigrogriseus	Hoary Wattled Bat	LR (lc)
Chalinolobus picatus	Little Pied Bat	LR (nt)
Falsistrellus mackenziei	Western False Pipistrelle	LR (nt)
Falsistrellus tasmaniensis	Eastern False Pipistrelle	LR (lc)
Kerivoula papuensis	Golden-tipped Bat	LR (nt)
Miniopterus australis	Little Bent-wing Bat	LR (lc)
Miniopterus schreibersii orianae	Northern Bent-wing Bat	LR (lc)
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	LR (lc)
Miniopterus schreibersii (Southern form)	Southern Bent-wing Bat	LR (cd)
Murina florium	Tube-nosed Insectivorous Bat	LR (nt)
Myotis macropus	Southern Myotis	LR (nt)
Myotis moluccarum	Northern Myotis	LR (lc)
Nyctophilus arnhemensis	Arnhem Long-eared Bat	LR (lc)
Nyctophilus bifax bifax	Northern Long-eared Bat	LR (lc)
Nyctophilus bifax daedelus	Pallid Long-eared Bat	LR (lc)
Nyctophilus geoffroyi	Lesser Long-eared Bat	LR (lc)
Nyctophilus gouldi	Gould's Long-eared Bat	LR (lc)
Nyctophilus howensis	Lord Howe Long-eared Bat	EX
Nyctophilus timoriensis sherrini	Tasmanian Long-eared Bat	LR (lc)
Nyctophilus timoriensis major	Western Long-eared Bat	LR (lc)
Nyctophilus timoriensis (Central form)	Central Long-eared Bat	LR (nt)
Nyctophilus timoriensis (South-eastern form)	Eastern Long-eared Bat	VU (A1c, A2c)
Nyctophilus walkeri	Pygmy Long-eared Bat	LR (lc)
Pipistrellus adamsi	Cape York Pipistrelle	LR (lc)
Pipistrellus murrayi	Christmas Island Pipistrelle	EN (C1)
Pipistrellus westralis	Northern Pipistrelle	LR (lc)
Scoteanax rueppellii	Greater Broad-nosed Bat	LR (nt)
Scotorepens balstoni	Inland Broad-nosed Bat	LR (lc)
Scotorepens greyii	Little Broad-nosed Bat	LR (lc)
Scotorepens orion	South-eastern Broad-nosed Bat	LR (lc)
Scotorepens sanborni	Northern Broad-nosed Bat	LR (lc)
Scotorepens sp.	Central-eastern Broad-nosed Bat	DD
Vespadelus baverstocki	Inland Forest Bat	LR (lc)
Vespadelus caurinus	Northern Cave Bat	LR (lc)
Vespadelus darlingtoni	Large Forest Bat	LR (lc)
Vespadelus douglasorum	Yellow-lipped Cave Bat	DD
Vespadelus finlaysoni	Finlayson's Cave Bat	LR (lc)
Vespadelus pumilus	Eastern Forest Bat	LR (lc)
Vespadelus regulus	Southern Forest Bat	LR (lc)
Vespadelus troughtoni	Eastern Cave Bat	LR (lc)
Vespadelus vulturnus	Little Forest Bat	LR (lc)