Recovery plan for the bridled nailtail wallaby (*Onychogalea fraenata*) 2005–2009

Prepared by Geoff Lundie-Jenkins and Janelle Lowry for the Bridled Nailtail Wallaby Recovery Team

Queensland Government
Queensland Parks and Wildlife Service

Australian Government

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This is the fourth edition of the bridled nailtail recovery plan (see also Davidson 1991, Clancy 1994, Lundie-Jenkins 2002).

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Contents

Summary

Current species status
'Endangered' (*Environment Protection and Biodiversity Conservation Act 1999; Nature Conservation Act 1992 – Nature Conservation (Wildlife) Regulation 1994*).

Bridled nailtail wallabies were apparently common west of the Great Divide at the time of European settlement. The range of the species has dramatically declined during the last one hundred years, with the only known significant population of the species occurring on Taunton National Park (Scientific) (149°11'E, 23°34'S) located near Dingo in central Queensland. A small, translocated population has been established on Idalia National Park (144°72'E, 24°70'S) and Avocet Nature Refuge (148°10'E, 23°50'S) and other translocations are currently underway.

Habitat requirements and limiting factors
The bridled nailtail wallaby previously occupied *Acacia* shrubland and grassy woodland in the semi-arid regions of eastern Australia. Competition with domestic herbivores (notably sheep), habitat alteration and predation by introduced predators, especially foxes, have been suggested as reasons for the species' decline. The speed and scale of the decline makes it impossible to identify any one predominant causal factor.

Recovery plan objective
To significantly improve the conservation status of the bridled nailtail wallaby by maintaining or expanding existing wild and captive populations, and establishing new wild and captive populations.

Recovery criteria
(1) Enhance or maintain existing free-range populations of bridled nailtail wallaby at Taunton and Idalia National Parks, and Avocet Nature Refuge.
(2) Two or more additional populations of the species (>100 individuals) established in areas of suitable habitat, at a distance of >100km from the existing free-range populations. This will demonstrate a positive rate of increase in the medium term (≥ three years). At least one population to be located in New South Wales and one on private land.
(3) A minimum of 5000ha of suitable habitat in the vicinity (100km radius) of Taunton National Park protected and managed in collaboration with landholders, to promote natural and assisted dispersal and expansion of wallaby populations.
(4) Areas of critical and potential bridled nailtail wallaby habitat identified and mapped within three years, and protected under legislation within five years.
(5) Five or more additional landholders, community or industry organisations actively contributing to the implementation of recovery actions.
(6) Maintain and enhance self-sustainable captive populations of bridled nailtail wallabies at appropriate institutions for future translocations, sanctuary populations and public education.
(7) Management guidelines published (within three years) based on the successful completion of key investigations completed under this and previous versions of the recovery plan.
(8) Maintain a recovery team with high levels of community and agency stakeholder support and involvement that coordinates and reports on actions in the recovery plan in both the short- and long-term.

Actions needed

(1) Management of free-range bridled nailtail wallaby populations
(2) Translocation of bridled nailtail wallabies to areas of suitable habitat
(3) Community extension and education
(4) Maintenance of captive breeding and sanctuary populations
(5) Investigations to underpin future management
(6) Manage, review and report on the recovery program

Biodiversity benefits

Protection of remnant vegetation in Brigalow Belt and Mulga Lands biogeographic regions. Promotion of improved land management practices in these areas to enhance conservation values.

Estimated cost of recovery: 2002 Prices (+5% p.a.) in $000s/year.

Action	(1)	(2)	(3)	(4)	(5)	(6)	Total
Year 1	314	103	80	57	60	16	630
Year 2	326	108	79	59	82	17	671
Year 3	340	112	85	62	79	17	695
Year 4	353	116	86	64	51	31	702
Year 5	367	121	92	67	31	19	697
Total	1,701	561	422	308	302	100	**3,394**

1 *Bridled nailtail wallaby*

1.1 Description of species

The bridled nailtail wallaby (*Onychogalea fraenata*) (Gould 1840) (Marsupialia: Macropodidae) is one of three species of a genus of macropod characterised by the possession of a small horny spur at the end of the tail. One species, the crescent nailtail wallaby (*O. lunata)* formerly occurring in central and south-western Australia, is presumed extinct (Burbidge 1983). The other species, the northern nailtail wallaby, *O. unguifera*, is common in tropical northern Australia and appears to be under little immediate threat of severe population reduction (Ingleby 1991).

The bridled nailtail wallaby is a medium-sized macropod with adult females reaching body-weights of 6kg (usually 4-5kg) and adult males 8kg (usually 5-6kg) (Gordon 1983, Evans 1992). The species is distinctively marked, possessing a white "bridle" line running from the centre of the neck along the shoulder to behind the forearm, on each side of the body. A black dorsal stripe runs the length of the body and common to many other species of macropod, white cheek stripes are present on both sides of the head. The horny "nail" at the tip of the tail is between 3-6 mm and is partly concealed by hair (Evans 1992).

1.2 Distribution

At the time of European settlement, bridled nailtail wallabies were apparently common west of the Great Divide. Reports by naturalists Gilbert (reported in Gould 1863), Gould (1863), Collet (1887, describing Lumholtz's collection) and Gordon and Lawrie (1980) indicate that in the mid-nineteenth century the species ranged from the Murray River region of north-western Victoria (possibly into eastern South Australia) through central New South Wales, and north to Charters Towers in Queensland (Gordon 1983).

The range of the species declined dramatically during the last one hundred years with no confirmed sightings during the period 1937-1973. However, reference to the wallaby occurring 50km outside Tambo (in central Queensland) was made by J.K. Wilson, in a letter to David Fleay in 1963 (Lavery and Tierney 1985). The species was "rediscovered" in 1973, after Mr D. Challacombe of Duaringa reported the presence of a population near the town of Dingo (Gordon and Lawrie 1980). Following its rediscovery it was recommended that the two properties (*Taunton* and *Redhill*), where the majority of sightings had been recorded, be acquired to enhance conservation of the species. *Taunton* and the *Redhill* properties were acquired separately (see Section 4.2) in 1979 and 1984 respectively. With the advent of the *Queensland Nature Conservation Act 1992*, Taunton reserve (149°11'E, 23°34'S), which included both properties, was declared as Taunton National Park (Scientific). Presently, the only known significant remnant population of the species occurs on Taunton National Park (Davidson 1991), with a few sightings of wallabies on properties within 20km of the park (Gordon and Lawrie 1980, G. Porter, unpublished data). Locations of known historical records are given in Figure 1.

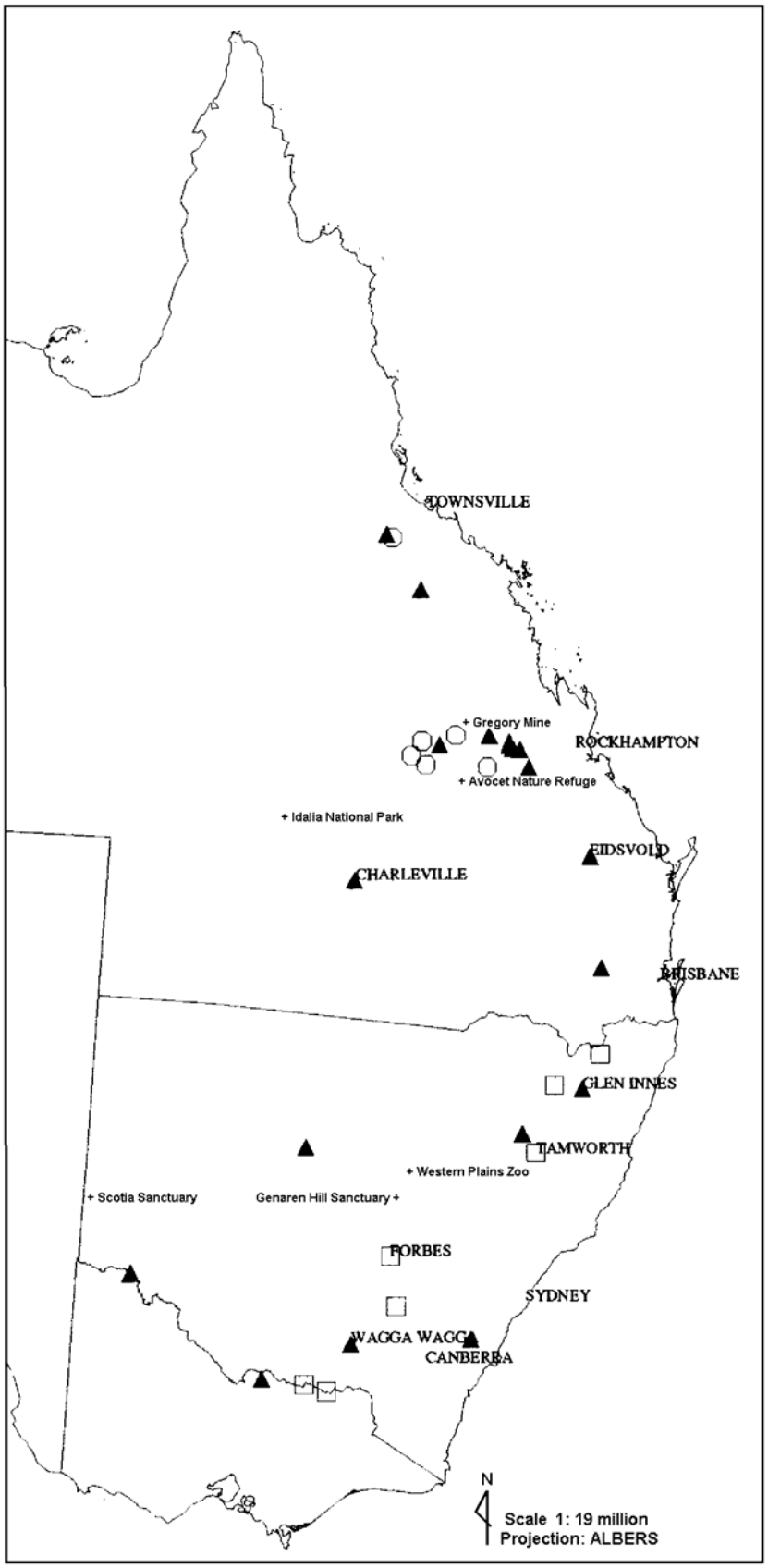

Figure 1. *Distribution records for the bridled nailtail wallaby (Onychogalea fraenata). Museum Specimens (□); Literature Sources (▲); and Surveys (Gordon and Lawrie 1980)(○).*

1.3 Habitat

The bridled nailtail wallaby previously occupied *Acacia* shrubland and grassy woodland in the semi-arid regions of eastern Australia. Gould (1863) reported that "It inhabits all the low mountain ranges, the elevation of which varies from one to six hundred feet, and which are of a sterile character – hot, dry, stony, and thickly covered with shrub-like stunted trees". Other historical comments (Krefft 1866; Collet 1887) on the species' habitat preferences, associate it with unspecified scrub types (Gordon and Lawrie 1980). Based on surveys of the Dingo region, Gordon and Lawrie (1980) concluded that the species had a preference for brigalow areas and the larger alluvial flats, the more fertile areas of the region.

