National recovery plan for the bare-rumped sheathtail bat *Saccolaimus saccolaimus nudicluniatus*

Prepared by Martin Schulz and Bruce Thomson

Australian Government

Queensland Government
Environmental Protection Agency
Queensland Parks and Wildlife Service

Northern Territory Government
Department of Natural Resources, Environment and the Arts

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Cover photograph: bare-rumped sheathtail bat by Athol Compton.

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Abbreviations

ABLV	Australian Bat Lyssavirus
ABS	Australasian Bat Society
DEW	Australian Government Department of the Environment and Water Resources
NTDNRETA	Northern Territory Department of Natural Resources, Environment and the Arts
QDNR&W	Department of Natural Resources and Water (Queensland)
QDPI&F	Department of Primary Industries and Fisheries (Queensland)
QEPA/QPWS	Environmental Protection Agency/Queensland Parks and Wildlife Service (Queensland)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
NRMB(NT)	Natural Resource Management Board (NT) Incorporated
NCA	*Queensland Nature Conservation Act 1992*
NRM	Natural Resource Management Regional bodies
TPWC	*Territory Parks and Wildlife Conservation Act* 2000 (Northern Territory)

EXECUTIVE SUMMARY

Species
Bare-rumped sheathtail bat *Saccolaimus saccolaimus nudicluniatus*.

Taxonomic issues: There are differing opinions regarding the subspecific status of *S. s. nudicluniatus* in Australia and taxonomic clarification is required. This recovery plan follows the taxonomic treatment given in the Australian Bat Action Plan (Duncan *et al*. 1999) and incorporates all records of the bare-rumped sheathtail bat, including those from the Northern Territory where no subspecific status has been attributed.

Current species status
The bare-rumped sheathtail bat is listed as 'Critically Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This species is listed as 'Endangered' under the Queensland *Nature Conservation Act 1992* (NCA). In the Northern Territory, the bare-rumped sheathtail bat (subspecies not identified) is listed as 'Data Deficient' under the *Territory Parks and Wildlife Conservation Act 2000*.

Habitat and distribution summary
Habitat: Poorly known.
In Australia all confirmed roosting records are from long deep tree hollows in the poplar gum *Eucalyptus platyphylla*, Darwin woollybutt *E. miniata* and Darwin stringybark *E. tetrodonta*. Hollows in these tree species have also been used as maternity roosts. Current information suggests this species forages over the canopy or along the edge of a variety of woodland, open forest and closed forest types. Knowledge about habitat use shifts (e.g. foraging and roosting) at different times of the year and commuting habitat is limited.

Distribution: This enigmatic bat has been recorded from less than 25 localities between Ayr and Iron Range in north-eastern Queensland and in the Top End of the Northern Territory. Predicted distribution from BIOCLIM modeling based on a very limited sample size (n=17) in Queensland suggested the species may primarily occur in coastal regions less than 40km inland centred in the Iron Range to Macrossan Range area, Cape Melville to Helenvale area, Mossman to Gordonvale area, inland of Ingham and Rollingstone to Ayr area.

Threats summary
The distribution, habitat preferences and biology of the bare-rumped sheathtail bat have not been comprehensively investigated making the identification of all known and likely threats facing this species difficult to determine. The known primary threat is habitat loss. Possible threats include vegetation change, timber collection and targeted tree removal, competition for tree hollows, disease and climate change.

Recovery objective
The overall objectives of recovery are to secure the long-term protection of the bare-rumped sheathtail bat through a reduction in the impact of threatening processes and to improve the information available to guide recovery.

Summary of recovery actions
The actions of this recovery plan seek to characterise the echolocation call used by the bat so that it can be detected in targeted surveys. Recovery actions also aim to protect roosts from known threatening processes, improve the knowledge of roosting requirements and the diet and foraging habitat of the bat, and to establish population monitoring. The taxonomic relationship of populations will be compared and described between Queensland and the Northern Territory, and between Australian and international populations.

1. GENERAL INFORMATION

Conservation status

The bare-rumped sheathtail bat *Saccolaimus saccolaimus nudicluniatus* is listed as 'Critically Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This species is listed as 'Endangered' under the Queensland *Nature Conservation Act 1992* (NCA) and 'Critically Endangered' in the Australian Bat Action Plan (Duncan et al. 1999). In the Northern Territory, the bare-rumped sheathtail bat (subspecies not identified) is listed as 'Data Deficient' under the *Territory Parks and Wildlife Conservation Act 2000* (TPWC).

The bare-rumped sheathtail bat has the largest extralimital distribution of any bat occurring in Australia. It occurs in New Guinea, including East New Britain and Bougainville Island; Solomon Islands; Indonesia; the Malay Peninsula; Philippines; Burma; Thailand; Sri Lanka; Bangladesh and India (Brosset 1962; Nowak and Paradiso 1983; Flannery 1995a; Bonaccorso 1998; Payne and Francis 1998). The bare-rumped sheathtail bat has been listed by the IUCN as of 'Lower Risk: Least Concern' (Baillie and Groombridge 1996; IUCN 2004).

Taxonomy relating to scope of the plan

There are differing opinions regarding the taxonomic status of the bare-rumped sheathtail bat *S. s. nudicluniatus* in Australia and taxonomic clarification is required. Australian forms were first described as a full species, *Taphozous nudicluniatus* (De Vis 1905). Subsequently this species was placed in the genus *Saccolaimus* based on cranial, dental and external morphology. This species was later synonymised with *Taphozous* (= *Saccolaimus*) *saccolaimus* (Goodwin 1979; Chimimba and Kitchener 1991). Some authors have considered *S. s. nudicluniatus* to be a subspecies of the widespread *S. saccolaimus* (e.g. Koopman 1984; Flannery 1995a, b). However, the validity of the subspecific status of *S. s. nudicluniatus* has been questioned (e.g. Goodwin 1979).

The Australian Bat Action Plan (Duncan et al. 1999) follows the currently accepted taxonomy of this species and recognised only one subspecies, *S. s. nudicluniatus* as occurring in Australia (incorporating both north-eastern Queensland and Northern Territory records). This approach has also been adopted in this plan.

