

Recovery Plan for Mabi Forest



Australian Government



Queensland Government
Environmental Protection Agency

Title: Recovery Plan for Mabi Forest

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Photos on title page: top left – Lumholtz’s tree-kangaroo; top right – Mabi forest; bottom – restoration work; bottom left – Mabi forest.

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Publication reference:

Latch, P. 2008. Recovery Plan for Mabi Forest. Report to Department of the Environment, Water, Heritage and the Arts, Canberra. Environmental Protection Agency, Brisbane.

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Executive Summary

Community description and status

Mabi Forest or Complex Notophyll Vine Forest Type 5b (Tracey 1982) is listed as 'Critically Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Under the EPBC Act, Mabi Forest is defined as those areas of Regional Ecosystem 7.8.3 and other patches identified as Complex Notophyll Vine Forest 5b in the Wet Tropics bioregion (DEH 2005). Since the listing, the Queensland Regional Ecosystem framework has been updated such that Mabi Forest (Tracey and Webb 1975, Tracey 1982) is now identified as Regional Ecosystems 7.8.3 (Complex Semi-Evergreen Notophyll Vine Forest of uplands on basalt) and 7.3.37 (Complex Semi-Evergreen Notophyll Vine Forest of uplands on alluvium). Both regional ecosystems are listed under the Queensland *Vegetation Management Act 1999* as 'Endangered' (EPA 2005). This recovery plan provides actions for the recovery of both regional ecosystems.

Distribution summary

Mabi Forest occurs within a restricted geographical range, primarily on the Atherton Tableland, approximately 50km southwest of Cairns, in Queensland's Wet Tropics bioregion, with several small remnant patches located near Cooktown in the Cape York Peninsula bioregion. Prior to European settlement, Mabi Forest on the Atherton Tableland occurred as continuous forest between Yungaburra in the east, Kairi - Cullamungie Pocket (now separated by Tinaroo Dam) to the north, Tolga in the west and past Wongabel State Forest in the south. Extensive clearing of Mabi Forest began around 1900 and greatly reduced its' extent (Tracey 1982, Graham et al. 1995, EPA 2005, Stanton and Stanton 2005). The current extent of Mabi Forest is 954.7 ha, of which 828.9 ha occurs on the Atherton Tableland (EPA 2005).

Threats summary

Clearing of Mabi Forest has left a severely fragmented and modified landscape, comprising remnant patches of various sizes, shapes, connectivity and condition. Fragmentation has allowed penetration by a range of serious weed species displacing native species and degrading habitat. Ecological processes such as seed dispersal are under threat, as fragments no longer support populations of the southern cassowary and musky rat-kangaroo; key seed dispersers in the Wet Tropics rainforests. Feral and domestic animals continue to threaten Mabi Forest wildlife due to predation. Grazing and other incompatible land management practices in the landscape, contribute to ongoing degradation of Mabi Forest remnants. Highly fragmented ecosystems like Mabi Forest, with their abrupt boundaries and high edge-to-area ratios, are vulnerable to the destructive forces of a severe cyclone.

Overall objective

To protect and rehabilitate Mabi Forest and, where possible, expand Mabi Forest into adjacent areas through an integrated program of habitat protection, on-ground management, rehabilitation, research and public involvement.

Summary of actions

Actions required to recovery Mabi Forest include, mapping the extent of remnant and rehabilitating Mabi Forest; undertaking biodiversity surveys of Mabi Forest fragments to assess condition for priority protection and management; reviewing and evaluating the regional planning framework to ensure that conservation of Mabi Forest is promoted and incorporated appropriately in planning, management and development assessment; developing strategies to enhance protection and management of Mabi Forest on private lands; rehabilitating disturbed areas and corridors of Mabi Forest based on established priorities; developing and implementing a weed management strategy; implementing a feral and domestic dog control program; minimising the impacts of roads and vehicles on Mabi Forest wildlife; encouraging landholders to develop and implement land management practices that are compatible with Mabi Forest recovery and agricultural sustainability; identifying information needs and design and conduct research on Mabi Forest; promoting and facilitating community and landholder involvement in recovery actions by raising community awareness; and facilitating Aboriginal participation in implementation of actions and the use of traditional knowledge in Mabi Forest recovery.

1. General information

Conservation Status

Mabi Forest or Complex Notophyll Vine Forest Type 5b (Tracey 1982) is listed as 'Critically Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Under the EPBC Act, Mabi Forest is defined as those areas of Regional Ecosystem 7.8.3 and other patches identified as Complex Notophyll Vine Forest 5b in the Wet Tropics bioregion (DEH 2005). Since the listing, the Queensland Regional Ecosystem framework has been updated such that Mabi Forest (Tracey and Webb 1975, Tracey 1982) is now identified as Regional Ecosystems 7.8.3 (Complex Semi-Evergreen Notophyll Vine Forest of uplands on basalt) and 7.3.37 (Complex Semi-Evergreen Notophyll Vine Forest of uplands on alluvium). Both regional ecosystems are listed under the Queensland *Vegetation Management Act 1999* as 'Endangered' (EPA 2005). This recovery plan provides actions for the recovery of both regional ecosystems.

Affected interests

Mabi Forest occurs on public and private land under a range of tenures. The recovery plan recognises the multiple uses and values associated with these lands and wherever possible recovery actions consider the interests of all stakeholders. Representatives from all major stakeholder groups are represented on the Mabi Forest Recovery Team. All actions are to be undertaken in collaboration with land managers and/or landholders on any lands directly affected by those actions and Traditional Owners will be consulted wherever appropriate.

Affected government authorities, organisations and individuals include:

- Australian Government Department of the Environment, Water, Heritage and the Arts (DEWHA)
- Environmental Protection Agency (EPA)
- Wet Tropics Management Authority (WTMA)
- Department of Natural Resources and Water (DNRW)
- Department of Primary Industries and Fisheries (DPIF)
- Forestry Plantations Queensland
- Department of Main Roads (DMR)
- Far North Queensland Natural Resource Management Regional body (FNQNRM)
- Ergon Energy
- Atherton and Eacham Shire Councils
- Ngadjon-ji and Yidin-ji
- Private landholders
- Local community conservation and tree planting groups including the Tree Kangaroo and Mammal Group (TKMG) and Trees for the Evelyn and Atherton Tablelands (TREAT)
- Scientific research organisations including CSIRO and universities

Consultation with Indigenous people

Implementation of recovery plan actions includes consideration of the role and interests of Aboriginal people whose country incorporates Mabi Forest. Traditional Owners through representatives from the Ngadjon-ji and Yidin-ji tribes have been, and will continue to be, consulted in the development and implementation of this plan and are represented on the recovery team.

Benefits to other species or communities

Protection and recovery of Mabi Forest will enhance protection of the large diversity of species occurring within it – to date over 550 plant and 160 animal species have been recorded (Hopkins et al. 1996, MFWG 2001). Several species are listed as threatened under Commonwealth or State legislation (Table 1). The listed threatened plant species found within Mabi Forest include *Hodgkinsonia frutescens*, *Sauropus macranthus*, *Marsdenia straminea* and *Alloxylon flammeum*. *Sauropus macranthus* is only known to occur within this forest type. 'Rare' plants include *Haplostichanthus* sp. (Topaz L.W. Jessup 520), *Elaeocarpus coorangooloo*, *Firmiana papuana*, *Alectryon semicinereus* and *Phyllanthera grayi*. Mabi Forest supports relatively high densities of the 'Rare' Lumholtz's tree-kangaroo *Dendrolagus lumholtzi* and is important habitat for other

'Rare' arboreal mammals such as the green ringtail possum *Pseudochirops archeri* and Herbert River ringtail possum *Pseudochirulus herbertensis*. Restoration of remnant Mabi Forest and key corridors will also enhance effort in the longer term to restore threatened ecological processes such as seed dispersal, through re-establishment of key frugivores such as the 'Endangered' southern cassowary *Casuarus casuarus johnsonii*, which has been lost from the community due to fragmentation.

Social and economic impacts

The implementation of this plan is unlikely to cause significant adverse social and economic impacts. Habitat issues and likely impact on landholders have been considered in the Wet Tropics Regional Vegetation Management Codes for Broadscale Clearing and for Ongoing Clearing Purposes developed under the *Vegetation Management Act 1999*.

There are presently limited opportunities for the local community to access and experience the original biodiversity of the Atherton Tableland region, of which Mabi Forest is a major component. The continued success of recovery efforts for this ecological community should have positive social, economic and educational impacts. Local businesses already derive economic benefit from Mabi Forest through various ecotourism ventures such as wildlife viewing; recovery of Mabi Forest will potentially enhance these and other economic opportunities. Successful recovery of a unique, 'Critically Endangered' ecosystem should provide opportunities for the local community to promote its success Australia wide, from which further educational, tourism and scientific research opportunities could flow. Mabi Forest also has significant cultural values to the Traditional Owners and actions to conserve Mabi Forest and promote culture and caring for country will be of great cultural benefit.