Within Taunton National Park, bridled nailtail wallabies are found in all four of the major vegetation types present (Tierney 1985) *viz.*:

- open grassy eucalypt woodland dominated by poplar box (*Eucalyptus populnea*)
- dense acacia forest dominated by brigalow (*Acacia harpophylla*)
- transitional vegetation intermediate between the woodland and forest areas of very dense brigalow regrowth

However, the preferred habitat is the narrow band of transitional vegetation that separates the dense *Acacia* scrub from open grassy eucalypt woodland (Tierney 1985). Bridled nailtail wallabies shelter underneath the low shrubby bushes of young brigalow regrowth, amongst *Carrisa ovata* thickets or in hollow logs (Tierney 1985; Evans 1992). Investigation of the patterns of shelter use of wallabies at two sites on Taunton revealed that adults strongly preferred hollow logs over other types of shelter when they were available (Fisher 1998). Radio-tracking studies identified that the core nocturnal feeding ranges for wallabies were centred on the ecotone between pasture and young brigalow regrowth (Evans 1992). However, during periods of drought, wallabies are forced to forage much further into open pasture (Fisher 1998).

1.4 Life history/ecology

1.4.1 Diet

The diet of the bridled nailtail wallaby has been investigated at Taunton over the past 12 years (Ellis *et al.* 1992; Evans 1992; Porter *unpublished data*). Comparisons of dietary niche breadth and plant preferences with two potential competitors, the black-striped wallaby (*Macropus dorsalis)* and domestic cattle (*Bos taurus/indicus)*, have been made (Dawson *et al.* 1992; Evans 1992). The nailtail has a diverse intake of plant types including herbaceous plants (grasses and forbs) and browse (Dawson *et al.* 1992). Patterns of intake vary with the seasons with wallabies eating mainly forbs during good seasons and taking mainly grass when forbs are scarce. Browse, however, becomes an important component of the species' diet when pasture availability is low (Ellis *et al.* 1992). However, at all times forbs and malvaceous plants were the preferred food plants (Dawson *et al.* 1992).

Plant species identified as being important dietary components at Taunton National Park include the herbaceous forbs *Portulaca oleraceae* and other pigweeds, *Helipterum* spp. And other daisies, *Trianthema triquetra*, and *Zalea galericulata*, and the monocots *Sporobolus carolii*, *Chloris divaricata* and other windmill grasses, *Dactyloctenium radulans* and *Bothriochloa bladhi*. During very dry periods *Eremophila mitchelli* (false sandalwood) forms a large proportion of the diet (Ellis *et al.* 1992; Evans 1992). Whether this plant is taken as leaf fall or cropped directly from the shrub is not known.

1.4.2 Reproduction and development

A detailed investigation of reproductive biology and pouch young development of captive bridled nailtail wallabies has been undertaken (Johnson 1993; Hendrich and Johnson, in preparation). Bridled nailtail wallabies breed continuously with a mean oestrous cycle length of 36.2 days and a mean gestation period of 23.6 days. No post-partum oestrus has been recorded. However, mating during pouch life has been recorded when pouch young were between 78-99 days old. Pouch life ranges between 119-126 days, and males and females are sexually mature from 270 and 136 days respectively. The age of sexual maturity and

maximum annual fecundity suggest they have a much higher potential reproductive output than other similar sized macropods (Johnson 1993).

In the wild, the species breeds continuously, raising up to three young a year if conditions are suitable. Females may breed one to two months after permanent pouch emergence. Males can grow rapidly in the wild and may be large enough to secure matings by around 18 months of age (Fisher 1998). Detailed studies of the behavioural ecology and demography of bridled nailtail wallabies on Taunton National Park found that adults of both sexes in the "Taunton" portion of the park were significantly larger than adults from the *Redhill* portion (Fisher 1998, refer Section 4.2). In females, this size difference was associated with better body condition and male-biased birth sex ratios.

An assessment of the mating system of wallabies in the wild, with a collaborative microsatellite analysis of paternity, revealed that the competitive ability of males was related to body size and this was the most important predictor of the number of offspring sired by individual males (Fisher 1998).

1.4.3 Movement patterns and behaviour

Information on movement patterns based on radio-tracking data has been reported by Evans (1992). Bridled nailtail wallabies move about only minimally during the day, and most of this movement is related to maintaining their position in the shade of shelter bushes. Shelter location may change from day to day with animals usually sheltering alone. However, females with young-at-foot and males and oestrus females will shelter together. Wallabies move to and from shelter areas at dawn and dusk respectively. At night, whilst feeding, wallabies moved at a rate of 10 to 200m per hour. Home-range size on Taunton National Park for male bridled nailtail wallabies is around 60ha whereas for females it is significantly smaller, at around 25ha. Home-ranges in general, and particularly core feeding areas, exhibit high levels of both intersexual and intrasexual overlap.

Immediately after the time of permanent pouch emergence, females cache their young in low, dense vegetation during daytime resting periods. Shelter sites of females and their offspring are usually > 100m apart with young generally staying close to their mother's feeding range during the day (Fisher 1998).

1.4.4 Population genetics

Genetic studies have been used to investigate the genetic structures and mating systems of the population of bridled nailtail wallabies at Taunton National Park and that of captive animals from Pallarenda Research Station (Townsville), which is maintained by EPA/QPWS. Initial sequencing of mitochondrial DNA (mtDNA) from a 577 bp control region in four individual Taunton National Park wallabies did not reveal any variation, indicating that mtDNA analysis was unlikely to produce useful information for population management. Combinations of primers developed for the yellow-footed rock wallaby and for the bridled nailtail wallaby (Moritz *et al*. 1997) were used to assay variation at five microsatellite loci in animals from both Taunton National Park and the captive colony at Pallarenda Research Station. These analyses revealed abundant variation with heterozygosity values at the different loci ranging from 0.69 to 0.84 and observed numbers of alleles from five to 10. There was no substantial difference in the heterozygosity between the captive and source populations and the latter appeared to breed randomly. Genetic diversity in the remnant population of the bridled nailtail wallaby is similar to that in the yellow-footed rock-wallaby.

These preliminary results indicate that there is sufficient diversity at microsatellite loci to allow for a high resolution analysis of the mating system and population subdivision within the remnant wallaby population, and to detect changes in the genetic diversity or mating system accompanying translocations. This is the focus of recent and current studies. The captive population, mostly derived from seven individuals taken from Taunton National Park in 1991 and another four obtained earlier, does not appear to have lost diversity relative to the source population, perhaps because of the higher reproductive rate of wallabies.

1.4.5 Population dynamics

Little is known about the population dynamics of the species. However, investigation of this aspect of its ecology has been ongoing at Taunton National Park. It seems probable that the number of bridled nailtail wallabies on the park increased following the reservation of the land and subsequent de-stocking of cattle (Davidson 1991). Estimates of population size declined markedly from around 1400 in December 1991 to around 450 in March 1994 due to the prolonged drought conditions (Clancy and Porter 1994). Since 1994, bridled nailtail wallaby numbers have remained relatively stable.

Proximate causes of death of bridled nailtail wallabies on Taunton National Park have been investigated using radio collared individuals. In adults, predation by dingoes has been recorded as the most common cause of death, although disease for example, toxoplasmosis and parasites (notably hydatid tapeworm) may also be important. Adult survival has been found to be closely related to individual health, but did not differ significantly between years or sexes. Juveniles had lower mean survival rates (47percent) than adults (80percent), early pouch young (93percent), and late pouch young (82percent). Most juvenile mortalities recorded could be attributed to cat predation (Fisher 1998).

2 Conservation status, threats and habitat

2.1 Conservation Status

The disappearance of the species from over 95 percent of its former range and the potential threat to the only known significant population from stochastic events such as wildfire, prolonged drought, over-predation and disease means the bridled nailtail wallaby is currently threatened with extinction. The species is considered to be endangered (Kennedy 1992) and is listed as such under both Federal and Queensland legislation (*Environment Protection and Biodiversity Conservation Act 1999*; *Nature Conservation Act 1992 – Nature Conservation (Wildlife) Regulation 1994*, Schedule 2).

2.2 Threats

Competition with domestic herbivores, notably sheep, habitat alteration and predation by introduced predators, especially foxes, have all been suggested as reasons for decline of the species. However, the speed and scale of the decline makes it impossible to identify any one predominant causal factor. Gordon and Lawrie (1980) build a strong case for the introduction of domestic grazing, especially that by sheep, as being the major cause in the decline of the species. This hypothesis is also supported by a comparison of the favoured diet of the two species. Sheep favour grassy areas, grazing predominantly on forbs (Groves 1989), similar to bridled nailtail wallabies (see above).

The clearing of native vegetation as land was developed for agriculture and stock pasture probably also played a role in the decline. There was an apparent decline in the number of wallabies adjacent to Taunton National Park during the late 1970s and early 1980s concurrent with the continued clearing of brigalow in the area (Lavery and Tierney 1985). The role played by the introduced European red fox (*Vulpes vulpes*) and the feral cat (*Felis catus*) can only be speculated upon. Foxes have been demonstrated to reduce numbers of the similar sized macropods including the black-footed rock-wallaby (*Petrogale lateralis)* (Kinnear *et al.* 1988) and predation of the species by feral cats has been recorded (Horsup and Evans 1992, Fisher unpublished data). It is possible also that competition with the European rabbit (*Oryctolagus cuniculus*) was a factor in the decline of the species in the southern part of its range. Bridled nailtail wallabies were also killed in large numbers by pastoralists in the early 1900s (Longman 1930, Hrdina 1997).