International obligations

The bare-rumped sheathtail bat is not listed under international agreements. In the Northern Territory, the majority of known records are from Kakadu National Park, a World Heritage area, with key objectives that include maintenance of biodiversity. This recovery plan is consistent with Australia's international obligations.

Affected interests

A range of public authorities, organisations and private individuals may be affected by actions to recover the bare-rumped sheathtail bat.

Government agencies with affected interests include:

<u>Australian Government</u>

- Wet Tropics Management Authority
- Department of Defence (i.e. field training areas)

<u>Queensland State Government</u>

- Environmental Protection Agency/Queensland Parks and Wildlife Service
- Department of Primary Industry and Fisheries
- Department of Natural Resources and Water
- Department of Main Roads (management of road reserves and stock routes)

Northern Territory Government

Department of Natural Resources, Environment and the Arts

Natural Resource Management Regional Bodies

Cape York Community Engagement Group
Terrain NRM
Torres Strait NRM
Burdekin Dry Tropics NRM
Landcare Council of the Northern Territory

Local government

Local government areas throughout the range of the species in Queensland and the Northern Territory.

Aboriginal councils and other bodies

Northern Land Council
Torres Strait Regional Authority
North Queensland Land Council
Central Land Council
Cape York Land Council
Representatives of communities e.g. Lockhart River, Hope Vale and Yarrabah in north-eastern Queensland

Additionally, actions proposed as part of this recovery plan may affect private landholders whose properties provide foraging or roosting habitat, conservation groups and research organisations

Consultation with Indigenous people

During the development of the plan, a draft was provided to the Northern Land Council, Torres Strait Regional Authority, North Queensland Land Council, Central Land Council and Cape York Land Council and comment invited. Aboriginal Land Management Facilitators from the following Natural Resource Management groups, Far North NRM, Burdekin Dry Tropics NRM and Torres Strait NRM were also provided with the opportunity to comment on the draft plan.

The bare-rumped sheathtail bat is a high-flying and seldom encountered species. There appear to be no known stories or associations specifically associated with the species (B. Thomson, unpublished records).

Regard must be had for the role and interests of Indigenous people in the conservation of Australia's biodiversity. The bare-rumped sheathtail bat ranges through a number of tribal groups, including (taken from Horton 2000):

1. North-eastern Queensland (from south to north): the Bindal, Gugu-Badhun, Nyawaygi, Djirbalngan, Yidinjdji, Djabuganjdji, Kuku-yalanji, Guugu-yimidhirr, Kokowarra, Mutumui, Lamalama, Umbindhamu, Kuku-yani, Umpila, Kaantju and Uutaalnganu.
2. Northern Territory: Konbudj, Gagudju, Bukurnidja, Ngombur, Wuningangk, Limilngan and Warray.

The species may also occur on Aboriginal council lands, including Indigenous Protected Areas.

Implementation of recovery actions under this plan will include consideration of the role and interests of Indigenous communities and further involvement from traditional owners will be sought during the recovery process.

Benefits to other species

Identified actions for the bare-rumped sheathtail bat may also provide protection for other species listed under the EPBC Act. These are primarily species restricted to coastal tropical vegetation communities (particularly tropical woodlands) in north-eastern Queensland and the

Top End of the Northern Territory and include the golden-shouldered parrot *Psephotus chrysopterygius*, buff-breasted button-quail *Turnix olivii*, Semon's leaf-nosed bat *Hipposideros semoni*, mahogany glider *Petaurus gracilis*, red goshawk *Erythrotriorchis radiatus* and partridge pigeon *Geophaps smithii smithii*.

Research and monitoring proposed for the bare-rumped sheathtail bat plan may provide additional beneficial habitat, distribution, roosting and echolocation data on sympatric threatened bat species. These may include species listed as threatened under State legislation, such as the large-eared horseshoe bat *Rhinolophus philippinensis*, Semon's leaf-nosed bat *Hipposideros semoni*, fawn leaf-nosed bat *Hipposideros cervinus*, tube-nosed insect bat *Murina florium,* Arnhem leaf-nosed bat *Hipposideros inornata*, Papuan sheathtail bat *Saccolaimus mixtus*, northern leaf-nosed bat *Hipposideros stenotis,* Arnhem sheathtail bat *Taphozous kapalgensis*, bare-backed fruit-bat *Dobsonia magna*, coastal sheathtail bat *Taphozous australis* and Torresian tube-nosed bat *Nyctimene cephalotes*).

Social and economic impacts

Actions proposed in this plan are unlikely to have significant adverse social and economic impacts. The majority of actions are designed to achieve a baseline understanding of the species' status, distribution and habitat preferences.

Some parts of the distribution of this species fall within areas managed by Aboriginal councils, including Indigenous Protected Areas. The potential occurrence of this species may assist Aboriginal people in procuring funds to provide a better understanding of the fauna present within their lands through systematic and targeted fauna surveys and monitoring.

3. BIOLOGICAL INFORMATION

Species

Bare-rumped sheathtail bat *Saccolaimus saccolaimus nudicluniatus*.

Scientific names and synonyms: Recent synonyms for this species include *Saccolaimus nudicluniatus*, *Taphozous saccolaimus* and *Taphozous nudicluniatus* (Mahoney and Walton 1988; Hall 1995; Duncan et al. 1999).

Alternative common names: This species has also been referred to as the naked-rumped sheathtail bat, naked-rumped freetail bat, naked-tailed saccolaimus, pouched bat and tomb bat (Hall 1995).

Description: The bare-rumped sheathtail bat is a large insectivorous bat with a forearm length of 72-80mm. It is distinguished from other Australian sheathtail bats (Emballonuridae) by the reddish-brown to dark brown dorsal fur irregularly flecked with white and the naked rump (Churchill 1998; Menkhorst and Knight 2001). A throat pouch is present in males and is rudimentary in females. The function of the naked rump is unknown. Northern Territory individuals seem to be slightly larger, darker (almost black) on the dorsal fur compared to the more uniformly mid to dark brown dorsal fur irregularly flecked with white in the north-eastern Queensland specimens (Troughton 1925; McKean et al. 1981; Hall 1995).