Table 1: 'Rare' and threatened plant and animal species recorded in Mabi Forest

Common name	Species name	Conservation status	
		NC Act ¹	EPBC Act
Flora			
Flame silky oak	<i>Alloxylon flammeum</i>	V	V
Atherton sauropus	<i>Sauropus macranthus</i>	R	V
	<i>Marsdenia straminea</i>	V	
Atherton turkey bush	<i>Hodgkinsonia frutescens</i>	LC	V
Pink leaf Haplostichanthus	<i>Haplostichanthus submoutanus ssp sessiliflorus</i>	R	
Brown quandong	<i>Elaeocarpus coorangooloo</i>	R	
	<i>Firmiana papuana</i>	R	
	<i>Alectryon semicinerus</i>	R	
	<i>Argyrodendron sp.</i> (Boonjie B.P. Hyland RFK 2139)	R	
	<i>Phyllanthera grayi</i>	R	
Fauna			
Southern cassowary*	<i>Casuarus casuarus johnsonii</i>	E	E
Macleay's fig-parrot	<i>Cyclopsitta diophthalma macleayana</i>	V	
Rufous owl (southern subspecies)	<i>Ninox rufa queenslandica</i>	V	
Square-tailed kite	<i>Lophoictinia isura</i>	R	
Grey goshawk	<i>Accipiter novaehollandiae</i>	R	
White-rumped swiftlet	<i>Collocalia spodiopygius</i>	R	
Spectacled flying fox	<i>Pteropus conspicicillatus</i>	LC	V
Lumholtz's tree-kangaroo	<i>Dendrolagus lumholtzi</i>	R	
Herbert River ringtail possum	<i>Pseudochirulus herbertensis</i>	R	
Green ringtail possum	<i>Pseudochirops archeri</i>	R	
Lemuroid ringtail possum	<i>Hemibedlides lemuroides</i>	R	
Skink	<i>Lampropholis robertsi</i>	R	
Skink	<i>Eulamprus tigrinus</i>	R	

1. Queensland *Nature Conservation Act 1992* E = Endangered; V = Vulnerable; R = Rare; LC = Least concern

* Southern cassowary is now extinct from Mabi Forest

2. Biological information

Community description

Mabi Forest has been identified and mapped by the Environmental Protection Agency as Regional Ecosystems 7.8.3 and 7.3.37 (EPA 2005). The name Mabi Forest has been adopted and used by the Atherton Tableland community to identify this forest type, the word derived from local Aboriginal names for Lumholtz's tree-kangaroo *Dendrolagus lumholtzii* (mabi or mapi). This 'Rare' and iconic species is one of the most conspicuous mammals found in this forest type.

Mabi Forest is almost entirely restricted to the Atherton Tableland at an altitude of 700-850m above sea level. Annual rainfall in this area is between 1300-1600mm. It occurs at sites of high soil fertility, typically on basaltic kraznozems, in a landscape still dominated by basaltic volcanic landforms from the Pliocene to most recent Pleistocene times. The variety of volcanic rock has produced a range of soil associations and complexes with variable characteristics such as soil moisture-holding capacity and internal drainage (Laffan 1988). The combination of factors such as soil, rainfall patterns, altitude and humidity determines seasonal water stress levels and this in turn influences the physiology, composition, structure and distribution of the Mabi Forest remnants (Laffan 1988, Webb and Tracey 1994, Graham et al. 1995). Landscape position, topography and drainage exert an influence at very small scales, resulting in significant site heterogeneity within remnants.

The climatic niche for Mabi Forest is quite different to other adjacent rainforest types on basalt soils. For example, Type 1b complex mesophyll vine forest (RE 7.8.2), occurs in wetter locations where seasonal moisture stress is lower, while Type 5a complex notophyll vine forest (RE 7.8.4), occurs at higher altitudes with both a cooler and wetter climate (Graham et al. 1995).

Distinct structural features and species composition characterise Mabi Forest (Tracey 1982).

Structural characteristics include:

- semi-evergreen canopy with trees 25 to 40m, tendency for heavy leaf fall in times of moisture stress;
- presence of scattered, often deciduous, emergent trees;
- well developed medium to dense shrub and scrambling vine understorey generally 1-3 metres high;
- plank buttress roots common;
- stem diameters are uneven;
- woody lianes are generally conspicuous; and
- epiphytes are rare.

Over 550 native species of vascular plants have been recorded in Mabi Forest, with trees, shrubs and vines representing 90 percent of the species, and a limited number of ferns, herbs and epiphytes (Hopkins et al. 1996, unpub. data). Key canopy species include candlenut *Aleurites moluccana*, black bean *Castanospermum australe*, white cedar *Melia azedarach*, red cedar *Toona ciliata*; key subcanopy species include lemon aspen *Acronychia acidula* and corduroy tamarind *Arytera divaricata*.

The dense shrub layer, which largely distinguishes Mabi from other rainforest types, is a reflection of the seasonal nature of rainfall patterns, being at the lowest end of the rainfall regime which can support complex notophyll vine forest (Tracey 1982). Seasonally induced moisture stress has resulted in a large component of the canopy flora being either deciduous or semi-deciduous, and this is generally considered to have induced the characteristic shrub layer comprised of Atherton turkey bush *Hodgkinsonia frutescens*, dichapetalum *Dichapetalum papuanum*, Atherton sauropus *Sauropus macranthus*, dwarf phaleria *Phaleria octandra* and *Codiaeum variegatum* var. *moluccanum* (MFWG 2001).

Mabi Forest supports a rich bird fauna; 114 species are known to reside, nest or forage in the forest, more species than is known to occur in any other plant community within the Wet Tropics bioregion (MFWG 2001). Twelve of the 13 species endemic to the Wet Tropics are found in Mabi Forest. Many birds play an important role in pollination and seed dispersal. The 'Endangered'

southern cassowary, *Casuarius casuarius johnsonii*, was an important seed disperser in the forest but has now disappeared from the remaining fragments.

Twenty-four mammal, six frog and 16 reptile species have been recorded in Mabi Forest. Endemic to the Wet Tropics, the 'Rare' Lumholtz's tree-kangaroo, occurs in high densities on the Atherton Tableland where it is primarily restricted to rainforests growing on basalt soils. They are most abundant in Mabi remnants including Curtain Fig National Park, Mt Quincan, Thomas Road and Wongabel State Forest. Population densities in Mabi Forest have been measured at 1-2 individuals/ha, the highest known densities throughout the species' range (Newell 1999). The abundance of tree-kangaroos in Mabi forest is attributable to the fertility of the basalt soils, as the trees and vines which grow on these soils have highly nutritious foliage that makes up the majority of their diet (Newell 1999, Kanowski et al. 2001).

Distribution

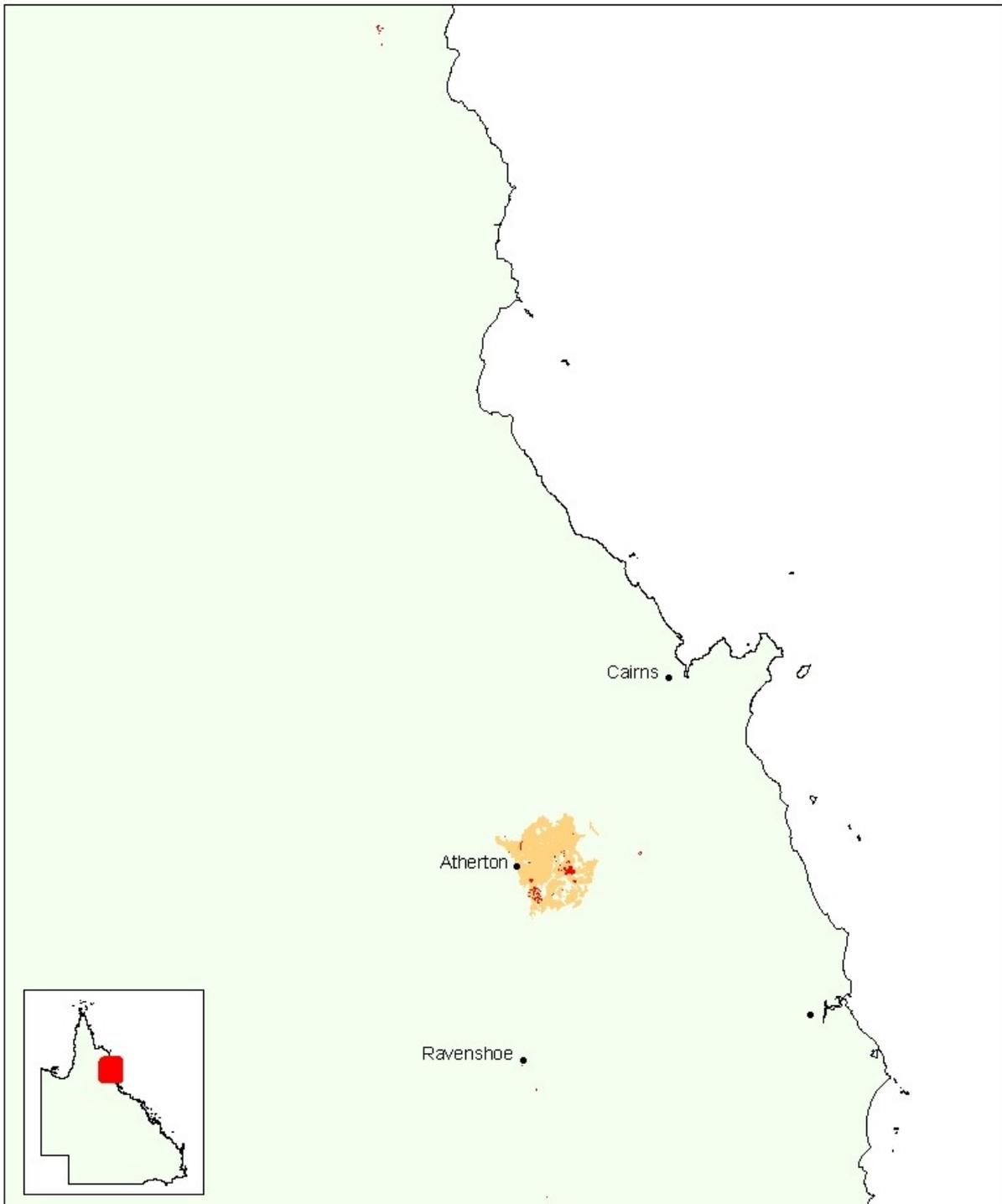
Mabi Forest occurs within a restricted geographical range primarily on the Atherton Tableland, approximately 50km southwest of Cairns, in Queensland's Wet Tropics bioregion, and several small remnant patches located near Cooktown in the Cape York Peninsula bioregion (Figure 1). Prior to European settlement, Mabi Forest on the Atherton Tableland occurred as continuous forest between Yungaburra in the east, Kairi - Cullamungie Pocket (now separated by Tinaroo Dam) to the north, Tolga in the west and past Wongabel State Forest in the south (Figure 2). Extensive clearing of Mabi Forest began around 1900 and greatly reduced its extent. After being cleared only small fragments of Mabi Forest remain (Tracey 1982, Graham et al. 1995, EPA 2005, Stanton and Stanton 2005) located between the towns of Atherton, Kairi, Yungaburra and Malanda (Figure 2).