The Queensland Statewide Landcover and Trees Study (Department of Natural Resources and Mines (DNRM), 2003) affirmed that the Brigalow Belt remained one of the bioregions with the highest rate of vegetation clearing in Queensland leading up to the turn of the century. During the 1997-1999 and 2001-2003 period, it contained 59percent and 37percent

of the total area cleared throughout the state, respectively. The Brigalow Belt has the dubious record of containing the largest number of threatened regional ecosystems (REs) of any bioregion in Queensland (Sattler *et al.,* 1999). Of the 163 regional ecosystems represented in the Brigalow Belt, 27 have less than 10percent of their original extents remaining and 43 are between 10percent and 30percent intact. This means that 70 (43percent) of the 163 regional ecosystems in the Brigalow Belt are threatened with extinction.

Threats that have contributed to the disappearance of the bridled nailltail wallaby from its former range (historical distribution) and threats to the existing wild (Taunton National Park) and translocated populations (Idalia National Park, Avocet Nature Refuge) are provided in Table 1. Although threats to existing populations, located on land that is now protected and managed by QPWS are still evident, the level of threat has been significantly reduced, for example, through firebreaks, predator control, weed control, drought feeding. Recovery actions relating to these threats and a guide to decision makers regarding these threats are covered in Section 6 and Section 8 respectively.

THREAT	Historical distribution[a]	Taunton NP[b]	Idalia NP[b]	Avocet NR[b]
Competition with domestic herbivores (mainly sheep and rabbits)	+	+	+	+
Drought	+	+	+	+
Disease & parasites	+	+	+	+
Exotic weed invasion	?	+	+	+
Fire	?	+	+	+
Predation (foxes, feral cats, dingos)	+	+	+	+
Land clearing	+	-	-	-
Hunting	+	-	-	-
Habitat alteration/ degradation	+	+	+	+

Table 1: *Threats contributing to the decline of the bridled nailtail wallaby since the mid-nineteenth century [(a)] and current threats to existing free-range populations [(b)].*

2.3 Habitat critical to the survival of the bridled nailtail wallaby

The *Environment Protection and Biodiversity Conservation Act 1999* prescribes that recovery plans for nationally listed threatened species identify habitat critical to the survival of the species [s270(2)(d)]. Under regulation 7.09 of the Act habitat critical to the survival of the bridled nailtail wallaby would include:

- breeding sites
- sites of food sources, water, shelter, fire and flood refugia, or those used at other times of environmental stress
- essential travel routes between the above sites
- sites necessary to maintain populations of species essential to the bridled nailtail wallaby
- habitat that is required to maintain genetic diversity
- areas that may not be occupied by the bridled nailtail wallaby but are essential for the maintenance of areas where it does occur.

Due to the extremely limited distribution and extent of bridled nailtail wallaby populations and the lack of detailed information on their past habitat preferences it is difficult to accurately define all areas of habitat which are critical to its survival. A number of the brigalow communities that are currently considered to be suitable habitat for the bridled nailtail wallaby are protected from clearing under the *Queensland Vegetation Management Act 1999*. This protection will provide both an interim measure to ensure that key areas of habitat are not lost or adversely impacted and a mechanism for areas of potential habitat to be inspected by QPWS officers. An action within the life of this plan is to undertake a program to identify, map and model critical habitat for the bridled nailtail wallaby (Section 6.5.2.1). Completion of this action will provide the basis for a more strategic approach to the development of future surveys, habitat protection/rehabilitation programs, identification of areas for nature refuge negotiations and future translocations.

3 Impacts, benefits and affected parties

During the initial phase of the recovery program for the bridled nailtail wallaby (covered in the first two editions of the recovery plan) significant focus was placed on consolidation of the remnant population of the species on Taunton National Park. However, during the past eight years there has been a significant shift in emphasis towards community participation, identification and protection of important off-park habitat and more recently, towards reintroduction of bridled nailtail wallabies onto private land. This shift has been deliberate and in recognition of the fact that protection of key habitat and recovery of this threatened species could be best achieved through partnerships involving all potential stakeholders. This approach to threatened species recovery has involved considerable collaboration between EPA/QPWS and other organisations, some of which have been reluctant to participate in nature conservation activities due to fears of restrictions on current land-use or the spectre of “compulsory acquisition” of land. The recent successful translocation of bridled nailtail wallabies to Avocet Nature Refuge has demonstrated that threatened species recovery programs can be conducted on private land in a manner that is completely compatible with a commercial agricultural enterprise. The proposed expansion of the existing extension program, outlined in the current recovery plan (Section 6.3), will continue to emphasise the mutual benefits that can be derived from this type of partnership.

4 Consultation with Indigenous people

Development and ongoing implementation of recovery actions under this plan has considered the role and interests of Indigenous communities in the region. The Indigenous groups and communities involved in the regions affected by this plan have been identified. The regional Aboriginal representative body, the Gurang Land Council Aboriginal Corporation, referred the recovery team to the Ghangalu and Kangoulu groups. These groups have been consulted with respect to management at Taunton National Park (Scientific) and its surrounding areas. A representative from these Indigenous groups has participated in the implementation team meetings to discuss the management of free-ranging Queensland bridled nailtail wallaby populations and habitat.

The EPA Duaringa Management Unit oversees the management of Taunton National Park (Scientific), Blackdown Tablelands National Park, Junee National Park, Blackwater Conservation Park, Kaiuroo and surrounding State Forests.

5 Existing conservation measures

5.1 Legislation

State and Commonwealth legislation which provide for the protection/conservation of the bridled nailtail wallaby and its habitat include:

- The Queensland *Nature Conservation Act 1992 – Nature Conservation (Wildlife) Regulation 1994*
  Schedule 2, Part 3-Declared Management Intent: (16)(d) to take action to ensure viable populations of the wildlife in the wild are preserved or re-established; (16)(f) to start education programs for the community and managers of public land on extinction processes and threatened species conservation and habitat; (16)(h) to encourage scientific research and inventory programs likely to contribute to an understanding of endangered wildlife and its habitat and management requirements; (16)(i) to recognise that the habitat of endangered wildlife is likely to be a critical habitat or area of major interest.

  - The *Vegetation Management Act 1999*

  A regional ecosystem is listed as endangered under the *Vegetation Management Act 1999* (VMA) if: remnant vegetation is less than 10 percent of its pre-clearing extent across the bioregion; or 10-30 percent of its pre-clearing extent remains and the remnant vegetation is less that 10,000ha. Under this legislation all endangered regional ecosystems are protected from clearing. "Of concern" regional ecosystems are listed under the Act if: remnant vegetation is 10-30 percent of its pre-clearing extent across the bioregion; or more than 30 percent of its pre-clearing extent remains and the remnant extent is less than 10,000ha. "Of concern" ecosystems are protected on leasehold and crown land, but not on freehold land. A number of important brigalow communities which are critical habitat for the bridled nailtail wallaby are listed as "endangered" and "of concern" regional ecosystems, and are therefore protected from clearing. In 2004, the Queensland Government passed an amendment to the VMA that would phase out broad scale clearing of remnant vegetation by 31 December 2006. Given that the Brigalow Belt is one of the bioregions with the highest rate of clearing (see Section 2.2) this legislative change may, in the long-term, aid recovery of the bridled nailtail wallaby. However, clearing of most vegetation regrowth and clearing for necessary ongoing management activities (for example, fodder harvesting and thinning) will still be allowed.

Other key pieces of legislation include the Queensland *Integrated Planning Act 1997,* which provides a "*framework to integrate planning and development assessment so that development and its effects are managed in a way that is ecologically sustainable, and for related purposes*", and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999,* under which the bridled nailtail wallaby is currently listed as endangered.

5.2 Taunton National Park (Scientific)

After the rediscovery of the bridled nailtail wallaby in 1973, it was recommended that the two properties (*Taunton* and *Redhill*), where the majority of sightings had been recorded, be acquired as reserves to enhance the survival chances of the species (Gordon, undated). The property *Taunton* (5346ha) was purchased by Queensland National Parks and Wildlife Service (now EPA/QPWS) with assistance from ANPWS (Commonwealth, now Department of Environment and Heritage) in 1979 and gazetted as a Scientific Reserve. The adjoining property *Redhill* (5898ha) was acquired in 1984 and added to the existing reserve. With the advent of the Queensland *Nature Conservation Act 1992*, the Taunton Reserve was declared a National Park (Scientific).

The Act (s 16) states that a National Park (Scientific) is to be managed to:

(a) protect the area's exceptional scientific values and, in particular-
  (i) ensure that the processes of nature continue unaffected in the area;
  (ii) protect the area's biological diversity to the greatest possible extent; and

(b) allow controlled scientific study and monitoring of the area's natural resources.

In cases where a threatened wildlife species is identified as a significant natural resource on a National Park (Scientific), as is the case for the bridled nailtail wallaby on Taunton National Park, it is intended that management practices involving manipulation of the species' habitat and the control of threatening processes related to the wildlife, including threatening processes caused by other wildlife would be permitted (s 16(2) *Nature Conservation Act 1992*). A management plan for the Taunton Reserve, which incorporates legislative requirements was first published in 1998. This plan forms the basis for the existing management program for the bridled nailtail wallaby.

It has been estimated that about 95 percent of the extant population of bridled nailtail wallabies is contained on what is now Taunton National Park (Davidson 1991, Evans 1992). Detailed survey work would be required to qualify this statement. In the past there has been some reluctance by landholders to report the presence of the species on their properties, possibly due to concerns over potential acquisition of properties by EPA/QPWS. Recent extension activities have facilitated a far more collaborative approach by neighbouring landholders, leading to enhanced protection and rehabilitation of bridled nailtail wallaby habitat as well as collaborative baiting programs.