Caution should be used for sight records based on individuals emerging from tree hollows or seen at roosts without being captured. For example, D. Milne (NTDNRETA, pers. comm.) cited an example where he found sheathtail bats roosting in a tree hollow in the Top End of the Northern Territory. On initial observation before capture, he suspected these bats to be the bare-rumped sheathtail bat due to the presence of white spots on the back. However, when captured these bats proved to be the more common and widespread yellow-bellied sheathtail bat *Saccolaimus flaviventris*. The appearance of white spots on the back was the product of matted fur resulting in some skin showing through. In the Northern Territory Museum specimen the white spots on the back are sparse and can only be seen upon close inspection.

Life history and ecology

The life history and ecology of this species are poorly known both within Australia and elsewhere within the bat's range. All information is based on anecdotal observations rather than from detailed ecological studies. The lack of biological information in Australia is partly a result of the lack of diagnostic echolocation calls and the fast and highly maneuverable flight above the canopy resulting in the species being extremely difficult to capture (Churchill 1998).

Diet and foraging ecology: Bare-rumped sheathtail bats are insectivorous (e.g. Mahoney and Walton 1988; Churchill 1998), although the type of insects taken has not been documented. The species has a fast, direct flight and is likely to forage primarily for aerial insects over the woodland/forest canopy but may fly lower when foraging over open situations (Bonaccorso 1998; Churchill 1998; Woinarski & Milne 2002). In Sarawak, Churchill (1998) recorded individuals foraging in the early evening along forest edges and around a large clearing.

Movements: No information is available on the movements of this species in Australia.

Roosting ecology: No studies have been conducted of the roosting ecology of this species and all located roosts are from incidental records. In Australia, all confirmed roosting records are from deep tree hollows in the poplar gum *Eucalyptus platyphylla*, Darwin woollybutt *E. miniata* and Darwin stringybark *E. tetrodonta* (McKean et al. 1981; Compton & Johnson 1983; Churchill 1998; Murphy 2002). Hollows in these tree species have also been used as maternity roosts. Such roosts are susceptible to damage by termites and by fire (Churchill 1998; Murphy 2002). Although recorded roosting in caves overseas, a survey of approximately 1000 coastal caves in

the Wet Tropics region of north-eastern Queensland failed to locate this species (Clague, Coles and Whybird cited in Coles et al. 1999). Similarly surveys across northern Australia, including the Top End of the Northern Territory and north-eastern Queensland in the 1980s and systematic bat surveys across the Top End have failed to locate this species (S. Churchill, bat expert, pers. comm.; D. Milne, NTDNRETA, pers. comm.). The possibility of this species utilising caves in some localities or at certain times of the year cannot be discounted, particularly as an unconfirmed sighting was made of a single individual in a sea cave on Prince of Wales Island in February 2002 (R. Coles, University of Queensland, pers. comm.).

Due to the lack of located roosts the details of documented individual roost trees have been included to assist in the future search for roosts (some caution should be given to sightings attributed to flying individuals):

1. Jerona Fauna Sanctuary south of Townsville in poplar gums that were pushed over during clearing operations (Compton & Johnson 1983; Figure 1): “Roosting trees were typical stunted forms with pipes 18-29cm in diameter in the trunks, into which the bats gained entry through spouts of similar size. In one tree, the entrance was approximately 7m above ground level while in another tree two spouts on opposite sides of the trunk were 6m and 7m respectively above the ground. The pipes within the trunks ranged in depth from 5-6m, their surfaces polished from constant use. During the 1978 and 1981 clearing operations, only the stunted timber was removed but it is possible that *S. saccolaimus* consequently utilised suitable hollows in the remaining taller trees.”

Figure 1. Poplar gum roosting habitat, Jerona Fauna Sanctuary, south of Townsville (from Compton & Johnson 1983).

2. Iron Range area (Murphy 2002; Figure 2): “The tree was a dead Darwin stringybark *E. tetrodonta*, 8m tall, with a diameter at breast height (DBH) of 39cm. The entrance to the cavity has been created by the crown breaking off. The entrance was approximately 7m above the ground and faced directly upward, although on all three occasions when bats were observed emerging, they flew downslope in an easterly direction, presumably to assist in gaining height. The tree had a slit-shaped fissure about 4m long on its northern face, which was above the floor of the cavity, but this was not used as access to the cavity. Thus, the cavity was estimated to be at least 3m deep. The wall of the cavity was approximately 30-40mm thick. The overall morphology of the roost site would give very little protection from rain storms, and it was therefore surprising that the bats remained at the roost site well into the 2001-2002 wet season.”

3. Edge of Darwin (exact locality unknown, S. Churchill, bat expert, pers. comm.): Colony of an unknown number of individuals with several young in a deep spout of a Darwin woollybutt that was located after the tree was felled for the construction of a house.

The species is gregarious, with between three and 40 individuals recorded from tree hollow roosts in Australia (Compton & Johnson 1983; Churchill 1998; Murphy 2002). Outside Australia, this species has been recorded roosting in groups ranging in size from “a few individuals to a few hundred” (Bonaccorso 1998; Payne & Francis 1998). In roosts individuals are alert and scurry away or as a last resort fly, if disturbed. The vigilant behaviour of this species at roost sites not only suggests that this species may be prone to disturbance. It may also aid in the location of further roosts through the detection of escaping individuals (see Murphy 2002).

Outside Australia, the bare-rumped sheathtail bat has been recorded roosting in structures, such as the eaves of houses and in old monuments; between boulders; and in caves (Boonsong & McNeely 1977; Hall 1995; Churchill 1998).

Figure 2. Roosting site in a Darwin stringybark, Iron Range area (from Murphy 2002).