Mabi Forest was originally identified and mapped by Tracey and Webb (1975) and Tracey (1982). A comprehensive survey of Mabi Forest fragments resulting in a 1:50,000 map was later completed by Graham et al. (1995). Clearing of Mabi Forest continued until the *Vegetation Management Act 1999* was introduced to protect the forest type as an 'Endangered' regional ecosystem. Stanton and Stanton (2005) recently mapped the extent of Mabi Forest at a scale of 1:50,000 as part of a comprehensive project by the Wet Tropics Management Authority. This mapping has subsequently been incorporated into the updated Wet Tropics Regional Ecosystem mapping by the Queensland Herbarium. Mabi Forest is currently restricted to those mapped areas of Regional Ecosystems 7.8.3 and 7.3.37 (EPA 2005).

The current extent of Mabi Forest is 954.7ha, 77.4ha at Shiptons Flat near Cooktown, 15.4ha in the Ravenshoe region and 861.9ha on the Atherton Tableland (EPA 2005). Mabi Forest occurs as numerous small and isolated patches throughout the landscape. In all 62 fragments have been identified and mapped. There are two remnant patches greater than 200ha in size; at 271ha the Curtain Fig remnant and at 267ha Wongabel State Forest are the largest, and between them represent 56 percent of the total Mabi extent. On the Atherton Tableland, 73 percent of all fragments are less than 5ha in size and collectively represent only 7 percent of the total Atherton Tableland Mabi extent (Figure 1). The Wongabel State Forest fragment, although supporting a large area of remnant Mabi Forest, is severely fragmented internally due to commercial forestry operations.

Of the two regional ecosystems identified as Mabi Forest, RE 7.8.3 is the most extensive. RE 7.3.37, once occurring on alluvial systems along streams surrounded by basalt on the Atherton Tableland, is now almost extinct due to clearing, with less than 8ha remaining in three very small fragments (EPA 2005).

Figure 1: Distribution of Mabi Forest



 **Mabi Forest remnant extent**
 **Mabi Forest pre-clearing extent**

0 12.5 25 50
Kilometres



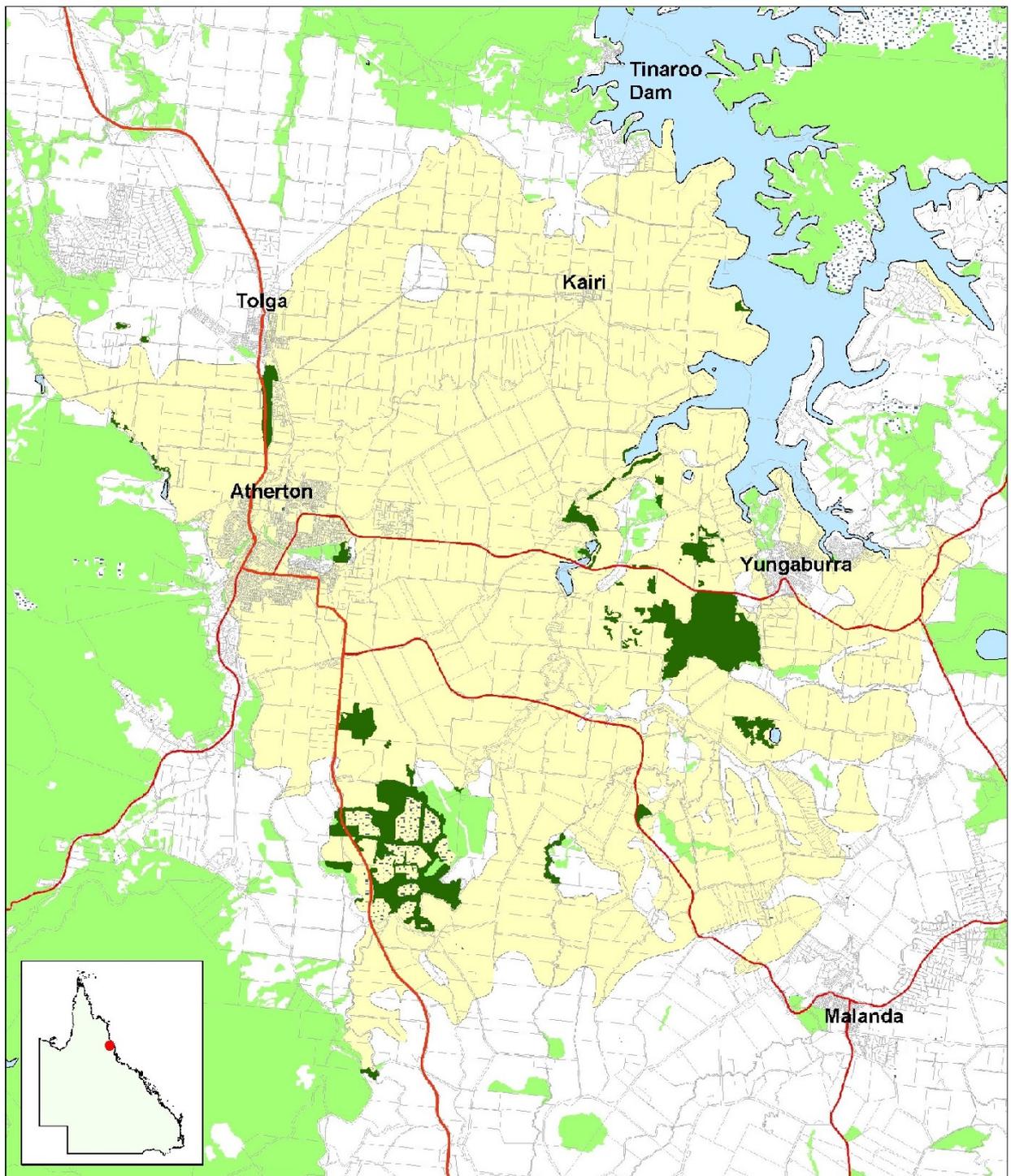
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Data sources:
EPA Regional Ecosystems Version 2005
Cadastral, DNRM Dec 2005

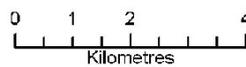
Produced Jan 2006
EPAQ PWS Atherton



Figure 2: Distribution of Mabi Forest Atherton Tablelands



- Mabi Forest remnant extent
- Mabi Forest pre-clearing extent
- Other remnant vegetation
- Cleared land, disturbed, regrowth
- Plantation forest



Major roads



The information shown on this map is for discussion purposes only. Not for reproduction or distribution.