5.3 Captive breeding

A captive colony of bridled nailtail wallabies was established in 1991 at the EPA/QPWS Pallarenda Research Station in Townsville by Peter Johnson. This population has provided stock animals for both the establishment of additional wild and captive populations, and for ongoing investigations into the reproduction and development of the species. Since 1991 breeding colonies of bridled nailtail wallabies have also been established in Queensland at Idalia National Park, Gregory Mine Site (Emerald), David Fleay Wildlife Park and Rockhampton City Zoo. In NSW a breeding colony has also been established at Western Plains Zoo Dubbo. In 2004, the breeding program at Rockhampton City Zoo was shutdown temporarily, and the Pallarenda and Idalia National Park programs concluded. Due to a reduction in the nutritional quality of the natural food within the Gregory Mine Site enclosure after a period of prolonged drought, the health of animals at this location declined. These animals are being caught and rehabilitated at at "Kial" (Marlborough) prior to their release on Avocet Nature Refuge. Once all animals on the 60ha enclosure at Gregory Mine have been caught the breeding program at the Mine Site will cease. "Kial" is a property owned by members of the Australian Animal Care and Education Inc. (AACE). AACE is a non-profit organisation dedicated to the rehabilitation and care of sick, injured and orphaned native wildlife and increasing public awareness on wildlife issues.

The current dispersal of captive holdings is indicated in the Table 2 below. All holdings are currently held under loan agreements between EPA/QPWS and the participating institutions, and hence all stock and their progeny remain the property of the Queensland government. A studbook has been developed for the species utilising SPARKS (Single Population Analysis and Record Keeping System) and a captive management plan is currently being developed in collaboration with ARAZPA (Australasian Regional Association of Zoological Parks and Aquaria).

Location	Total
<u>EPA/QPWS facilities:</u>	
David Fleay Wildlife Park	35
<u>Zoos and sanctuaries:</u>	
Western Plains Zoo	26
Rockhampton City Zoo (Temporary shutdown 2004)	0
Gregory Mine Site (Shutdown complete in 2005)	10
"Kial", Marlborough (current holding facility)	70

TOTAL	141+

Table 2: *Holdings of captive-bred bridled nailtail wallabies as at last population census (January 2005).*

5.4 Translocation

An initial translocation project for the bridled nailtail wallaby commenced in mid 1993, at Idalia National Park with a trial release of captive-bred animals. The project was designed with an adaptive management framework so as to provide information on the development and continual improvement of methodologies. To date a total of 275 animals have been released at three separate sites on Idalia National Park. An extensive predator control program has been conducted in conjunction with the translocations, and has benefited from strong support from neighbouring landholders. There has been good survival of released animals and natural recruitment to the reintroduced population. During resighting surveys in 1999, the population size was estimated at around 450 individuals.

Avocet Nature Refuge was chosen as the second translocation site (see Section 6.1). During 2001-2005 captive-bred wallabies from the nearby BHP Billiton operated Gregory Mine were successfully translocated to Avocet Nature Refuge in several separate releases. This release program was initiated as a collaborative effort involving Emerald Shire Council, BHP Billiton, EPA/QPWS, local landholder Hugo Spooner and a number of local community groups and organisations. The bridled nailtail population at this site is currently self-sustaining, mating successfully and natural recruitment to the population has occurred. Monitoring and predator control will be ongoing components of the management of this reintroduced population.

Preliminary surveys have also been conducted at a number of other potential release sites in Queensland to assess their suitability for future translocations. Preliminary discussions have been held with New South Wales National Parks and Wildlife Service in relation to the proposed translocation and release of bridled nailtail wallabies at Yathong Nature Refuge (NSW).

5.5 Sanctuaries

Captive-bred bridled nailtail wallabies have been translocated and released into intensively managed predator-free enclosures at BHP Threatened Species Sanctuary at Western Plains Zoo, Scotia Sanctuary, Genaren Hill Sanctuary and Gregory Mine Site. The Gregory Mine Site enclosure will shutdown in 2005 (see Section 4.4 and Table 2). Monitoring and reporting frameworks have been established in collaboration with the managers of these respective facilities and transfers of animals will be initiated in the future to manage the genetics of these populations.

5.6 Recovery plan

A recovery plan was prepared 12 years ago (Davidson 1991) and funded by the Australian Government Department of the Environment and Heritage (formerly ANPWS) Endangered Species Program in 1992. The plan effectively started with a regional workshop, held in August 1992, by the QPWS Central Coast Region to discuss the management of Taunton Scientific Reserve and consider research strategies related to the conservation of the bridled nailtail wallaby. A recovery team was formed in March 1993 and the first meeting held on 2 April 1994 at Taunton Scientific Reserve. Subsequent meetings have been held at about six monthly intervals at QPWS Central Coast Regional Office, Rockhampton and Idalia National Park (site of the trial translocation project). Regular progress reports and annual reports have been provided to the Department of Environment and Heritage (DEH).

The original plan was revised and updated in 1994 with funding provided until the end of the 1996/97 financial year (Clancy and Porter 1993). A major external review of the plan implementation was undertaken in 1996 and the recovery plan was subsequently revised. A

further major review and revision of the plan was initiated in 2001. The process of reviewing and revising the plan has involved input from an external panel of experts, which consists of a minimum of three persons with backgrounds in vertebrate threatened species recovery programs from the following perspectives: state agency, research organisation, and commonwealth agency. The current plan (4th Edition) has an operational span of four years. However, the recovery process is conservatively expected to take more than 10 years.

6 Recovery objectives, strategy and criteria

6.1 Objective

To significantly improve the conservation status of the bridled nailtail wallaby by maintaining or expanding existing wild and captive populations, and establishing new wild and captive populations.

6.2 Strategy for recovery

The prevention of extinction hinges primarily on the protection of existing free-range populations, including the Taunton National Park population and other translocated populations established during previous phases of the recovery program. This will be achieved through a reduction in predation pressure and fire risk, protection and enhancement of habitat, drought feeding, management targeted research and other actions. In addition, the maintenance of captive colonies is viewed as a necessary precaution against the advent of an uncontrollable catastrophe, as well as, providing stock animals for reintroduction into suitable habitats.

Given this framework as a starting point recovery of the species revolves around four concurrent strategies:

1. Optimisation of existing free-range populations of bridled nailtail wallaby at Taunton and Idalia National Parks and Avocet Nature Refuge by implementing management programs that manipulate areas of disturbed vegetation to provide the best possible habitat.

2. Identification and protection (by conservation agreement or other means) of other areas of critical habitat for bridled nailtail wallabies.

3. Community Nature Conservation initiatives in the areas surrounding extant populations and critical habitat to increase the available habitat and the capacity for expansion of populations through both natural dispersal and deliberate translocations.

4. Translocation of bridled nailtail wallabies to other areas within the likely historic range of the species (the North and South Brigalow Belt and Mulga Lands Biogeographic Zones) with suitable habitat to establish additional populations.

The bridled nailtail wallaby is one of the Australia's most endangered vertebrates and the recovery process is a long-term one. Public knowledge regarding the plight of the species and the suspected reasons for its decline needs to be increased to ensure the continued commitment of the relevant government authorities to its recovery.

6.3 Criteria

For the species to be considered as no longer endangered, criterion (1) and at least two of the subsequent three criteria will need to be fully achieved.

(1) Enhance or maintain existing free-range populations of bridled nailtail wallaby at Taunton and Idalia National Parks and Avocet Nature Refuge.

(2) Establish two or more additional populations of the species (>100 individuals) in areas of suitable habitat, at a distance of >100 km from the existing free-range populations. This will demonstrate a positive rate of increase in the medium term (≥three years). At least one of the additional populations to be located in New South Wales and one on private land.

(3) A minimum of 5000ha of suitable habitat in the vicinity (100km radius) of Taunton National Park protected and managed in collaboration with landholders to promote natural and assisted dispersal and expansion of wallaby populations.

(4) Areas of critical and potential bridled nailtail wallaby habitat identified and mapped within three years and protected under legislation within five years.

(5) Five or more additional landholders, community or industry organisations actively contributing to the implementation of recovery actions.

(6) Maintain and enhance self-sustainable captive populations of bridled nailtail wallabies at appropriate institutions for translocations, sanctuary populations and public education.

(7) Management guidelines published (within three years) based on the successful completion of key investigations completed under this and previous versions of the recovery plan.

(8) Maintain a recovery team with high levels of community and agency stakeholder support and involvement that co-ordinates and reports on actions in the recovery plan in both the short and long-term.

7 Recovery actions

7.1 Management of free-range bridled nailtail wallaby populations

An essential component of the conservation and recovery program for the bridled nailtail wallaby is the consolidation of existing known free-ranging populations, including the only known remnant population at Taunton National Park and reintroduced populations at Idalia National Park and Avocet Nature Refuge, established during early phases of the recovery program. All three of these populations are critical populations for the long-term survival and recovery of the species**.** Management and monitoring programs at these sites will be similar to enable results to be compared across all sites and hence provide a complete overview of the free-ranging bridled nailtail wallaby population. A map and summary of the bridled nailtail wallaby free-range population locations in Queensland is provided in Figure 2 and Table 3 respectively.

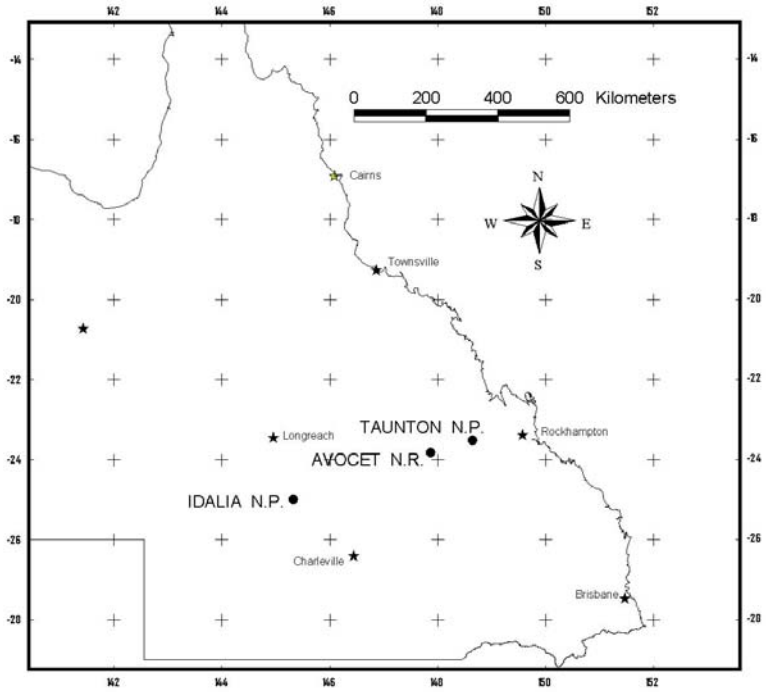

Figure 2: *Free-range population locations of the bridled nailtail wallaby in Queensland* (●). *Map courtesy of Dr Greg Gordon (EPA/QPWS 2003).*

	Area (ha)	Distance from Taunton NP	Latitude Longitude	Bioregion	Nearest town (local government area)
Taunton National Park (Scientific)	11626	-	-23.53 149.22	Brigalow Belt North and Brigalow Belt South	Dingo (Duaringa Shire)
Idalia National Park	144000	≈460 km southwest	-25 144.75	Mulga Lands	Yaraka (Blackall, Isisford and Quilpie Shire)
Avocet Nature Refuge	1150[#]	≈105 km southwest	-23.83 148.17	Brigalow Belt North	Springsure (Emerald Shire)

Table 3: *Location summary for free-range bridled nailtail wallaby populations*
[#]This area includes suitable remnant habitat on the neighbouring Australian Bush Heritage Trust owned property of Goonderoo.