Breeding: One young is born with females lactating during the tropical wet season however the exact periods of mating and parturition are unknown (Hall 1995). Breeding appears to be slightly later in the Northern Territory with pregnant females recorded between January and March (McKean et al. 1981; Churchill 1998). A colony containing juveniles was recorded in April in the Top End (Churchill 1998).

Echolocation and other vocalisations: The echolocation call of this bat may have been confused with other large generally high-flying bats, such as the Troughton’s sheathtail bat *Taphozous troughtoni* and the common sheathtail bat *T. georgianus* (R. Coles, University of Queensland, pers. comm.). Echolocation calls of the white-striped freetail bat *Tadarida australis* in parts of north-eastern Queensland have been mistakenly attributed to this species in the past (G. Richards, bat consultant, pers. comm.). Elsewhere within the range of *Saccolaimus saccolaimus*, echolocation calls have peak energy in the range 23-25kHz, similar to the frequency band of other large sheathtail bats in Australia (Coles et al. 2004). However, due to the potential for call confusion with other large insectivorous bats (i.e. sheathtail bats and some large freetail bats) and the possibility that the taxa present in Australia may be

taxonomically distinct (e.g. De Vis 1905; Nowak & Paradiso 1983) caution must be applied in using echolocation calls collected from elsewhere in the species' range.

Echolocation clicks produced by this species in flight have been reported to be audible (Bonaccorso 1998), possibly assisting in targeted surveys in the future when the echolocation calls of this species have been fully documented. At roosts the species is normally silent but utters just audible, high-pitched calls when disturbed (Murphy 2002).

Disease: No diseases have been recorded in this species in Australia. However, no specimens collected recently have been analysed for the presence of diseases (H. Field, Qld DPI, pers. comm.). A rabies-like disease, Australian Bat Lyssavirus (ABLV), has been recorded in the closely related yellow-bellied sheathtail bat *Saccolaimus flaviventris* (Barrett 2004) and may also occur in the bare-rumped sheathtail bat.

Distribution

The distribution of the bare-rumped sheathtail bat is poorly known and its Australia-wide range incorporating both current and historical records is shown in Figure 3.

Figure 3. Distribution of the bare-rumped sheathtail bat in Australia (from Churchill 1998).

Current known national distribution

The absence of records over a 16-year period prior to the preparation of the 'The Action Plan for Australian Bats' (Duncan et al. 1999) led this species to be listed as 'Critically Endangered'. Since the publication of Duncan et al. (1999), there have been only two further documented records: one road-killed individual on Magnetic Island off Townsville (Queensland Museum Specimen No. JM13938) and a sighting of up to 15 individuals flushed from a roost tree in the Iron Range area (Murphy 2002). An unconfirmed sighting was made of an individual in a sea cave on Prince of Wales Island in February 2002 (R. Coles, University of Queensland, pers. comm.). Churchill (1998) cites the location of a roost tree in the Northern Territory. However, this record was considered unsubstantiated and was not referred to in the threatened species account for this species by Woinarski and Milne (2002).

The paucity of current records may be a combination of factors: i) lack of described echolocation call making it difficult to reliably identify the species in current echolocation surveys; ii) difficulty in trapping this species; and iii) less frequent use of shotguns as a primary technique for sampling fast-flying bats (for example, of the 20 adult specimens of the bare-rumped sheathtail bat in the Queensland Museum at least 12 had been collected using this technique). Consequently, it is possible this species is more widespread and common than the few recent records. However, extensive surveys in the Top End of the Northern Territory have not located the species (D. Milne, NTDNRETA, pers. comm.).

Although a number of authors do not recognise the subspecies *S. s. nudicluniatus* (e.g. Goodwin 1979; Chimimba & Kitchener 1991), it has been reported to also occur in New Guinea,

including East New Britain and Bougainville Island (Flannery 1995a; Bonaccorso 1998). Nowak and Paradiso (1983) also list it as a full species occurring in the Solomon Islands. Elsewhere in the region, the bare-rumped sheathtail bat is found in Indonesia, Timor, Malay Peninsula, Philippines, Burma, Thailand, Sri Lanka, Bangladesh and India (Brosset 1962; Nowak & Paradiso 1983; Flannery 1995a; Bonaccorso 1998; Payne & Francis 1998). This distribution is one of the largest extralimital distributions of any bat occurring in Australia.

Historical distribution

The type locality for the bare-rumped sheathtail bat *S. s. nudicluniatus* (formerly *Taphozous nudicluniatus*) is Babinda Creek near Cardwell, with syntypes collected from Gowrie Creek near Cardwell (De Vis 1905). Since the location of the type specimen, occasional individuals have been collected from a narrow coastal region (less than 40km inland) between Ayr and Cooktown, with one isolated specimen from north of Coen on Cape York Peninsula (20 specimens held in the Queensland Museum; Ingram & Raven 1991; Coles et al. 1999). There are no confirmed records from the Torres Strait Islands, although an unconfirmed sighting was made in a sea cave on Prince of Wales Island (Coles et al. 1999; R. Coles, University of Queensland, pers. comm.). This species may be expected to occur on the Torres Strait Islands, as specimens attributed to this subspecies have been collected from the coastal plains of south-west Papua New Guinea (Waithman 1979). In the Northern Territory it was first recorded in 1979 (McKean et al. 1981) and there have been less than five confirmed records since that time (Thomson 1991; Woinarski & Milne 2002).

Figure 4. Confirmed Northern Territory records (from Woinarski & Milne 2002).

Extent and geographic location(s) of populations

The extent and geographic location of current populations is poorly known. All locations in north-eastern Queensland that could be assigned an accurate location are shown in Figure 5 and all confirmed records for the Northern Territory are outlined in Figure 4. Sites were revisited (by B. Thomson, accompanied by R. Coles, University of Queensland) at the former Jerona Fauna Sanctuary south of Townsville and the Iron Range area in December 2003. However, no individuals of this species were located using bat detection, trapping and roost tree checking techniques. It is not known whether the bats were no longer present in the area, had seasonally moved elsewhere or were not located but were still present in these localities.