Data sources:
 EPA Regional Ecosystems Ver 5.0 2006
 Cadastre, DNRM Dec 2006

Prod. cad Jan 2006
 EPA/QPWS Atherton



Queensland Government
 Environmental Protection Agency
 Queensland Parks and Wildlife Service

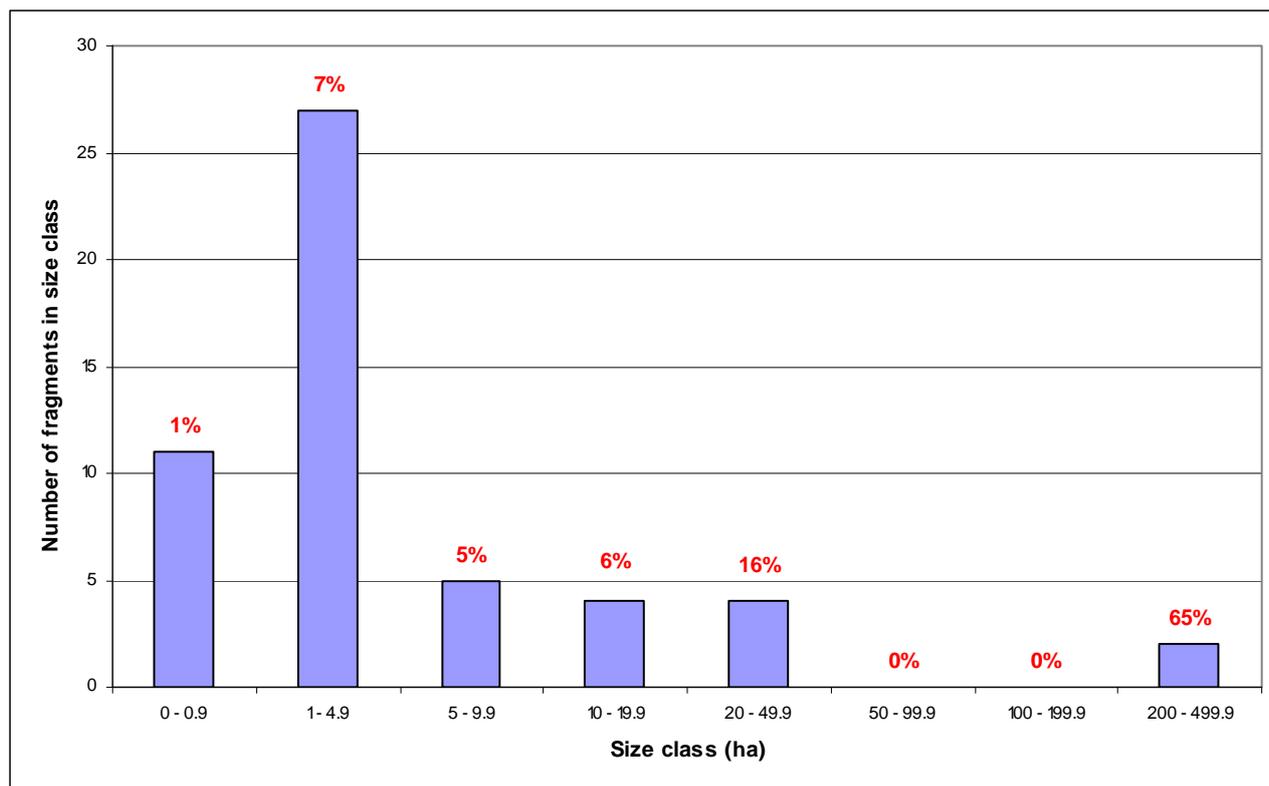


Figure 3: Size class distribution of Mabi Forest remnants on the Atherton Tableland. Percentages represent the proportion of total Mabi extent that each size class represents (derived from EPA 2005).

Land use changes

Mabi Forest has been occupied by people from the Ngadjon-ji and Yidin-ji tribes for many thousands of years. The landscape which supports Mabi and other forest types, continues to have great cultural significance for the Traditional Owners whose oral legends include stories of the eruption of volcanoes such as the twin vents at Halloran’s Hill and Bones Knob, between which the town of Atherton now sits. Names for the towns of Yungaburra (*janggaburru*) and Kairi (*giri*) are taken from the Yidin-ji language.

Europeans first appeared soon after Dalrymple’s 1873 expedition, and began logging the forest, firstly for red cedar, *Toona australis*, and then for other high quality timber trees. By 1900, red cedar accounted for 75 percent of Queensland’s total export earnings, though unlicensed harvesting quickly depleted the resource (MFWG 2001). Such was the concern for its future supply that red cedar seedlings were dug up from Tolga Scrub and re-planted at Wongabel State Forest where the species was not regenerating.

After removal of the highly prized hardwood timbers, extensive clearing for agriculture began in the 1900s and dairy, maize and tobacco farming were established. Many people commenced market gardening on the rich, well drained soils. A few reserves were left for timber production on the steeper or rockier areas which were less suitable for agriculture. A few small areas were also left for their amenity value at this time.

Soldier settlement schemes introduced after World War 1 contributed to further clearing and by the 1920s it is estimated that 80 percent of Mabi Forest had been cleared (Winter et al. 1987). Clearing of Mabi Forest for agricultural development continued up until the late 1990s, when its designation as an ‘Endangered’ Regional Ecosystem under the *Vegetation Management Act 1999* prohibited further clearing.

The area across which Mabi Forest was historically distributed on the Atherton Tableland, now supports a mix of land uses – grazing, mixed cropping, forestry, national parks, populated areas and associated infrastructure. The town of Atherton with 6,000 residents, is the main centre of population. Tourism, much of it nature based and centred on the presence of Mabi Forest, is important for the local economy.

Fifty-eight percent of Mabi Forest extent on the Atherton Tableland is within some type of protected tenure (national park, forest reserve, state forest or local government managed reserve) while 34 percent occurs on freehold land (Table 1). Thirty-five percent of Mabi Forest lies within the Wet Tropics World Heritage area. The majority of Mabi Forest occurs within the Atherton Shire.

Table 2: Extent of Mabi Forest by tenure and local government area (derived from EPA 2005)

Tenure	Extent of Mabi Forest in local government areas (ha)				Total
	Atherton	Eacham	Herberton	Cook	
National Park	180.8	0.0	4.5	0.0	185.3
Forest Reserve	0.0	32.9	5.8	0.0	38.7
State Forest	243.1	0.0	0.0	0.0	243.1
Timber Reserve	0.0	0.0	0.0	54.9	54.9
Council Reserve	40.7	0.1	0.0	0.0	40.8
Freehold	250.7	46.6	4.8	0.7	302.7
Leasehold	2.6	0.0	0.0	11.3	13.9
Road/road reserve	55.5	1.0	0.4	10.6	67.6
Other	5.9	1.8	0.0	0.0	7.8

Note: Of the 67ha approximately 15ha occurs in the State Controlled Road Reserve.

Habitat critical to survival

Of the extent of Mabi Forest that existed on the Atherton Tableland at the time of European settlement, only four percent remains in a highly fragmented state. It is one of the most threatened vegetation types in the Wet Tropics. Very little of the area has escaped the consequences of human activities such as clearance, logging and weed invasion (Stanton and Stanton 2005). Some of the larger remnants may retain a moderate to high level of ecological integrity while other fragments may exist in lower condition states; some of these may have the capacity to be rehabilitated under appropriate management regimes. Given its very restricted and fragmented distribution, all areas that meet the definition of this ecological community should be considered habitat critical for the community's long-term survival.

Important areas

The extent of clearing of the Mabi Forest community means that all areas of Mabi Forest are important. The larger fragments and corridors that contribute to preserving the majority of biodiversity and the three small fragments of RE 7.3.37 should be considered as priorities for conservation management.

3. Threats

Identification of threats

Clearing and fragmentation

Rainforest clearance for timber and agricultural land on the Atherton Tableland was a very extensive and dramatic operation, with the majority of the clearing completed by the 1920s (Winter et al. 1987). Although short in duration, this period of concentrated clearing has had a dramatic impact on Mabi Forest extent and a corresponding reduction in the distribution and connectivity of component species. Of an estimated 19,806ha of pre-clearing extent on the Atherton Tableland, only 862ha or 4.3 percent remains (EPA 2005).

The legacy of clearing on the Atherton Tableland, and one of the most serious threats to the long-term viability of Mabi Forest, is a severely fragmented and modified landscape comprising remnant patches of various sizes, shapes, connectivity and condition. Sixty-two fragments have been identified and mapped, ranging in size from less than half a hectare to 271ha.

Fragmentation of Mabi Forest has led to a reduction in species abundance and diversity, increased isolation of populations leading to reduced opportunities for re-colonisation and increased vulnerability to edge effects, disturbances and stochastic events. Research on the Atherton Tableland indicates that edge effects have an important influence on the structure, floristic composition (Laurance 1991b, 1997) and microclimate (Turton and Freiburger 1997) of forest fragments.

A total of 110km of edge-affected boundary exposes plant and animal populations to the threats of invasive weeds, domestic and feral animals, road and traffic impacts (including road construction and maintenance) and fire encroachment from the intervening landscape. This landscape, a matrix of agricultural land, roads and urban settlement, can be a barrier to the movement of some species, while others that do cross it, such as tree-kangaroos, are vulnerable to vehicle strikes and predators (Newell 1999, Schmidt et al. 2000). Many remnant patches suffer severe wind damage due to their ecologically-abrupt boundaries and high edge-to-area ratios (Laurance 1997) while some are further fragmented internally by roads and clearings. Within Wongabel State Forest, several large cleared areas support commercial forestry operations, dramatically increasing the length of forest edge and vulnerability to edge effects.