7.1.1 Taunton National Park (Scientific)

Management of Taunton National Park (Scientific) to maintain viable populations of bridled nailtail wallabies will be undertaken including regular population monitoring of macropod species and predators on the reserve, manipulation of selected areas of the reserve to enhance the availability of suitable habitat for the species, provision of emergency fodder during periods of extended drought, and control of known predators of the species as necessary. Other management actions (for example, maintaining firebreaks, weed control, landholder interactions/negotiations, management of other macropod species) will be undertaken as required to ensure the survival of the bridled nailtail wallaby on Taunton National Park.

Where possible, research targeted at obtaining a better understanding of bridled nailtail wallaby ecology, the ecosystem the species exists in and appropriate management to benefit species' survival will be supported. The *Taunton* Homestead complex and other elements of the park infrastructure will be maintained for use by research personnel. Research proposals relating to the bridled nailtail wallaby will be reviewed by the recovery team.

There is a full-time park manager stationed on Taunton National Park as well as regional park staff available to undertake the appropriate management actions. A management plan for Taunton Narional Park (Scientific) has been produced which outlines the general management strategies for the park (EPA/QPWS 1998). Protocols for monitoring and management have been developed and refined over the 12 years that the bridled nailtail wallaby recovery program has been operating on Taunton National Park.

Potential contributors: EPA/QPWS (Central Region), DEH, volunteers, Fitzroy Basin Association Natural Resource Management (NRM) body.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$103,800	$107,930	$112,400	$116,840	$121,360

7.1.2 Idalia National Park

The initial project to translocate bridled nailtail wallabies to Idalia National Park commenced in mid 1993, with the establishment of an on-site breeding enclosure and a trial release of captive-bred animals. The project was designed within an adaptive management framework with translocations being implemented in a manner so as to provide information on the development and continual improvement of methodologies. The 133 wallabies released since late 1996 comprised four groups: captive-bred animals directly transferred and released (no acclimatisation period), wild caught from the single remaining wild population on Taunton NP (not acclimatised on-site), animals that were captive-bred elsewhere and acclimatised at the translocation site in a 10ha predator-proof enclosure, and animals which had been bred in the enclosure on Idalia National Park. Survival was highest in those bred in the on-site enclosure and highly variable among animals that were bred in captivity at other locations. Survival estimates for wild recruits from Taunton National Park suggest that the population would maintain a positive rate of increase under prevailing environmental conditions. Spotlighting surveys indicate that the population on Idalia National Park had increased to approximately 450 animals by late 1999, although above average rainfall between 1996 and 1999 and no apparent predation suggests caution should be taken when describing the translocation as a success.

Ongoing monitoring is critical because it is uncertain how the population will cope with drought and inevitable predation events, and whether the population will expand and survive outside of the limited, preferred habitat. Baiting, fire management and infrastructure development practices, consistent with the more general aims of park management will be developed and implemented in consultation with park managers.

Potential contributors: EPA/QPWS (Central region), DEH, research organisations (for example, University of Queensland), volunteers, South West and Desert Channels Qld Inc. NRM bodies.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$69,100	$71,970	$74,900	$77,910	$80,950

7.1.3 Avocet Nature Refuge

Avocet Nature Refuge, covering a 560ha area, is part of an 1150 ha agricultural property (known as *Goonderoo*), with intact grasslands and mixed acacia and eucalypt woodland

habitat. Suitable habitat for the bridled nailtail wallaby on Avocet Nature Refuge is contiguous with habitat on the adjoining *Goonderoo* property, which is owned by the Bush Heritage Trust and provides an additional 590ha of suitable habitat. During 2001-2005 captive-bred bridled nailtail wallabies from the nearby BHP Billiton operated Gregory Mine Site were successfully translocated to Avocet Nature Refuge in several separate releases. Whilst there are no historical records of bridled nailtail wallabies from the chosen release site on Avocet Nature Refuge there are numerous anecdotal accounts of "flashjacks" (a common name for the species) in the area. The Avocet Nature Refuge site also lies well within the known historical distribution for the bridled nailtail wallaby. Establishing and managing the free-range population of the species has required extensive collaboration between EPA/QPWS, Emerald Shire Council, Avocet Nature Refuge owner (Mr Hugo Spooner) and a number of local groups. Ongoing management and monitoring will need to be implemented at Avocet NR that is consistent with protocols used at Taunton and Idalia National Parks.

Potential contributors: EPA/QPWS (Central Region), DEH, Emerald Shire Council, conservation organisations (for example, Bush Heritage Trust) and groups (Australian Animal Care and Education Inc.), Hugo Spooner, volunteers, research organisations (for example, University of Queensland), Fitzroy Basin Association NRM body.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$78,160	$81,370	$84,680	$88,100	$91,640

7.1.4 Other sites

Where translocations are initiated at other sites during the course of this recovery program appropriate management and monitoring programs will be developed and implemented. The costing provided below is only an estimate of the costs involved in initiating a comprehensive program, which includes both managing key threats (for example, predators, weeds, fire) and monitoring the translocated bridled nailtail wallabies and other significant native and pest species. Community participation in monitoring will be fostered as a means of reducing the future costs of monitoring and to encourage community ownership of the program.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Central Queensland), landholders, volunteers, NRM bodies, New South Wales National Parks and Wildlife Service

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$62,700	$65,180	$67,860	$70,590	$73,450

7.2 Translocation of bridled nailtail wallabies to areas of suitable habitat

The endangered status of the bridled nailtail wallaby is unlikely to change while there are only three small sub-populations within a restricted area. For this reason, translocation of the species is a necessary conservation measure. The recovery criteria (Section 6.3) require that two or more additional populations be established during the course of this recovery plan. Whilst the range of the bridled nailtail wallaby corresponds closely to the sheep rangelands of eastern Australia, the level of dingo control and number of rabbits (and hence the probable fox population) is greater in these areas than in regions used primarily for cattle grazing (such as the area around Taunton National Park). The initial translocation site (Idalia National Park) is at the edge of the sheep rangelands. To increase the range of the species' and reduce possible threats to the translocated wallabies it is proposed that at least one of the two additional sites be in NSW and one on private land, preferably in cattle country (i.e. in the northern part of the species historic range).

The failure of most macropod translocations (Short *et al.* 1992, Lundie-Jenkins 1998) has been attributed to fox predation. Therefore, intensive fox control measures for at least the first few years of the re-introduction is essential. This, together with careful monitoring is required to adequately assess the success of the control measures and to obtain an early warning of any problems.

7.2.1 Identification and inspection of alternative sites

There is an urgent need to identify and attempt to secure the protection of areas of critical habitat for bridled nailtail wallabies, both to expand the habitat available to extant populations and to enable translocations to proceed. An ongoing public education program will be undertaken to encourage the reporting of information regarding the species to EPA/QPWS and all reliable leads will be followed up. Previous phases of the recovery program incorporated a program of surveys of central Queensland to identify and monitor any extant populations of bridled nailtail wallabies. As protection and rehabilitation of any extant populations or habitat on private land was reliant on landholder support the current recovery plan will seek to identify and inspect suitable habitat via a proactive extension and education campaign.

The identification of alternative translocation sites will involve the inspection and assessment (using developed criteria) of areas by experienced personnel and will be integrated into the survey and off-park conservation agreement actions.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Central Queensland), landholders, conservation organisations and groups, NRM bodies.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$22,680	$23,560	$24,500	$25,500	$26,520

7.2.2 Translocations to other sites

All translocation sites will need to undergo intensive predator control measures (especially for foxes) prior to the introduction of new animals, and ongoing control is likely to be necessary after the bridled nailtail wallaby population has been established. Predator control will involve the use of 1080 baits applied aerially and/or from vehicles and opportunistic spotlight shooting. Sandplots and spotlighting will be used for monitoring. During all translocations at least a proportion of animals released during the initial release phase will be fitted with radio-telemetry collars to enable their survival and dispersal to be closely monitored. Subsequent management of newly established translocated populations is covered under Action 6.1.4.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Queensland, University of Central Queensland), New South Wales National Parks and Wildlife Service, landholders, shire councils, conservation groups (Australian Animal Care and Education Inc.), NRM bodies, volunteers.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$80,746	$84,110	$87,450	$90,930	$94,510

7.3 Community extension and education

To ensure the success of translocation programs and to protect populations of bridled nailtail wallabies occurring outside of protected areas, a coordinated strategy of protecting potential and actual bridled nailtail wallaby habitat is required. During the 2005-2009 phase of the recovery plan emphasis will be placed on the Brigalow Belt biogeographic region because of the rapid rate and scale of land clearing that has occurred in this region (see Section 2.2). Amendments to the Vegetation Management Act (see Section 4.1), which come into effect

by December 2006, will result in the cessation of broad scale clearing of remnant vegetation across Queensland. This legislative amendment may aid the long-term recovery of the bridled nailtail wallaby and its habitat in the Brigalow Belt. Nevertheless community awareness and education remains an important recovery action for the bridled nailtail wallaby.