Anecdotal evidence suggests this species occurs in low densities. For example, at Jerona Fauna Sanctuary “numerous” bat surveys prior to the location of the species in 1978 failed to record the bare-rumped sheathtail bat until trees were pushed over in clearing operations (Compton & Johnson 1983). This result suggests the species was uncommon and readily overlooked in the area. The roost in the Iron Range area supported between three and 15 individuals, but a check of approximately 150 similar tree cavities in the region between early 1999 and early 2002, including 60 trees inspected every two months, failed to detect evidence

of other bare-rumped sheathtail bat colonies (Murphy 2002). This suggests that the species occurs at low densities in the region.

Habitat critical to the survival of the species

Currently it is not possible to provide a map of habitat critical to survival. Actions under this recovery plan will identify habitat critical to survival.

Roosting habitat: The limited available information is detailed in the Roosting Ecology section (pp. 9).

Foraging habitat: Only anecdotal information is available based on habitat around roosts or from shot specimens and no information is available on foraging habitat shifts between the dry and wet seasons. The habitat adjacent to the roost in the Jerona Fauna Sanctuary was in poplar gum woodland typical of the alluvial plains adjacent to the lower Burdekin and Houghton Rivers (Compton & Johnson 1983). Adjacent to this woodland were woodlands dominated by carbeen *Eucalyptus tessellaris* and ghost gum *E. papuana*. At Iron Range, roosts were located in Darwin stringybark woodland with Clarkson's bloodwood *Corymbia clarksoniana* and *E. tessellaris* subdominant. Adjacent to the roost was a narrow strip of gallery forest along a seasonally dry watercourse and less than one kilometre away were large patches of rainforest associated with the Claudie River floodplain (Murphy 2002). The specimen from Attack Creek, north of Coen was collected in riverine vine forest with adjacent open forest/woodland (WildNet database, EPA/QPWS, Queensland). In either case, it was not known if individuals foraged over some or all of the vegetation communities in the vicinity of the roost. The Kakadu National Park specimens were collected from open *Pandanus* woodland fringing the sedgelands of the South Alligator River (Friend & Braithwaite 1986).

The bare-rumped sheathtail bat has been suggested to forage over habitat edges such as the edge of rainforest and in forest clearings (e.g. Churchill 1998).

Commuting habitat: No information is available on this type of habitat usage.

Temporal habitat usage: No information is available of habitat use shifts (e.g. foraging and roosting) at different times of the year.

Predicted habitat: All point locality records of the bare-rumped sheathtail bat in north-eastern Queensland were analysed using 35 biophysical parameters to predict the theoretical potential distribution of the species (Nix 1986; Carpenter et al. 1993) (Figure 5). This analysis must be regarded as very preliminary modeling due to: a) the limited record dataset (e.g. 17 point records compared to a minimum of 30-50 points used in most BIOCLIM investigations), and b) this model is based entirely on climate and does not take into account other environmental and biological parameters that may influence the actual distribution of the bare-rumped sheathtail bat, such as the presence of suitable habitat, topography, interactions with other species and disturbance regimes. The predicted distribution corresponded to existing records, indicating this species to be confined to coastal areas less than 40km inland centred on the Iron Range to the Macrossan Range area, Cape Melville to Helenvale area, Mossman to Gordonvale area, inland of Ingham and Rollingstone to Ayr area (Figure 5).

Habitat modeling was not conducted for the Northern Territory due to the low number of records.