Fragmentation effects on rainforest arboreal mammals have been documented on the Atherton Tableland (Laurance 1990, 1991a, 1994, 1997, Laurance and Laurance 1999). Data indicate that populations are influenced by not only the size of habitat fragments but also by the surrounding modified landscape. There is a strong gradient in extinction proneness; the lemuroid ringtail possum *Hemibelideus lemuroides* appears especially sensitive to habitat disturbance and rapidly declines in fragmented forest. Herbert River ringtail possums *Pseudochirulus herbertensis* and Lumholtz's tree-kangaroos *Dendrolagus lumholtzi* show intermediate responses to fragmentation, whilst coppery brushtail possums *Trichosurus vulpecula* and green ringtail possums *Pseudochirops archeri* appear least vulnerable to fragmentation.

The long-term persistence of species like tree-kangaroos in remnant patches may depend on the dispersal of individuals from extensive areas of prime habitat to maintain genetic diversity (Bowyer et al. 2002), or to recolonise remnants after droughts, cyclones or other catastrophes (Kanowski et al. 2003). Furthermore, fragmentation of Mabi Forest is likely to have also impacted on tree-kangaroo populations in the surrounding areas of more marginal habitat, as the high quality Atherton Tableland forests like Mabi act as a source population for the region (Kanowski 1999).

Weeds

Many weed species have invaded fragments and threaten their structure and ecological integrity (Graham et al. 1995, Tucker et al. 2003, Stanton and Stanton 2005, QPWS unpub. data). The occurrence of small, isolated fragments within or close to agricultural and urban areas, which can act as significant weed sources, means that fragments are highly vulnerable to ongoing weed invasion. Of the 417 species of vascular plants recorded by Hopkins et al. (1996), 29 were exotic species. Recent surveys of Mabi Forest by the EPA on the Atherton Tablelands have identified 79 weed species, 14 percent of the total number of plant species recorded (QPWS unpub. data). Turbina vine *Turbina corymbosa*, Madera vine *Anredera cordifolia*, Dutchman's pipe *Aristolochia elegans* and cat's claw vine *Macfadyena unguis-cati* already established in several fragments, are of greatest concern and pose a significant threat to the ecological values of Mabi Forest. A further 11 species present are of concern and should receive attention in weed management programs (QPWS unpub. data). These include Japanese sunflower *Tithonia diversifolia*, which chokes forest margins and the shade tolerant coral berry *Rivina humilis* which invades the understorey and displaces native shrubs such as *Hodgkinsonia frutescens*. Guinea

grass *Panicum maximum* grows in thick swards several metres wide along disturbed edges (such as the margins of roads) and encroaches on rainforest edges.

Loss of functionally important species

The small size of Mabi Forest remnant patches and their relatively large distance from major blocks of rainforest has resulted in the local extinction of the southern cassowary and musky rat-kangaroo. These species have significant ecological roles in the Wet Tropics rainforests as seed dispersers (Stocker and Irvine 1983, Dennis 2003). Cassowaries for example, are the only long distance dispersal vector for many large seeded fruits, and combined with landscape-scale movements, they can play important roles in dispersing seeds between forest patches and into regenerating areas (Westcott et al. 2005). The combination of long distance dispersal ability and landscape scale movement means that cassowaries play a significant role in moving seeds between populations and into new regenerating areas (Westcott et al 2005). The loss of cassowaries from part of their range could result in relatively rapid selection for changes in fruit dimensions in those areas as well as changes in population level dynamics, particularly for large-seeded species (Westcott et al 2005).

Incompatible land use management in the landscape

Incompatible or inappropriate land management practices in the intervening landscape contribute to ongoing degradation of Mabi Forest remnants. Many small, unfenced remnants are grazed at their edges or used as shelter by stock. These animals trample the understorey, preventing natural recruitment and regeneration processes. Where fragments are surrounded by grassy agricultural areas/pastures, the potential for fire, particularly in late dry season, to enter these fragments is very high, as fires are often lit by landholders to burn crop refuse. A number of fragments are showing signs of being repeatedly impacted by fire resulting in weed encroachment as the forest is pushed back (ASC 2005). Other fragments have had large boulders and other debris pushed up against edges during clearing or property management activities, resulting in edges that may inhibit natural recruitment and/or any attempt to rehabilitate the fragment. There are some areas of state land supporting Mabi Forest where encroachments by landholders are negatively impacting on the forest. This includes a number of dedicated, but unformed, road reserves being used informally by adjoining landowners for stock grazing and cropping purposes (Tucker et al. 2003).

Feral and domestic animals

Dogs are a major source of mortality for tree-kangaroos (Schmidt et al. 2000). Tree-kangaroos are particularly vulnerable to being attacked by roaming dogs, both wild and domestic, when they are dispersing between isolated remnants of forest. Feral cats, feral pigs and cane toads have also been recorded in Mabi Forest fragments although no assessment of their impact on wildlife has been made.

Roads and traffic

A number of major roads dissect Mabi Forest fragments. Roads fragment habitat, create barriers to animal movement, produce edge effects, are potential sources for exotic species introduction and can cause substantial mortality to wildlife. Tree-kangaroos are particularly vulnerable, as individuals come to the ground to cross between trees and forest patches and can travel considerable distances, especially dispersing sub-adults (Newell 1999). Many road fatalities are recorded (Schmidt et al. 2000). Curtain Fig road has been identified as one of five problem spots for tree-kangaroo mortalities on the Atherton Tableland (Schmidt et al. 2000, Izumi 2001).

Stream bank erosion

Major watercourses such as the Barron River and Peterson Creek flow through Mabi Forest. Clearing of riparian vegetation has contributed to stream bank erosion; slumping and undercutting in some areas causing the original vegetation to be washed away (ASC 2005, BRICMA 2005). In the Picnic Crossing area, some bank sections of the Barron River are highly degraded, with levels of native plant cover greatly reduced and intervening areas covered by weeds such as guinea grass and Asian wait-a-while *Caesalpinia decapetala* (ASC 2005). Stream bank clearing and subsequent weed invasion has been identified as one of the major

contributors to the decline in river health within the Barron River catchment in north Queensland (BRICMA 2004).

Natural catastrophic events

Tropical cyclones are an integral part of the natural history of north Queensland and the most widespread and intensive agent of natural disturbance (Webb 1958, Unwin et al. 1988, Adam 1992). However, highly fragmented ecosystems like Mabi Forest with their abrupt boundaries and high edge-to-area ratios, are vulnerable to the destructive forces of a severe cyclone. The effects of cyclones on rainforests in north Queensland have been documented (e.g. Unwin et al. 1988), but no comprehensive assessment of cyclone disturbance to Mabi Forest has been undertaken. This is despite general reports of disturbance to forests on the Atherton Tableland following major cyclones in 1918, 1927, 1959, 1986, 1990, 1997 and 2000 (Jeff Callaghan Bureau of Meteorology, pers. comm. 2006). One of the severest cyclones to cross the Queensland coast, Cyclone Larry, passed over Mabi Forest in March 2006. McCarthy (2006) reported that in four Mabi Forest remnants ranging in size from 16.4 ha to 260 ha; almost 90% of trees in the plots sampled experienced some type of damage, ranging from total uprooting or snapping of trunks to light limb damage.

Vegetative recovery of forests can be rapid and widespread following cyclones (Unwin et al. 1988, Applegate and Bragg 1992), but the increased threat of fires and weed invasion to disturbed areas, places already stressed habitat at further risk of degradation. Turton and Dale (2007) noted the rate and extent of recovery from cyclone damage would depend on the severity of the structural damage to the forest and the size of the forest affected. Smaller rainforest patches, including patches of Mabi Forest, which suffered more damage than larger forest patches in Tropical Cyclone Larry, are considered to have less resilience to recover (Tucker et al. 2006; Turton and Dale 2007). Turton and Dale (2007) commented that loss of canopy cover in these forests (including Mabi Forest) may allow invasion of weed species and 'could result in major disruptions to ecological processes including succession'. They considered natural recovery unlikely in some instances.

4. Recovery objectives, Performance Criteria and Actions

Overall objective:

To protect and rehabilitate Mabi Forest and, where possible, expand Mabi Forest into adjacent areas through an integrated program of habitat protection, on-ground management, rehabilitation, research and public involvement.

Specific objective 1: Identify and evaluate the extent and quality of Mabi Forest and component species

Action 1.1 Map extent of remnant and rehabilitating Mabi Forest and other vegetation communities within Mabi pre-clearing extent

Performance criterion 1.1 Mabi Forest extent identified and map produced at 1:10,000 scale

The remnant and pre-clearing extents of Mabi Forest have been mapped as Regional Ecosystems 7.8.3 and 7.3.37 under the EPA Wet Tropics Regional Ecosystem (RE) mapping Version 5 (EPA 2005). Further work is required to refine this mapping at a scale of 1:10,000 to better delineate and map very small fragments, many of which may be crucial for long-term corridor recovery. This action will also identify and map Mabi Forest rehabilitating habitat. Rehabilitating habitat represents non-remnant vegetation in the landscape, including disturbed or regenerating habitat that retains habitat values. While not formally protected under legislation, rehabilitating habitat is considered to be crucial to the long-term recovery of Mabi Forest as many of these areas form critical corridor linkages suitable for restoration.