The recovery plan described here is expensive in terms of both staff and other resources and the support of the landholders, community organisations, corporations and the broader general public is essential if the bridled nailtail wallaby is to be conserved.

7.3.1 Education and extension to rural landholders

Extension of nature conservation and threatened species conservation initiatives within the context of sustainable production will be undertaken through direct liaison, field days, production of information kits, etc. Information presented in this manner will promote the nature conservation values of the region and options for protection of habitat.

Potential contributors: EPA/QPWS, DEH, Fitzroy Basin Association, South West, Desert Channels Qld Inc. and other NRM bodies, volunteers.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$22,250	$21,882	22,720	$23,600	$24,500

7.3.2 Negotiation of voluntary conservation agreements and development of incentive schemes for rural landholders

In order to secure key areas of off-park wallaby habitat, negotiations will be initiated with landholders, including pastoralists, mining companies, private land trusts and others, to protect and enhance the nature conservation values of habitat remnants, including the conservation of existing bridled nailtail wallaby populations and habitat. These negotiations may lead to the development of Nature Refuge declarations.

To encourage and facilitate the conservation and protection of existing off-park wallaby populations and key areas of habitat, discussions and negotiations will be undertaken with stakeholders including landowners, shire councils, conservation groups and mining companies to facilitate the development and implementation of effective incentive schemes.

Potential contributors: EPA/QPWS, DEH, NRM bodies, conservation organisations.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$47,150	$49,040	$50,990	$53,000	$55,130

7.3.3 Communication to increase public awareness and involvement

EPA/QPWS, in cooperation with other relevant organisations including the Centre for Conservation Biology (University of Queensland), Wildlife Preservation Society of Queensland, Capricorn Conservation Council, Queensland Department of Education and BHP, will develop and coordinate a communication and public education program on the bridled nailtail wallaby. This program will include information on processes that are currently threatening recovery of this species and on measures being undertaken to prevent extinction.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, Centre for Conservation Biology (University of Queensland)), conservation organisations (e.g. Wildlife

Preservation Society of Queensland, Capricorn Conservation Council), conservation groups (Australian Animal Care and Education Inc.), Queensland Department of Education, Fitzroy Basin Association, South West, Desert Channels Qld Inc. and other NRM bodies, BHP coal.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$10,600	$8,430	$11,500	$9,120	$12,430

7.4 Maintenance of captive breeding and sanctuary populations

There are three principal reasons for undertaking a coordinated captive breeding program for the bridled nailtail wallaby, to:

1. Maintain a genetically viable and demographically stable population of captive bridled nailtail wallabies (and maintain a well-documented studbook for the species) to ensure conservation of this unique species in the event that some catastrophe should befall wild populations;
2. Provide genetically diverse captive-bred animals, of known ancestry, as founder stock for reintroductions to secure and/or managed habitats;
3. Provide captive stock, which can be utilised for specific research to aid in the management of this threatened species, including research into important aspects of species' biology and ecology (nutrition, reproduction and threatening processes);

Captive populations may also be displayed in order to promote awareness of the species as well as the importance of biodiversity and threatening processes; and help to generate funds for *in situ* conservation of the species.

Husbandry of animals will be coordinated by EPA/QPWS and Western Plains Zoo, and animals will be maintained using appropriate captive management techniques. A Captive Species Management Plan (Draft) has been developed by EPA/QPWS in cooperation with the Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA). This plan provides detailed protocols for the management of the captive populations to ensure maintenance of genetic diversity and individual fitness, as well as prescribing basic standards for husbandry and interpretive displays.

7.4.1 Breeding for translocations

Due to the high priority placed on translocation as a strategy for recovery of the bridled nailtail wallaby it is critical to maintain genetically diverse, captive-bred animals of known ancestry as founder stock for reintroductions. Participation in the captive breeding program, to provide stock for translocations, will be directed by the Captive Species Management Plan currently being finalised by EPA/QPWS. Institutions will be required to implement appropriate genetic management of their populations and hence must participate in transfers of animals between institutions.

Potential contributors: EPA/QPWS (for example, David Fleay Wildlife Park), DEH, zoos and wildlife parks (for example, Western Plains Zoo), ARAZPA, conservation organisations (for example, Australian Wildlife Conservancy).

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$13,560	$14,100	$14,700	$15,300	$15,900

7.4.2 Management of sanctuary populations

A number of self-sustaining populations of bridled nailtail wallaby have been established in predator proof sanctuaries during previous phases of this recovery program (see Section 4.5). Management of these populations and the infrastructure associated with the sanctuaries will be critical to ensure that they continue to act as ark populations for the

species, that is, by maintaining genetically viable, demographically stable populations which ensure conservation of the species in the event that some catastrophe should befall wild populations. Based on the results from the Idalia National Park translocation experiment sanctuary bred animals are likely to be the preferred stock for future translocations. This is on the basis that they would have similar survival characteristics to wild and site-bred animals. Successful genetic management of sanctuary populations will also be extremely important, and transfers of stock between sanctuaries will be an ongoing component of their management.

Potential contributors: EPA/QPWS (for example, David Fleay Wildlife Park), DEH, zoos and wildlife parks, BHP Coal, conservation organisations (for example, Australian Wildlife Conservancy).

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$39,500	$41,000	$42,500	$44,250	$46,000

7.4.3 Public education/display populations

Captive populations maintained in facilities with high levels of public visitation have a role to play in public education and promotion of both the plight and recovery program for the bridled nailtail wallaby.

Potential contributors: EPA/QPWS (for example, David Fleay Wildlife Park), DEH, zoos and wildlife parks.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$4,010	$4,170	$4,330	$4,500	$4,670

7.5 Investigations to underpin future management

During the previous phases of the bridled nailtail recovery program a significant body of research has been completed. As a consequence, the information base available to direct species' management has both broadened and strengthened. The actions detailed in this section represent a number of existing studies and a number of gaps in our current knowledge with respect to management of the species. Implementation of these actions will be achieved through collaborations with other research organisations.

7.5.1 Collation and interpretation of existing research findings to provide specific management recommendations

A major review of the bridled nailtail wallaby recovery program, which was completed in 2001, identified the need for the results of all existing research to be compiled and analysed so that clear recommendations for species' management are available. Collation and interpretation of results will be conducted in close collaboration with the individuals and groups that were involved in the original studies.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Queensland).

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$14,800	$15,400	NIL	NIL	NIL

7.5.2 Identification of key habitat and resource requirements

7.5.2.1 Identification, mapping and modelling of critical habitat

There is an urgent need to identify and map the extent of habitat that is critical for the conservation of the bridled nailtail wallaby so that these sites can be protected in the future. Given that extensive areas of potentially suitable habitat occur within the Brigalow Belt bioregion it is probable that significant areas of critical habitat still exist.

Whilst some preliminary mapping and analyses have been conducted on the basis of historic and currently known population records for the species these analyses have been limited by the small number of sites, the limited range of the species, and the limited thematic mapping and imagery available for that region. Recent improvements in quality and availability of thematic coverages and satellite imagery should make it possible to generate maps of bridled nailtail wallaby habitat. These maps can then be used to direct future survey work, habitat protection/rehabilitation programs, identification of areas for nature refuge negotiations and future translocations.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Queensland), Fitzroy Basin Association, South West, Desert Channels Qld Inc. and other NRM bodies.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	NIL	$23,150	$24,170	NIL	NIL

7.5.2.2 Developing practical tools for assessing the suitability and appropriate management of remnant habitats

The purpose of this action is to develop and refine quantitative methods to investigate the relationships between the occurrence and density of bridled nailtail wallabies in remnant habitat, and the structural and floristic characteristics of these remnants. The predictive power of these quantitative methods would be evaluated by conducting field tests on properties in close proximity to Taunton NP (Scientific) where wallaby populations are both present and absent.

The major outcome of this action would be the development of practical methods for assessing the suitability of future translocation sites and for guiding the management of remnant habitats for the bridled nailtail wallaby. A further outcome will be to improve knowledge of off-park populations of bridled nailtail wallabies so that interactions/collaborations with landholders, in relation to the species' conservation are enhanced.

Potential contributors: EPA/QPWS, DEH, research organisations (e.g. University of Central Queensland, University of Queensland).

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$13,330	$8,620	NIL	NIL	NIL

7.5.2.3 Characterisation and restoration of habitat for the bridled nailtail wallaby

This action is funded by the Australian Research Council (ARC) Linkage Grants scheme as a partnership between BHP Coal, the Ecology Centre (University of Queensland) and the Centre for Mine Site rehabilitation. This action will:

a) Investigate temporal and spatial variability in the forage available to, and selected by, the bridled nailtail wallaby across both existing and potential habitats, particularly in terms of:

- bridled nailtail wallaby forage preferences;
- botanical species diversity and yield;
- the nutritional value of dominating forage species; and
- the quality of the diet for bridled nailtail wallabies at the different locations, across different seasons.

b) Explore the eco-physiological traits of a range of botanical species important to the bridled nailtail wallaby. Research associated with this objective will be undertaken in glasshouse experiments at the University of Queensland.

c) Determine the influence of livestock grazing on the habitat of the bridled nailtail wallaby, particularly with respect to botanical species.

d) Develop restoration techniques that are able to enhance the suitability of a degraded habitat by encouraging the persistence of botanical species essential to the survival of the bridled nailtail wallaby.

Potential contributors: EPA/QPWS, DEH, University of Queensland, BHP Coal, Australian Research Council (ARC).

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$21,980	$3,280	NIL	NIL	NIL

7.5.2.4 Monitoring and experimental management of buffel grass on Taunton National Park (Scientific)

Prior to its acquisition, Taunton National Park was a grazing property and bridled nailtail wallabies were widespread in varying densities. Presently half the wallaby population on the park is restricted to 500 hectares of brigalow regrowth area. There is anecdotal evidence that continuing encroachment by buffel grass on the park has reduced the area of suitable wallaby habitat. Since cattle have been removed buffel grass has out-competed other herbaceous species, which are the preferred browse of wallabies. In addition, dense swards of buffel grass may act as a barrier to wallaby dispersal.