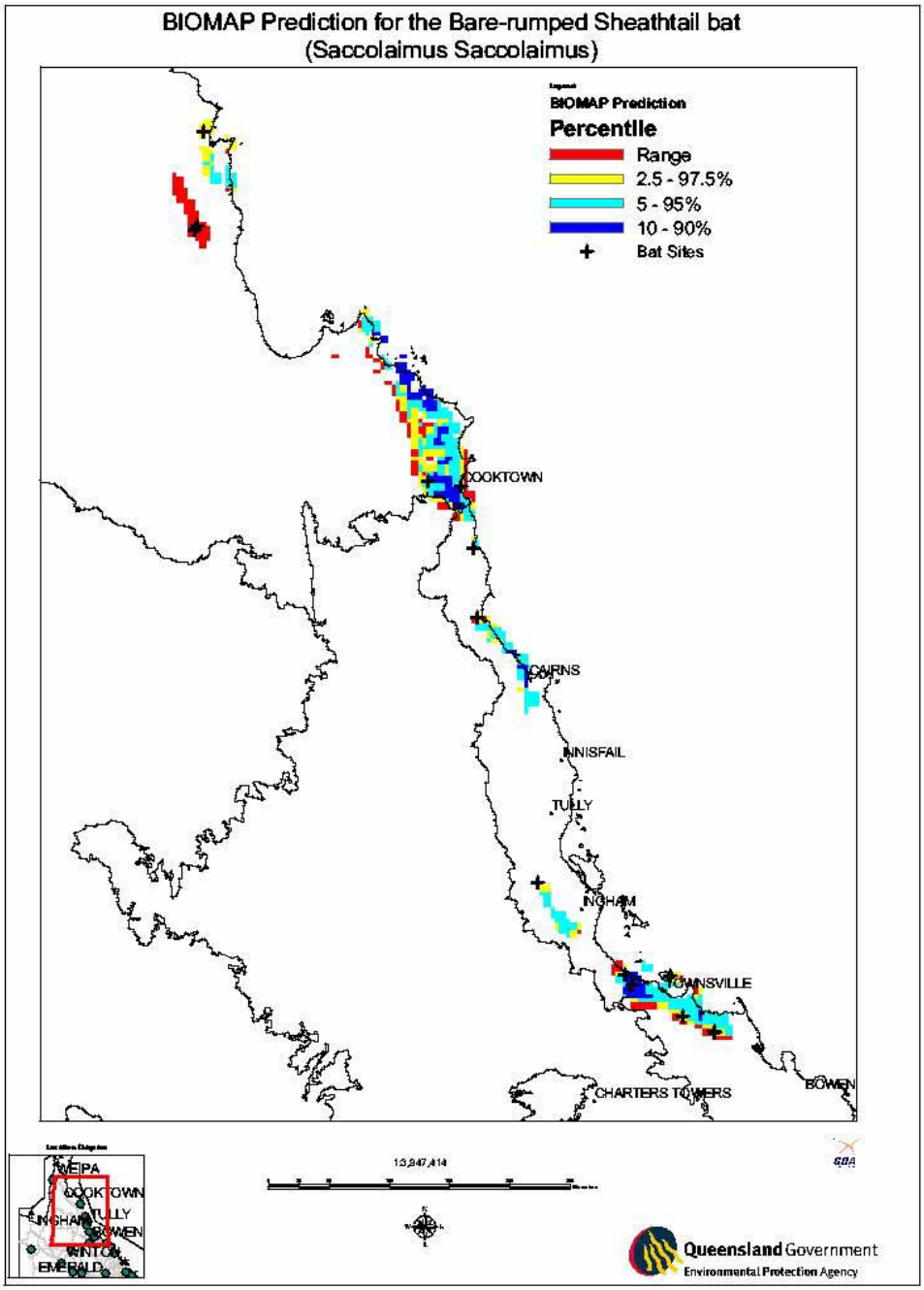

Figure 5. Capture localities and predicted distribution of the bare-rumped sheathtail bat in north-eastern Queensland using all known localities.

Important populations

The bare-rumped sheathtail bat is currently listed as 'Critically Endangered' (EPBC Act), therefore it is considered that all populations are important for the long-term conservation of the species. Only two records have been made in recent times: from Magnetic Island and in the Iron Range area. Therefore, it is not known if extant populations occur in sites where this species was previously recorded prior to the early 1980s.

3. THREATS

Identification of threats

Because the distribution, habitat preferences and biology of the bare-rumped sheathtail bat are poorly known the identification of known and likely threats facing this species may be incomplete.

***Known threats*:**

Habitat loss

The bare-rumped sheathtail bat occurs primarily in tropical eucalypt woodland and possibly rainforest in the coastal lowlands of north-eastern Queensland and the Top End of the Northern Territory. Parts of its range have been subjected to extensive habitat clearance for agriculture and urban development (Figure 5, Duncan et al. 1999). The Jerona Fauna Sanctuary site (Compton & Johnson 1983) has been extensively modified by broadscale clearing for agriculture (R. Coles, University of Queensland, pers. comm.).

The small number of confirmed roosts located in Australia have been in tree hollows. Tree hollow availability is likely to be reduced in some areas due to land clearance, such as in the Darwin-Mary River area (Woinarski & Milne 2002).

***Likely threats*:**

Vegetation change

Clearing of understorey vegetation for agriculture and livestock grazing, altered fire regimes, saltwater intrusion and invasion by exotic weed species e.g. mimosa *Mimosa pigra*, may adversely affect habitat suitability (Duncan et al. 1999; Woinarski & Milne 2002; A. Kutt, QEPA/QPWS, pers. comm.). This may affect recruitment, longevity and growth of roost trees and impact on prey resources.

Timber collection and targeted tree removal

Timber collection and the targeted removal of hollow-bearing and dead trees along road reserves, in parks and other urban situations may result in the destruction of some roosts (L. Hall, retired University of Queensland, pers. comm.).

Competition for hollows

In some areas this species may be adversely impacted by feral birds such as the common myna *Acridotheres tristis*, native birds that have benefited as a result of urban/agricultural environments (e.g. rainbow lorikeet *Trichoglossus haematodus* and the sulphur-crested cockatoo *Cacatua galerita*) and introduced insects (e.g. feral bees).

Disease

The impact of diseases on the bare-rumped sheathtail bat is unknown. Diseases such as Australian Bat Lyssavirus (ABLV) have not been recorded for the bare-rumped sheathtail bat, but this may primarily be a function of the lack of specimens presented for examination. In the related yellow-bellied sheathtail bats, five of seven individuals (71.4 percent) examined in Queensland were found to be ABLV-positive (Barrett 2004).

Climate change

The loss of climatic habitat such as tropical forests caused by anthropogenic emissions of greenhouse gases has been identified as a key threatening process under the EPBC Act. The narrow bioclimatic habitat range occupied by the bare-rumped sheathtail bat may make it susceptible to climate change.

Areas under threat

Extant populations of the bare-rumped sheathtail bat are virtually unknown in Australia so it is difficult to identify areas occupied by this species that are under threat. Extensive areas of tropical coastal woodland may be occupied by this species, some of which may be under threat by land clearance due to agricultural and urban development.

Populations under threat

No populations are currently known to be under threat.

Existing conservation measures

Currently there are no conservation measures specifically aimed at the bare-rumped sheathtail bat. The protection of suitable and potential habitat in conservation reserves, such as coastal areas of the Wet Tropics bioregion and Kakadu National Park are likely to protect the species in these areas.

4. RECOVERY OBJECTIVES

Overall objectives
The overall objectives of recovery are to secure the long-term protection of the bare-rumped sheathtail bat by reducing in the impact of threatening processes and increasing the amount of information available to guide recovery.

Specific objectives
The specific objectives of this recovery plan have been adapted from Coles *et al*. (1999) and Woinarski and Milne (2002) and include:

- developing more effective detection techniques and undertaking systematic surveys to enable a more effective assessment of distribution, population size, status and habitat preferences;
- increasing protection of known roosts both on and outside reserved lands;
- determining the roosting and foraging requirements of the species, including seasonal and distributional differences;
- identifying of threatening processes;
- establishing monitoring sites to investigate population trends in the species; and
- further clarifying the taxonomic status of the species.

Evaluation of recovery plan
The plan's performance is to be reviewed after five years. Potential contributors to the review include: QEPA/QPWS, NTDNRETA, Australasian Bat Society (ABS) and selected bat researchers.