Potential contributors: EPA, WTMA, DNRW and DMR.

Action 1.2 Undertake biodiversity surveys of Mabi Forest fragments to assess condition for priority protection and management

Performance criterion 1.2 Biodiversity surveys and condition assessment of fragments undertaken, priority rankings assigned and report produced

On completion of Action 1.1, a comprehensive flora and fauna survey will be undertaken of both remnant and rehabilitating habitat. Many Mabi Forest fragments have been subject to vegetation surveys as part of large mapping projects, however very few fauna surveys have been conducted (e.g. Hopkins et al. 1995, Stanton and Stanton 2005). In addition, a condition assessment of key remnants will be undertaken to inform the process of prioritising recovery effort. This will include detailed assessments of any post cyclone disturbance.

On completion of biodiversity surveys, all areas of Mabi Forest will be ranked as to the urgency for recovery action. Assessment criteria will be developed to ensure that a consistent and defensible approach is taken to priority ranking. Criteria will be based upon factors influencing the ecology of the remnant including size, shape, position in landscape, condition and connectivity as well as threats, recovery potential and the likelihood of success of management actions. The assessment process will be based on GIS and field-derived data. This process will also recommend the most appropriate form of recovery action for the identified sites and prepare recovery proposals for them. A schedule of recommended priorities with costings and potential contributors will be presented to the recovery team for endorsement.

Potential contributors: EPA, FNQNRM, research institutions, WTMA, local councils, community groups, Traditional owners and DMR.

Specific objective 2: Enhance planning, management and conservation of Mabi Forest

Action 2.1 Review and evaluate the regional planning framework to ensure that conservation of Mabi Forest is promoted and incorporated appropriately in planning, management and development assessment

Performance criterion 2.1 A review of current planning instruments is completed and organisations involved in planning, management and development control of Mabi Forest have incorporated these matters into relevant planning documentation

Various legislation, planning schemes and conservation and natural resource management plans provide for the protection of Mabi Forest and/or support implementation of Mabi Forest recovery actions. These include the *Vegetation Management Act 1999*, Wet Tropics NRM Plan, Wet Tropics Conservation Strategy, catchment management plans and local government planning schemes. A review will be made of planning instruments and their effectiveness in protecting habitat and regulating other development activities that might impact on Mabi Forest and its recovery.

Based on the review a strategy will be developed to promote and better integrate Mabi Forest recovery into natural resource planning and investment, through consultation and liaison with stakeholders. The recovery plan will be promoted as the major strategic document directing Mabi Forest conservation effort. One expected outcome is that any development or activity is assessed with reference to this recovery plan and any future advice from the Recovery Team regarding the distribution, threats and ecology of Mabi Forest. This should also include any consent issued on land in the vicinity of known Mabi Forest fragments and in those areas identified as key corridors within this recovery plan.

Potential contributors: EPA, local councils, FNQNRM, WTMA, DMR.

Action 2.2 Investigate strategies to enhance protection and management of Mabi Forest on private lands

Performance criterion 2.2 Conservation measures for private land identified and additional areas of Mabi Forest are protected and being managed by landholders

Thirty-two percent of remaining Mabi Forest occurs on private land. While protected from clearing, few remnants on private land are managed for conservation purposes. Building on Action 1.2, this action will investigate the use of conservation and other incentives to encourage involvement of landholders in the management of Mabi Forest on their land. A range of non-regulatory approaches will be explored, including rate deferrals and rebates, voluntary conservation agreements such as nature refuges, covenants, revolving funds and development benefits. A report will document the effectiveness of existing measures and monitor the implementation of new strategies to provide recommendations for future activities and preferred community options.

Potential contributors: FNQNRM, EPA, WTMA, DNRW, DLGPSR, local councils, community groups and Traditional owners.

Action 2.3 Support the development and implementation of site-specific management plans, for Mabi Forest fragments

Performance criterion 2.3 Management plans for key remnants developed and recommendations implemented

Site-specific management plans will be developed in consultation and negotiation with landholders where Mabi Forest occurs (with potential assistance from non government conservation groups). A number of Mabi Forest fragments managed by public authorities are subject to existing management plans. Three wildlife habitat management plans have been developed for private properties with Mabi Forest (TKMG 2002). This action will review existing plans, with land managers consent, to ensure consistency of management intent and that management actions support recovery plan objectives. It will also recommend where appropriate, and support where possible, the development of new management plans.

Potential contributors: EPA, FNQNRM, WTMA, DNRW, DPIF, Forest Plantations Queensland, landholders, local councils, DMR, community groups such as Greening Australia and Traditional owners.

Action 2.4 Encourage landholders to develop and implement land management practices that are compatible with Mabi Forest recovery and agricultural sustainability

Performance criterion 2.4 Landholders of Mabi Forest remnants have implemented sustainable, recovery focused land management practices

Since most impacts on remnant patches originate from the surrounding landscape, there is a need to adopt an integrated landscape management approach to Mabi Forest conservation. Communication with landholders and industry groups will be established to develop and promote land management practices that enhance recovery of Mabi Forest while allowing for other land uses and economic enterprises. Cooperation with landholders will also be sought to ensure boundary compliance in areas where fencing, cropping or grazing is encroaching into Mabi Forest. Information could be disseminated via landholder workshops supported by printed information outlining appropriate practices for fire, grazing and weed management in Mabi Forest habitat. This action will complement proposed grazing and weed management initiatives under the Wet Tropics NRM Plan (FNQ NRM Ltd and Rainforest CRC 2005). A case study approach could be taken drawing on previous successful projects with Mabi Forest landholders (TKMG 2002). Upon completion of Actions 1.1 and 1.2, maps and reports on biodiversity surveys, condition assessments and conservation priorities will be distributed to relevant landholders and land managers.

Potential contributors: EPA, WTMA, DNRW, DPIF, landholders, local councils, community groups, FNQNRM and industry groups.

Specific objective 3: Reduce threats to, and improve ecological condition of fragments ensuring a landscape approach to Mabi Forest conservation

Action 3.1 Rehabilitate disturbed areas of Mabi Forest based on established priorities

Performance criterion 3.1 Rehabilitation of high priority areas is under way, based on established priorities

Rehabilitating remnants is an ideal way to create forest, establish buffers and reduce edge effects. Plantings could take a variety of forms, varying from ecological restoration at one end of a spectrum, through to agroforestry using native species in linear windbreak configurations at the other (Tucker et al. 2003). Restoration of degraded riparian areas, through a combination of bank stabilisation and revegetation programs, would also enhance water quality of affected waterways. A list of Mabi Forest species suitable for use in rehabilitation plantings is available (Goosem and Tucker 1995) and will be updated. Action 1.2 will guide rehabilitation priorities.

Potential contributors: EPA, FNQNRM, local councils, community groups and Traditional owners.

Action 3.2 Improve connectivity of Mabi Forest remnants at local and landscape scales

Performance criterion 3.2 Mabi Forest corridors are prioritised and restoration work of high priority corridors completed

Management and connectivity of Mabi Forest remnants will be crucial for the forest's long-term recovery. Community groups have already completed much restoration work on Mabi Forest corridors on the Atherton Tableland and work will continue on connecting remnants within Mabi Forest preclearing extent, and between Mabi Forest and other ecological communities. Actions to connect the large rainforest blocks to the east via corridors through Lakes Eacham and Barrine (see Tucker 2000) should continue, as should enhancement of riparian connectivity along waterways like the Barron River. Further work is required to adequately connect Mabi Forest westwards to continuous forest on the Herberton Range (Kanowski et al. 2003). This action will build upon the success of existing projects and planning initiatives such as the Curtain Fig Precinct Plan (Tucker et al. 2003), to develop and implement a strategic corridor plan. The plan will identify and prioritise corridors, assign management actions and costs and identify potential participants and funding sources.

Potential contributors: EPA, WTMA, FNQNRM, DNRW, local councils, DMR, community groups and Traditional owners.

Action 3.3 Develop and implement a weed management strategy

Performance criterion 3.3 A Mabi Forest Weed Management Strategy developed and implemented by relevant land managers

Various authorities, including FNQ NRM, local governments and EPA have developed weed management plans or strategies. To ensure a coordinated approach to weed management in Mabi Forest and surrounding areas, an audit will be conducted of existing and proposed control programs to determine to what extent actions consider Mabi Forest issues and how programs might be enhanced. The intended outcome is development of a weed management strategy to ensure a consistent and strategic approach is taken and to provide support to landholders and managers involved in weed control programs. This should incorporate a code-of-practice for vegetation management of roadsides in Mabi Forest that seeks to reduce potential for weed species introduction and spread as well as maintaining the ecological integrity of roadside vegetation.