Changes to Taunton National Park and wallaby habitat will be monitored, as will the impacts of buffel grass on species diversity (flora and fauna) within the Park. Conventional management techniques, such as burning and slashing, will be further investigated and trialed, along with any other approaches that may arise as a result of experimentation and monitoring. Information will be used to develop a strategy for the long-term management of buffel grass areas on Taunton National Park and other sites where the wallabies occur or are established.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Central Queensland, University of Queensland).

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$9,550	$9,900	$10,200	$10,600	$11,010

7.5.3 Dynamics and management of introduced predator populations

7.5.3.1 Population dynamics of introduced predators and its implications for survival and management of bridled nailtail wallabies

Whilst it is known that predators pose a direct threat to bridled nailtail wallaby populations, how this predator threat is influenced by seasonal conditions, alternative prey availability and competition between predators is unclear. As the dynamics of introduced predator populations is poorly understood it is proposed that a research project addressing this action be

undertaken by a postgraduate student. The outcome of this action will assist in designing targeted control campaigns to mitigate the impact of predators on remnant populations of the bridled nailtail wallaby. The budget has been estimated on the basis of providing top-up funding to an existing an APAI scholarship plus an appropriate level of operational funds for travel and field costs.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Central Queensland, University of Queensland), Fitzroy Basin Association, South West, Desert Channels Qld Inc. and other NRM bodies.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	NIL	NIL	$18,250	$18,970	$19,710

7.5.4 Biology

7.5.4.1 Diet and nutritional requirements of bridled nailtail wallabies introduced to different environments

Due to the success of the translocation program in establishing free-range and sanctuary populations of bridled nailtail wallabies in a range of environments there is a need to better understand the diet and nutritional requirements of the species. This is particularly important in understanding how bridled nailtail wallabies will cope with drought in these different environments and how these sites and populations can be more successfully managed in the long-term. To investigate the diet and nutritional requirements of the bridled nailtail wallaby, information on the relative abundance of potential dietary species will be collected from vegetation monitoring plots established at sites at which either remnant populations of the species exist or where it has been reintroduced. A minimum of 20 separate scat samples will also be collected from each site, within a one month period, during Aug/Sept and again in Feb/Mar each year. These months represent the driest and wettest periods of the year respectively, based on long-term rainfall records. All subsequent analysis will be undertaken using well established procedures for identifying plant epidermal fragments. Analysis and interpretation of the data will be similar to past studies (Ellis *et al.* 1992; Evans 1992)

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Central Queensland, University of New England).

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	NIL	$16,000	$16,650	$17,300	NIL

7.5.5 Socio-economic investigations to support management

In recent years studies have been conducted to examine the socio-economic factors affecting nature conservation. As many of the elements of the bridled nailtail recovery program depend on effective collaboration between EPA/QPWS and landowners. Both human and economic elements are crucial to the recovery plan's success. Understanding the nature of socio-economic "drivers" will enable better and perhaps novel approaches to be developed to tackle existing problems.

7.5.5.1 Factors/psychology influencing land management decisions

This action will involve undertaking a detailed survey of landholders in central Queensland to investigate the range of factors and psychology that influences land management decisions. It is proposed that this research be undertaken by an Honours level student from a university. The successful outcome of this action/project will provide recommendations and methods on how to develop community programs and effective incentive schemes that will lead to conservation the bridled nailtail wallaby in the long-term. It is likely that further research/investigations may be required to fully develop the incentive schemes.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Central Queensland), landholders.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	NIL	$5,230	$4,100	NIL	NIL

7.5.5.2 Incorporating Aboriginal and historical European knowledge to effectively manage the bridled nailtail wallaby

Information derived from historical accounts of early Europeans has been important to developing our current understanding of the past distribution, habitat preferences and ecology of the bridled nailtail wallaby. However, to date little Aboriginal knowledge of the species has been collated or used to complement existing knowledge or guide our approach to management. Action 6.5.5.2 will involve researching and compiling both Aboriginal and historical European knowledge on the bridled nailtail wallaby and evaluating this information in an effort to enhance the current and future management of the species. It is proposed that this aspect of the recovery plan will form the basis of an Honours project.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Central Queensland), Fitzroy Basin Association, South West, Desert Channels Qld Inc. and other NRM bodies,Traditional Owners.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	NIL	NIL	$5,300	$4,260	NIL

7.5.5.3 Identifying appropriate/adequate incentives to encourage habitat retention

No funding has been allocated to this action as the need for funds will be dependent on the outcome of Action 6.5.5.1. Funding may be required to foster further research identified in the initial study.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Central Queensland), Fitzroy Basin Association, South West, Desert Channels Qld Inc. and other NRM bodies.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	NIL	NIL	NIL	*****TBC	*****TBC

* TBC: TO BE CONFIRMED

7.6 Manage, review and report on recovery program

In order to effectively coordinate such a multifaceted recovery program it is important to establish and maintain an active recovery team made up of representatives from all relevant stakeholder groups. The aim of the ongoing review and reporting program is to allow the effectiveness of the key actions to be evaluated, in terms of both their ongoing relevance to management and in relation to specific findings and new technologies. Effective reporting will also ensure that the results of investigations are incorporated as appropriate to alter the direction or emphasis of the overall recovery program. This approach will guarantee that recovery program for the bridled nailtail wallaby remains a dynamic, evolving process.

7.6.1 Maintenance of recovery team

The implementation of the recovery plan as specified here is the responsibility of the recovery team. There is a need for the team to communicate on a regular basis to ensure the objectives of the plan are being met.

The bridled nailtail wallaby recovery team includes individuals from EPA/QPWS, the Wildlife Preservation Society, Capricorn Conservation Council, Emerald Shire Council, Central Duaringa Landcare Group and other organisations as appropriate. The team will coordinate and supervise all recovery actions. Changes to the team composition may be necessary during the life of this recovery plan, and other people involved with the program (for example, students involved in research related actions) may attend meetings when appropriate. To facilitate effective and timely decision making and implementation of recovery actions the team will be divided into a number of sub-groups which will oversee particular recovery actions. The current composition of the team will be provided in each annual report.

Twice yearly meetings will be undertaken during the period covered by this recovery plan (2005-2009). Dissemination of meeting minutes, reports and other relevant information to team members is the responsibility of the team coordinator.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Queensland), conservation organisations (for example, Queensland Conservation Council, Wildlife Preservation Society), conservation groups (for example, Capricorn Conservation Council, Duaringa Landcare Group), shire councils (for example, Emerald Shire Council), Fitzroy Basin Association, South West, Desert Channels Qld Inc. and other NRM bodies, community representatives.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$10,960	$11,410	$11,880	$12,350	$12,860

7.6.2 Annual review and reporting of recovery program

Members of the recovery team will review and update the recovery plan as information becomes available. Performance will be measured against the recovery criteria. Updates on the bridled nailtail recovery program will be distributed to the Commonwealth Department of Environment and Heritage (DEH) and the Queensland Environmental Protection Agency (EPA) as required, and newsletter articles will be provided to relevant community newspapers. Annual progress reports, identifying progress against the specified recovery plan actions and recovery criteria, will be completed and circulated to the relevant organisations.

Potential contributors: EPA/QPWS, DEH, research organisations (for example, University of Queensland), Department of Environment and Heritage.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	$5,150	$5,350	$5,550	$5,780	$6,010

7.6.3 Major external review of recovery program (every five years)

To ensure that any review of the recovery plan is sufficiently rigorous it is proposed that appropriate external experts be engaged to review both the initial draft of the research plan and implementation of the final plan. This review process would be conducted in accordance with ESP guidelines (Department of Environment and Heritage, 1998).

Potential contributors: EPA/QPWS, DEH, research organisations, all stakeholders.

	Year 1	Year 2	Year 3	Year 4	Year 5
Total Cost	NIL	NIL	NIL	$13,100	NIL

8. Implementation schedule

				Year 1	Year 2	Year 3	Year 4	Year 5	Total
7.1	**Management of free-range bridled nailtail wallaby populations**								
7.1.1	Taunton National Park (Scientific)	1	100%	103,800	107,930	112,400	116,840	121,360	**562,330**
7.1.2	Idalia National Park	1	100%	69,100	71,970	74,900	77,910	80,950	**374,830**
7.1.3	Avocet Nature Refuge	1	100%	78,160	81,370	84,680	88,100	91,640	**423,950**
7.1.4	Other Sites	2	90%	62,700	65,180	67,860	70,590	73,450	**339,780**
7.2	**Translocation of bridled nailtail wallaby to areas of suitable habitat**								
7.2.1	Identification and inspection of alternative sites	1	100%	22,680	23,560	24,500	25,500	26,520	**122,760**
7.2.2	Translocations to other sites	1	90%	80,740	84,110	87,450	90,930	94,510	**437,740**
7.3	**Community Extension and Education**								
7.3.1	Education and extension to rural landholders	1	100 %	22,250	21,880	22,720	23,600	24,500	**114,950**
7.3.2	Negotiation of voluntary conservation agreements and development of incentive schemes for rural landholders	1	90 %	47,150	49,040	50,990	53,000	55,130	**255,310**
7.3.3	Communication to increase public awareness and involvement	2	100 %	10,600	8,430	11,500	9,120	12,430	**52,080**
7.4	**Maintenance of Captive Breeding and Sanctuary Populations**								
7.4.1	Breeding for translocations	1	90 %	13,560	14,100	14,700	15,300	15,900	**73,560**
7.4.2	Management of sanctuary populations	2	100 %	39,500	41,000	42,500	44,250	46,000	**213,250**
7.4.3	Public education/display populations	2	100 %	4,010	4,170	4,330	4,500	4,670	**21,680**

				Year 1	Year 2	Year 3	Year 4	Year 5	Total
7.5	**Investigations to underpin future management**								
7.5.1	Collation and interpretation of existing research finding into specific management recommendations	2	100 %	14,800	15,400	NIL	NIL	NIL	**30,200**
7.5.2	Identification of key habitat and resource requirements								
7.5.2.1	Identification, mapping and modelling of critical habitat	1	90 %	NIL	23,150	24,170	NIL	NIL	**47,320**
7.5.2.2	Developing practical tools for assessing the suitability and appropriate management of remnant habitats	2	90 %	13,330	8,620	NIL	NIL	NIL	**21,950**
7.5.2.3	Characterisation and restoration of habitat for the bridled nailtail wallaby	2	90 %	21,980	3,280	NIL	NIL	NIL	**25,260**
7.5.2.4	Experimental management of buffel grass on Taunton N.P. by grazing	2	90 %	9,550	9,900	10,200	10,600	11,010	**51,260**
7.5.3	Dynamics and management of introduced predator populations								
7.5.3.1	Population dynamics of introduced predators and its implications for survival and management of bridled nailtail wallabies	2	90 %	NIL	NIL	18,250	18,970	19,710	**56,930**
7.5.4	Biology								
7.5.4.1	Diet and nutritional requirements of bridled nailtail wallabies introduced to different environments	3	90 %	NIL	16,000	16,650	17,300	NIL	**NIL**