5. PERFORMANCE CRITERIA AND RECOVERY ACTIONS

Objective 1: To develop more effective detection techniques (including obtaining echolocation reference calls) and undertake systematic surveys to enable a more comprehensive assessment of distribution, population size, status and habitat preferences.

Performance criterion 1a: *The echolocation call of the species in Australia is characterised in a format that can be applied in targeted surveys.*

Action 1.1
Obtain voucher echolocation calls from individuals confirmed to be the bare-rumped sheathtail bat through the collection of calls from flying individuals, the fly-out of individuals from roosts or released individuals that have been captured.

Note: Voucher echolocation calls to be collected using a range of detector systems that may better distinguish call characteristics.

Collecting flying individuals: There has been confusion about separating the echolocation call of the bare-rumped sheathtail bat from other similar species. This confusion has hampered current echolocation surveys, thereby limiting the amount of background information available on the species. The most effective and least labour-intensive method to obtain diagnostic 'search phase' echolocation calls to overcome this confusion is by recording voucher calls from flying individuals which are then collected. Echolocation calls obtained from roost flyouts generally do not provide good 'search-phase' call (D. Milne, NTDNRETA, pers. comm.).

Potential contributors: QEPA/QPWS, NTDNRETA, ABS, researchers.

Action 1.2
Where reliable voucher calls are obtained and the echolocation call is determined to be diagnostic, review libraries of reference calls of bats collected in the north-eastern Queensland and the Top End of the Northern Territory for the presence of this species.

Note: Such an approach may result in the detection of this species from previously unknown sites that could then be targeted in subsequent surveys (e.g. Actions 1.3 and 4.1). Such an approach was used successfully in finding additional localities for the poorly known Arnhem sheathtail bat *Taphozous kapalgensis* (Milne et al. 2003).

Potential contributors: NTDNRETA, QEPA/QPWS, ABS, researchers, fauna consultants.

Performance criterion 1b: *Targeted surveys using bat detectors and other techniques such as roost tree searches and the setting of harp traps and mistnets at canopy level are conducted at known and predicted localities within the species' range.*

Action 1.3
Conduct targeted surveys using a range of non-lethal techniques during the wet season (when the majority of records have been obtained), concentrating sampling effort around recent localities and in areas of north-eastern Queensland identified by the BIOCLIM analyses as occurring within the predicted distribution.

Potential contributors: QEPA/QPWS, NTDNRETA, ABS, researchers from various institutions.

Action 1.4
Increase public and landholder awareness of the species through the production and distribution of an information sheet to assist in the location of roosts.

Potential contributors: QEPA/QPWS, QDNR&W, Wet Tropics Management Authority (WTMA), NTDNRETA, Cape York Community Engagement Group, Terrain NRM, Torres Strait NRM and Burdekin Dry Tropics NRM, NRMB(NT), ABS, private interpretation consultants.

Objective 2: To increase protection of known roosts both on and outside reserved lands.

Performance criterion 2: *All current or located roosts are protected from known threatening processes.*

Action 2.1
Protect all roosts located within and outside conservation reserves through ensuring all known roosts are recorded on WildNet and Northern Territory Wildlife Atlas databases and through discussions and information sessions with relevant land managers and landholders.

Potential contributors: QEPA/QPWS, WTMA, NTDNRETA, Cape York Community Engagement Group, Terrain NRM, Torres Strait NRM and Burdekin Dry Tropics NRM, local government.

Action 2.2
On availability, supply researchers, departmental staff and consultants with voucher echolocation calls to assist with the assessment of the potential presence of this bat in proposed development areas within the predicted distribution in north-eastern Queensland and in the Darwin-Mary River area of the Northern Territory.

Potential contributors: QEPA/QPWS, WTMA, NTDNRETA, ABS, researchers, environmental consultants.

Objective 3: To better determine roosting requirements and document foraging requirements of the species, including potential seasonal and distributional differences and the identification of threatening processes.

Performance criterion 3a: *Roosting requirements are characterised, including maternity and non-breeding roosts.*

Action 3.1
Determine the roosting requirements during both the non-breeding and breeding seasons. Compare roosts used with available roosting habitat to investigate roost site selection.

Potential contributors: QEPA/QPWS, NTDNRETA, researchers.

Performance criterion 3b: *The diet and foraging habitat are characterised in both the wet and dry season.*

Action 3.2
Identify the diet in the dry and wet seasons by analysing droppings collected from trapped individuals or collected at roosts and identify foraging habitat by the identification of feeding buzzes recorded using a bat detector.

Potential contributors: QEPA/QPWS, NTDNRETA, researchers.

Objective 4: To establish monitoring sites to investigate population trends in the species.

Performance criterion 4: *Currently occupied roosts and located foraging areas are used for the establishment of population monitoring and the determination of population trends.*

Action 4.1
Dependent on the location of roosts and the results of targeted surveys, establish sites for bi-annual monitoring to document the seasonality of occurrence of the species in the dry and wet season. This monitoring should be conducted twice yearly beyond the life of the plan to assess population trends.

Potential contributors: WTMA, QEPA/QPWS, NTDNRETA, Cape York Community Engagement Group, Terrain NRM, Torres Strait NRM, Burdekin Dry Tropics NRM and traditional owners.

Objective 5: To clarify the taxonomic status of the species.

Performance criterion 5a: *Taxonomic relationship of populations in north-eastern Queensland and the Northern Territory is resolved.*

Action 5.1
Conduct a genetic study investigating the taxonomic status of populations in north-eastern Queensland and the Northern Territory by the use of existing material, in addition to material collected in Action 1.1, and molecular techniques.

Potential contributors: QEPA/QPWS, NTDNRETA, genetic taxonomists.

Performance criterion 5b: *Taxonomic relationship of the Australian populations and extralimital populations is resolved.*

Action 5.2
Conduct a genetic study comparing the taxonomic status of Australian populations with those from New Guinea, Timor and elsewhere within the species' distribution using existing (e.g. museum specimens) material and molecular techniques. This investigation is recommended to be undertaken by, or in conjunction with, an experienced bat taxonomist.