Potential contributors: EPA, DNRW, WTMA, FNQNRM, DMR, and local councils.

Action 3.4 Implement feral and domestic dog control to minimise attacks on Mabi Forest wildlife

Performance criterion 3.4 Appropriate dog control programs and community education initiatives in place

A recommended list of actions to reduce dog attacks on tree-kangaroos has been developed (Schmidt et al. 2000). These actions include encouraging councils to adopt and enforce dog registration and control regulations and incentives to minimise the incidence of roaming dogs. A range of regulatory mechanisms will be investigated and appropriate models will be provided and promoted. A responsible dog ownership education program will be developed and promoted through various community education activities. This could include production of an educational pamphlet that would be distributed to the local community.

Potential contributors: EPA, DNRW, local councils, FNQNRM, TKMG and community groups.

Action 3.5 Minimise the impacts of roads and vehicles on Mabi Forest wildlife

Performance criterion 3.5 Strategies to minimise fauna road mortality incorporated in road planning, construction and management and a reduction in road mortality recorded

Mabi Forest conservation should receive thorough consideration in the planning, construction, ongoing maintenance and upgrading of roads within its distribution. Local community groups such as TKMG have been active in promoting wildlife road mortality issues and have been successful in getting appropriate signage erected in tree-kangaroo black spots. This action will build upon the success of existing measures to implement a more coordinated and strategic approach to managing the issue. Response is multifaceted and needs a combination of wildlife crossing designs, road signage, traffic calming techniques and speed regulation supported by appropriate monitoring and public education. Liaison with State and local government road authorities will be sought to develop a set of planning and management guidelines. All fauna road strikes, injuries and deaths should be reported to EPA and entered into a database to enable ongoing assessment of the issue.

Potential contributors: EPA, WTMA, FNQNRM, research institutions, local councils and DMR.

Action 3.6 Develop and implement if required a post-cyclone response strategy

Performance criterion 3.6 Post-cyclone Mabi Forest management response strategy developed

While severe cyclone events are infrequent, preliminary analysis of the impacts of Cyclone Larry to Mabi Forest indicate the need for a strategic and coordinated response to cyclone disturbance. This action will formalise such a post cyclone response strategy to guide management and assist recovery of affected Mabi Forest fragments, including targeted recovery of affected species. A strategy should incorporate immediate on-ground management needs (including appropriate post-cyclone clean-up responses) and assessment of habitat disturbance. Longer-term habitat and population recovery monitoring and consideration of management responses such as the siting and effectiveness of buffer plantings should be considered.

Potential contributors: EPA, WTMA, FNQNRM, research institutions and local councils.

Specific objective 4: Implement a monitoring and research program to inform conservation management decisions

Action 4.1 Identify information needs and design and conduct research on Mabi Forest

Performance criterion 4.1 Priority research projects incorporated into a research strategy, projects completed and reports produced

Research should be designed to increase understanding of Mabi Forest management and recovery issues to better inform future management decisions. Research priorities will be developed and where possible linked to existing programs within research institutions. The

recovery team will liaise with research groups to facilitate their involvement in leading Mabi Forest research projects. Research priorities include:

- the ecological impact of weed species;
- long-term maintenance of species diversity in remnants;
- the role of disturbance in regeneration of the community;
- maintenance of ecological processes such as pollination and seed dispersal;
- the use of fragmented landscapes by wildlife;
- assessment of the biological/ecological value of regrowth, modified and/or disturbed vegetation;
- identifying the fragmentation, patch size and connectivity thresholds for maintenance of biodiversity and ecosystem processes;
- best land rehabilitation practices and their costs and benefits in environmental, social and economic terms;
- monitoring tools and approaches to assess landscape and ecosystem health; and
- application of traditional ecological knowledge in Mabi Forest recovery; how can it best be recorded, integrated and used in a culturally appropriate way.

Potential contributors: EPA, CSIRO, WTMA, DMR, research institutions, community groups and Traditional owners.

Action 4.2 Monitor condition and biodiversity of key sites biannually

Performance criterion 4.2 Monitoring program established and implemented at key sites and regular research and monitoring reports completed and disseminated to stakeholders

Monitoring components of Mabi Forest ecology is crucial in assessing recovery of this ecosystem and in assessing effectiveness of management actions. A number of long-term monitoring sites are to be established in remnant and rehabilitating Mabi Forest sites. Identification and establishment of these sites will be determined in part by outcomes of Action 1.2. Monitoring of vegetation (including floristic diversity, structural characteristics, disturbance, foliage cover) as well as abiotic parameters should occur. Species of conservation significance will also be targeted and their populations monitored. The monitoring program will facilitate community participation.

Potential contributors: EPA, FNQNRM, DMR, community groups and Traditional owners.

Action 4.3 Assess the effectiveness of rehabilitated areas in restoring ecological processes

Performance criterion 4.3 A study completed assessing the effectiveness of rehabilitated areas and a report prepared

To assess the effectiveness of corridors in re-establishing remnant habitat, facilitating wildlife movement and restoring ecological processes, a corridor monitoring, research and management program will be established. While much effort has gone into restoration of fragmented landscapes, the effectiveness of various techniques used to restore biodiversity and associated ecological functions remains largely unassessed (Tucker 2000). Appropriate corridor lengths, widths and intrinsic resources necessary to facilitate dispersal of key species are largely unknown at this stage; there is a paucity of empirical data on faunal corridors in the tropics (Laurance 1990, Laurance and Laurance 1999).

Potential contributors: EPA, research institutions, FNQNRM, community groups and Traditional owners.

Action 4.4 Maintain an information and GIS database on Mabi Forest and dependent key species

Performance criterion 4.4 The Mabi Forest GIS database is up-to-date and all information is available to relevant parties

A database is developed and maintained to support implementation of the recovery plan. A Mabi Forest database has been established by EPA. This database is readily available to inform management decisions including habitat distribution mapping, and threatened species

management, development assessment and other planning matters. The database should be expanded to incorporate all new data collected through the life of this recovery plan. The need for ongoing reporting of Mabi Forest wildlife sightings to EPA by the wider community will continue to be publicised and encouraged. Appropriate GIS layers will also be developed to inform recovery actions.

Potential contributors: EPA, local councils, FNQNRM, WTMA and local community.

Specific objective 5: Develop public awareness of, and facilitate community participation in Mabi Forest recovery

Action 5.1 Promote and facilitate community and landholder involvement in recovery actions by raising community awareness

Performance criterion 5.1 Level of community involvement in recovery actions has measurably improved over the life of plan and the current range of public educational materials updated and disseminated to community

Mabi Forest is a high profile ecological community that attracts considerable interest and conservation support in the Atherton Tableland community. The Mabi Forest Recovery Team, community conservation groups and tree planting groups have been active for many years promoting Mabi Forest conservation issues and undertaking much on-ground conservation work. These community groups and dedicated individuals will continue to be supported. Habitat restoration, monitoring, education and other programs identified in this recovery plan should, where possible, continue to involve landholders, schools, Indigenous communities and community conservation and other action groups. The development and implementation of corridor restoration plans will be a major conduit for community involvement and it is expected that many of these projects will be led by community groups and funded through community grant programs.

This action will also seek to raise the level of community awareness and understanding of Mabi Forest conservation issues by developing and disseminating appropriate information and educational materials to land managers, schools, tourists and the wider community. A variety of Mabi Forest information material has been produced by various public agencies and community conservation groups. All existing material is to be reviewed and evaluated and, if necessary, updated or new material developed. Up-to-date reference material should be collated and distributed to local libraries and other information providers throughout the local area as well as to DEWHA, EPA, WTMA, local government and community groups' websites. Media publicity on Mabi Forest conservation and the role of the recovery plan will continue to be sought. Educational projects promoting Aboriginal culture and Mabi Forest conservation will be particularly encouraged and supported.

Potential contributors: EPA, WTMA, FNQNRM, community groups and Traditional owners.

Action 5.2 Facilitate Aboriginal participation and the use of traditional knowledge in Mabi Forest recovery

Performance criterion 5.1 Aboriginal interests in recovery of Mabi Forest have been identified and involvement facilitated as required

The value and importance of Aboriginal traditional knowledge and the cultural responsibilities of Aboriginal people to care for country cannot be overlooked in the development and implementation of recovery actions. Aboriginal people wish to be actively involved in the management and protection of the Mabi Forest and their participation can result in mutually beneficial sharing of knowledge, greatly enhancing its recovery. As loss and fragmentation of the landscape has had significant impacts on Aboriginal cultural landscape values, efforts to recover Mabi Forest will help in restoring these values and healing country. Implementation of this plan will require comprehensive negotiation and consultation with Aboriginal communities to facilitate their participation. A priority action is to establish a consultative protocol from which the future engagement of Aboriginal communities in the recovery plan will be directed. Protocols regarding

the use and application of traditional ecological knowledge in Mabi Forest recovery; how can it best be recorded, integrated and used in a culturally appropriate way, may also be negotiated. Intellectual and cultural property protocols for collection, use, access and storage of information will be developed. Aboriginal communities will continue to be represented on the Recovery Team.