				Year 1	Year 2	Year 3	Year 4	Year 5	Total
7.5.5	Socio-economic investigations to support management								
7.5.5.1	Factors/psychology influencing land management decisions	2	90 %	NIL	5,230	4,100	NIL	NIL	**9,330**
7.5.5.2	Incorporation of Aboriginal and historical European knowledge into management of the bridled nailtail wallaby	2	90 %	NIL	NIL	5,300	4,260	NIL	**9,560**
7.5.5.3	Identifying appropriate/adequate incentives to encourage habitat retention	2	90 %	NIL	NIL	NIL	To be confirmed	To be confirmed	To be confirmed
7.6	**Manage, Review and Report on Recovery Program**								
7.6.1	Maintenance of recovery team	1	100 %	10,960	11,410	11,880	12,350	12,860	**59,460**
7.6.2	Annual review and reporting of recovery program	1	100 %	5,150	5,350	5,550	5,780	6,010	**27,840**
7.6.3	Major external review of recovery program (5 years)	1	100 %	NIL	NIL	NIL	13,100	NIL	**13,100**
	Total Cost			**630,020**	**671,080**	**694,630**	**702,000**	**696,650**	**3,394,380**

9 Guide to decision makers

Whilst detailed appraisal of the patterns of decline and regional extinction of the bridled nailtail wallaby fails to reveal a single cause or consistent combination of causes there is general agreement that four factors represent the major potential threats to the persistence and expansion of bridled nailtail wallaby populations:

- destruction and loss of habitat associated with clearing or vegetation;
- increased predation pressure from foxes and feral cats;
- increased competition with introduced and domestic herbivores; and
- changes to the suitability of critical habitat associated with weed incursion, changes to fire regimes and manipulation of habitat structure, connectivity and floristics.

The first three of these were introduced in Section 2.2 and are well supported by historical accounts of the species decline across its former range. The fourth is less dramatic in its operation but will become increasingly significant for a species that persists in small remnant habitats within a highly disturbed landscape. The information listed below is therefore intended to guide decision makers so as to reduce or mitigate the potential for these threats to impact the viability and recovery of the bridled nailtail wallaby:

9.1 Destruction and loss of habitat associated with clearing of vegetation

Widespread clearing of native vegetation for agriculture, stock pasture and urbanisation has almost certainly played a role in the decline of the bridled nailtail wallaby (see Section 2.2). Declines in wallaby numbers adjacent to Taunton were recorded during the late 1970s and early 1980s concurrent with the continued clearing of brigalow in the area. Satellite monitoring of tree cover within Queensland (DNRM, 2003) confirms that the Brigalow Belt remained the bioregion with the highest rate of vegetation clearing up to the turn of the century (see Section 2.2). Amendments to the VMA (see Section 4.1), which come into effect by December 2006, will result in the cessation of broad scale clearing of remnant vegetation across Queensland. This legislative amendment may aid the long-term recovery of the bridled nailtail wallaby and its habitat in the Brigalow Belt. Clearing of most vegetation regrowth and clearing for necessary ongoing management activities (e.g. fodder harvesting and thinning) will still be allowed. Therefore, decision makers should closely consider all applications to clear areas of brigalow vegetation for their potential impact on the bridled nailtail wallaby and other threatened fauna and flora. In considering the potential impacts on the bridled nailtail wallaby special attention should be given to areas that are likely to be critical to the survival of the species, including:

- breeding sites
- sites of food sources, water, shelter, fire and flood refugia, or those used at other times of environmental stress
- essential travel routes between the above sites
- sites necessary to maintain populations of species essential to the bridled nailtail wallaby
- habitat that is required to maintain genetic diversity
- areas that may not be occupied by the bridled nailtail wallaby but are essential for the maintenance of areas where it does occur.

Actions proposed within this recovery plan program to identify, map and model critical habitat for the bridled nailtail wallaby (Section 6.5.2.1) will provide information to support decision makers when considering applications to clear areas of remnant brigalow habitat.

9.2 Increased predation pressure from foxes and feral cats

Whilst the role the introduced European red fox (*Vulpes vulpes*) and the feral cat (*Felis catus*) have played in the decline and regional extinction of the bridled nailtail wallaby can only be speculated upon there is ample evidence to indicate that increased predation pressure by these introduced species has impacted severely on bridled nailtail wallaby populations. Foxes adversely impacted the initial reintroduction of bridled nailtail wallabies to

Idalia NP and have been found to reduce numbers of the similar sized macropods, including the black-footed rock-wallaby (*Petrogale lateralis)* (Kinnear *et al.* 1988). Predation of bridled nailtail wallabies by feral cats has been documented by Horsup and Evans (1992) and Fisher (unpublished data) and in the latter case was suspected as being one of the major factors influencing juvenile recruitment into the population. Decision makers and land managers, in areas where there are either extant populations of bridled nailtail wallabies or where reintroductions have been implemented or are proposed, should therefore adopt monitoring and management practices which enable them to both detect and control significant increases in fox and feral cat populations. Experience has shown that such practices are most effective when coordinated amongst groups of neighbouring land managers. The key elements of such programs are:

- regular qualitative or quantitative monitoring and reporting on fox and feral cat populations across a local area;
- established communication networks between land managers and other relevant agencies in relation to monitoring and management activities;
- coordination of activities, at an appropriate local scale, associated with the control and/or management of fox and feral cat populations;
- regular control programs which provide opportunities to share/pool resources and to exchange information; and
- shared ownership and mutual benefit are strongly emphasised to encourage participation in monitoring and management.

In areas where reintroduction of bridled nailtail wallabies is proposed it will be essential that a formal program of monitoring and management of foxes and feral cats is developed and endorsed by the recovery team and EPA/QPWS well in advance of any animals being released.

9.3 Increased competition with introduced and domestic herbivores

Studies by Dawson *et al.* (1992) and Evans (1992), conducted at Taunton National Park, have compared the dietary niche breadth and plant preferences of the bridled nailtail wallaby with two potential competitors, the black-striped wallaby and domestic cattle. Despite the fact that the bridled nailtail wallaby was found to have a highly variable and diverse diet, including herbaceous plants (grasses and forbs) there was potential for competition with other herbivore species, particularly during periods when herbage is scarce (that is, during drought, post-fire or overgrazing). While no specific studies have examined dietary overlap and potential competition between bridled nailtail wallabies and rabbits it is probable that competition would occur at particular sites under certain conditions. As the nature of the competition between bridled nailtail wallabies and other introduced and domestic herbivores relates to their shared use of a common resource, it is best monitored with reference to the resource. Thus monitoring would focus on the abundance and condition of herbaceous plants that are utilised by bridled nailtail wallabies. Where monitoring indicates declines in the abundance and condition of important plant species that are inconsistent with known seasonal variations in these species, land managers and decision makers would need to initiate management practices to either reduce the grazing pressure associated with other herbivore species or protect or enhance the remaining forage for use by bridled nailtail wallabies. Such action could include the following:

- adjustment of stocking rates for domestic livestock based on assessments of the potential carrying capacity of the vegetation accounting for all herbivore species;
- implementation of control programs to reduce the populations of introduced herbivore species and hence reduce their potential to compete with bridled nailtail wallabies for limited plant resources;
- erection of barriers to exclude other herbivore species from important feeding areas used by bridled nailtail wallabies; and
- provision of food supplements in a controlled manner to enable them to be accessed by bridled nailtail wallabies in preference to other herbivore species.

Ideally any program to manage the potential impacts of competition with introduced and domestic livestock on bridled nailtail wallabies would integrate all these actions to provide a strategy for responding to different circumstances.

9.4 Changes to the suitability of critical habitat associated with weed incursion, changes to fire regimes and manipulation of habitat structure, connectivity and floristics.

Although changes to the suitability of critical habitat, associated with weed incursion, changes to fire regimes and manipulation of habitat structure, connectivity and floristics, operates far more subtly than the factors discussed above it is as important in terms of its potential effect on the persistence and expansion of bridled nailtail wallaby populations. Studies by Tierney (1985) and Evans (1992) have shown that the selection and use of habitats by bridled nailtail wallabies is influenced by access to suitable shelter and food resources. Subtle changes to a habitat which impact on the wallabies ability to access these resources can therefore lead to habitat being either unsuitable or sub-optimal. Current research by students from University of Central Queensland and the University of Queensland are seeking to identify the key components of a habitat that influence its suitability for bridled nailtail wallabies. The results of this work will be relevant for management and rehabilitation of remnant habitats and to selecting and managing areas for reintroduction of bridled nailtail wallabies.

Introduced weed species including buffel grass, mother of millions and parthenium weed are all well established in central Queensland in areas of known and potential habitat for bridled nailtail wallabies. These and other species have the potential to out compete important native species and hence change the nature of critical habitat for the bridled nailtail wallaby. Effective monitoring and control programs for all invasive weed species therefore need to be implemented to protect the integrity of nailtail wallaby habitat. Such programs are currently in place on Taunton and Idlalia National Parks. As with other pest animal and plan programs such activity is most effective when coordinated amongst groups of neighbouring land managers. The key elements of such coordinated programs are detailed in Section 8.3.

Management of fire regimes and other factors that involve manipulation of habitat is critical to the persistence and expansion of bridled nailtail wallaby populations. Since the influences of fire and a range of other natural and man-controlled agents on bridled nailtail wallaby habitat is not completely understood a precautionary approach should be taken to the management of these agents in areas of critical habitat for the bridled nailtail wallaby. The development of habitat management plans which consider these agents should incorporate available knowledge on the ecology of the bridled nailtail wallaby and its habitat.

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