Potential contributors: QEPA/QPWS, NTDNRETA, genetic taxonomists from various institutions.

Summary

Objective	Performance criteria	Action	Potential Contributors	P*
Objective 1	Criterion 1a The echolocation call of the species in Australia is characterised in a format that can be applied in targeted surveys.	Action 1.1 Obtain voucher echolocation calls from individuals confirmed to be the bare-rumped sheathtail bat.	NTDNRETA, ABS, researchers	1
		Action 1.2 Review libraries of reference calls of bats collected in the north-eastern Queensland and the Top End of the Northern Territory for the presence of this species. *NB: Directly dependent on success of Action 1.1*	NTDNRETA, ABS, QEPA/QPWS, researchers, fauna consultants	1
	Criterion 1b Targeted surveys using bat detectors and other techniques such as roost tree searches and the setting of harp traps and mistnets at canopy level are conducted at known and predicted localities within the species' range.	Action 1.3 Conduct targeted surveys using a range of techniques in the wet season.	QEPA/QPWS, NTDNRETA, ABS, researchers	1
		Action 1.4 Increase public and landholder awareness of the species through the production and distribution of an information sheet to assist in the location of roosts.	QEPA/QPWS, WTMA, QDNR&W, NTDNRETA, NRM regional bodies, NRMB(NT), ABS, private interpretation consultants	2

Objective 2	Criterion 2 All current or located roosts are protected from known threatening processes.	Action 2.1 Protect all roosts located within and outside conservation reserves	QEPA/QPWS, WTMA, NTDNRETA, NRM regional bodies, local government	1
		Action 2.2 On availability, supply researchers, departmental staff and consultants with voucher echolocation calls. *NB: Dependent on the outcomes of Action 1.*	QEPA/QPWS, WTMA, NTDNRETA, ABS, researchers, environmental consultants	1
Objective 3	Criterion 3a Roosting requirements are characterised, including maternity and non-breeding roosts.	Action 3.1 Determine the roosting requirements during both the non-breeding and breeding seasons.	QEPA/QPWS, NTDNRETA, researchers	2
	Criterion 3b The diet and foraging habitat are characterised in both the wet and dry season.	Action 3.2 Identify the diet in the dry and wet seasons.	QEPA/QPWS, NTDNRETA, researchers	2
Objective 4	Criterion 4 Currently occupied roosts and located foraging areas are used for the establishment of population monitoring and the determination of population trends.	Action 4.1 Establish sites for bi-annual monitoring to document the seasonality of occurrence of the species.	WTMA, QEPA/QPWS, NTDNRETA, NRM bodies	2
Objective 5	Criterion 5a Taxonomic relationship of populations in north-eastern Queensland and the Northern Territory is resolved.	Action 5.1 Conduct a genetic study investigating the taxonomic status of populations in north-eastern Queensland and the Northern Territory.	Genetic taxonomists	1
	Criterion 5b Taxonomic relationship of the Australian populations and extralimital populations is resolved.	Action 5.2 Conduct a genetic study comparing the taxonomic status of Australian populations with those from New Guinea, Timor and elsewhere within the species' distribution.	Genetic taxonomists	1

*Priority ranking: 1 = High; 2 = Medium; 3 = Low.

6. MANAGEMENT PRACTICES

As there are few Australian records and ecological information is not available, it is difficult to identify threatening processes directly affecting this bat and therefore difficult to provide informed management recommendations. Actions identified in this plan will help to increase the available ecological information about the species and thereby the ability to make informed management decisions.

Based on the current state of knowledge of the species and known threats, management practices that destroy significant areas of coastal tropical forest or caves less than 40km inland

between Ayr and Cape York and in the Top End of the Northern Territory, or alter this habitat to the extent that its productivity or suitability to the species is diminished, are likely have an adverse impact on this species.

7. COST OF RECOVERY

***Note*:** All figures provided are in $.

Recovery Action	Year of Implementation					
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Action 1.1: Obtain voucher echolocation calls from individuals confirmed to be the bare-rumped sheathtail bat	40,000*	-	-	-	-	**40,000***
Action 1.2: Review libraries of reference calls of bats collected in the north-eastern Queensland and the Top End of the Northern Territory for the presence of this species (*NB*: dependent on success of Action 1.1, therefore probably no cost to be incurred)	-	-	-	-	-	**-**
Action 1.3: Conduct targeted surveys using a range of techniques in the wet season	-	45,000*	20,000*	-	-	**65,000***
Action 1.4: Increase public and landholder awareness of the species	5000	-	-	-	-	**5000**
Action 2.1: Protect all roosts located within and outside conservation reserves	-	-	-	-	-	**-**
Action 2.2: On availability, supply researchers, departmental staff and consultants with voucher echolocation calls	7500	7500	-	-	-	**15,000**
Action 3.1: Determine the roosting requirements during both the non-breeding and breeding (i.e. wet) seasons #	-	20,000*	15,000*	15,000*	-	**50,000**
Action 3.2: Identify the diet in the dry and wet seasons #	-	20,000*	15,000*	15,000*	-	**50,000**
Action 4.1: Establish sites for bi-annual monitoring to document the seasonality of occurrence of the species	-	5000	5000	5000	5000	**20,000**
Action 5.1: Conduct a genetic study investigating the taxonomic status of populations in north-eastern Queensland and the Northern Territory #	-	7000*	-	-	-	**7000**
Action 5.2: Conduct a genetic study comparing the taxonomic status of Australian populations with those from New Guinea, Timor and elsewhere within the species' distribution #	-	7000*	-	-	-	**7000**
TOTAL COST	52,500	111,500	55,000	35,000	5,000	**259,000**

* = Costs could be considerably reduced by: 1. Postgraduate student involvement, or 2. Organising field trips to selected sites with experienced bat enthusiasts from organisations such as the Australasian Bat Society.

= Actions to be conducted over the same timeframe with the same researcher(s).

= Assessment to be conducted by responsible agencies in consultation with selected bat experts.

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