Potential contributors: EPA, WTMA, FNQNRM, community groups and Traditional owners.

Specific objective 6: Manage the recovery program

Action 6.1 Ensure recovery plan implementation is coordinated effectively

Performance criterion 6.1 Recovery team meets regularly and successfully communicates outcomes of meetings to stakeholders and a recovery plan implementation schedule is in place

To guide implementation of this plan, a comprehensive implementation schedule will be developed by the Recovery Team upon the plan's approval. Implementation of this recovery plan will be monitored and reviewed by the Recovery Team. Communication to stakeholders will be facilitated through the dissemination of meeting minutes, reports and other relevant information to Recovery Team. Reporting will also be provided to relevant agencies and funding organisations.

Potential contributors: EPA with Recovery Team.

Action 6.2 Review the recovery plan

Performance criterion 6.2 An independent review of the recovery plan completed

Annual reviews will provide an opportunity to monitor progress of recovery actions and provide direction to any actions that may be necessary in the future. Prior to expiration of plan a major five-year review of the recovery plan will be undertaken in accordance with EPBC Act requirements. This will be done by an external reviewer in consultation with the Recovery Team.

Potential contributors: DEWHA and consultant.

Table 3: Summary of relationship between objectives, performance criteria, actions and potential contributors.

Objectives	Performance Criteria	Actions	Potential contributors	P^a
1 Identify and evaluate the extent and quality of Mabi Forest and component species	1.1 Mabi Forest extent identified and map produced at 1:10,000 scale	1.1 Map extent of remnant and rehabilitating Mabi Forest and other vegetation communities within Mabi pre-clearing extent	EPA, WTMA, DNRW, DMR	1
	1.2 Biodiversity surveys and condition assessment of fragments undertaken, priority rankings assigned and report produced	1.2 Undertake biodiversity surveys of Mabi Forest fragments to assess condition for priority protection and management	EPA, FNQNRM, research institutions, WTMA, local councils, community groups, TOs, DMR	1
2 Enhance planning, management and conservation of Mabi Forest	2.1 A review of current planning instruments completed and organisations involved in planning, management and development control of Mabi Forest have incorporated these matters into relevant planning documentation	2.1 Review and evaluate the regional planning framework to ensure that conservation of Mabi Forest is promoted and incorporated appropriately in planning, management and development assessment	EPA, local councils, DMR, FNQNRM and WTMA	2
	2.2 Conservation measures for private land identified and additional areas of Mabi Forest are protected and being managed by landholders	2.2 Investigate strategies to enhance protection and management of Mabi Forest on private lands	FNQNRM, EPA, WTMA, Department of Local Government, Planning, Sport and Recreation (DLGPSR), DNRW, local councils, community groups, TOs	2
	2.3 Management plans for key remnants developed and recommendations implemented	2.3 Support the development and implementation of site-specific management plans for Mabi Forest fragments	EPA, FNQNRM, WTMA, DNRW, DMR, landholders, local councils, community groups, TOs, Greening Australia	1
	2.4 Landholders of Mabi Forest remnants have implemented sustainable, recovery focused land management practices	2.4 Encourage landholders to develop and implement land management practices that are compatible with Mabi Forest recovery and agricultural sustainability	EPA, WTMA, DNRW, DPIF, landholders, local councils, community groups, FNQNRM, industry groups	1
3 Reduce threats to, and improve ecological condition of Mabi Forest fragments	3.1 Rehabilitation of high priority areas is under way, based on established priorities	3.1 Rehabilitate disturbed areas of Mabi Forest based on established priorities	EPA, FNQNRM, local councils, community groups, TOs	2
	3.2 Mabi Forest corridors are prioritised and restoration work of high priority corridors completed	3.2 Improve connectivity of Mabi Forest remnants at local and landscape scales	EPA, WTMA, FNQNRM, DNRW, DMR, local councils, community groups, TOs	1
	3.3 A Mabi Forest Weed Management Strategy developed and implemented by relevant land managers	3.3 Develop and implement a weed management strategy	EPA, DNRW, WTMA, FNQNRM, local councils, DMR	1
	3.4 Appropriate dog control programs and community education initiatives in place and a reduction in dog attacks recorded	3.4 Implement feral and domestic dog control to minimise attacks on Mabi Forest wildlife	EPA, DNRW, local councils, FNQNRM, community groups	3
	3.5 Strategies to minimise fauna road mortality incorporated in road planning, construction and management and a reduction in road mortality recorded	3.5 Minimise the impacts of roads and vehicles on Mabi Forest wildlife	EPA, WTMA, FNQNRM, research institutions, local councils, DMR	2
	3.6 Post-cyclone Mabi Forest management response strategy developed	3.6 Develop and implement if required a post-cyclone response strategy	EPA, WTMA, FNQNRM, research institutions, local councils	3

4 Implement a monitoring and research program to inform conservation management decisions	4.1 Priority research projects incorporated into a research strategy, projects completed and reports produced	4.1 Identify information needs and design and conduct research on Mabi Forest	EPA, CSIRO, WTMA, research institutions, community groups, TOs, DMR	1
	4.2 Monitoring program established and implemented at key sites and regular research and monitoring reports completed and disseminated to stakeholders	4.2 Monitor condition and biodiversity of key sites biannually	EPA, FNQNRM, community groups, TOs, DMR	1
	4.3 A study completed assessing the effectiveness of rehabilitated areas and a report prepared	4.3 Assess the effectiveness of rehabilitated areas in restoring ecological processes	EPA, research institutions, FNQNRM, community groups, TOs	2
	4.4 The Mabi Forest GIS database is up-to-date and all information is available to relevant authorities	4.4 Maintain an information and GIS database on Mabi Forest and dependent key species	EPA	3
5 Develop public awareness of, and facilitate community participation in Mabi Forest recovery	5.1 Level of community involvement in recovery actions has measurably improved over the life of plan and the current range of public educational materials updated and disseminated to community	5.1 Promote and facilitate community and landholder involvement in recovery actions by raising community awareness	EPA, WTMA, FNQNRM, community groups, TOs	1
	5.2 Aboriginal interest in recovery of Mabi Forest has been identified and involvement facilitated as required	5.2 Facilitate Aboriginal participation and the use of traditional knowledge in Mabi Forest recovery	EPA, WTMA, FNQNRM, community groups, TOs	1
6 Manage the recovery program	6.1 Recovery team meets regularly and successfully communicates outcomes of meetings to stakeholders and a recovery plan implementation schedule is in place	6.1 Ensure recovery plan implementation is coordinated effectively	EPA with Recovery Team	2
	6.2 An independent review of the recovery plan completed	6.2 Review the recovery plan	DEWHA and consultant	3

a: **P = Priority ranking** 1 = High priority, 2 = Medium priority, 3 = Low priority

5. Management practices

Due to the extent and fragmented nature of remnant Mabi Forest, further clearing of any fragments will have an adverse impact on the ecological community. Selective logging should be discouraged in order to maintain the ecological integrity of remnant and regrowth fragments.

The *Vegetation Management Act 1999* (VMA) through the draft Regional Vegetation Management Code for Coastal Bioregions regulates and restricts clearing of Mabi Forest as Regional Ecosystems 7.8.3 and 7.3.37. Applications for clearing activities assessable under the VMA need to refer to the Code to identify the applicable part relevant to the nature of the proposed activity, including the performance requirements.

Distribution of Mabi Forest is identified and mapped as RE 7.8.3 and RE 7.3.37 by the Environmental Protection Agency. The distribution of Mabi Forest will continue to be used to assess applications to clear remnant vegetation, tenure dealings and development applications under the draft regional vegetation management codes. Mapping of Mabi Forest will be updated regularly in line with changes to the EPA's Wet Tropics regional ecosystem mapping.

6. Evaluation of recovery plan

Progress will be monitored and evaluated annually by the recovery team. An independent external reviewer will be contracted to review and evaluate performance of the recovery plan within five years from adoption as a national recovery plan.

7. Costs of recovery

Table 4: Estimated cost of recovery (\$ per annum)

Action	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
1.1 Map extent of remnant and rehabilitating Mabi Forest and other vegetation communities within Mabi pre-clearing extent	15,000	5000	0	0	0	20,000
1.2 Undertake biodiversity surveys of Mabi Forest fragments to assess condition for priority protection and management	15,000	15,000	15,000	10,000	10,000	65,000
2.1 Review and evaluate the legislative and regional planning framework to ensure that conservation of Mabi Forest is promoted and incorporated appropriately in planning, management and development assessment	7000	7000	2000	2000	2000	20,000
2.2 Investigate strategies to enhance protection and management of Mabi Forest on private lands	5000	10,000	10,000	10,000	10,000	45,000
2.3 Support the development and implementation of site-specific management plans, including species specific actions, for Mabi Forest fragments	5000	10,000	10,000	10,000	10,000	45,000
2.4 Encourage landholders to develop and implement land management practices that are compatible with Mabi Forest recovery and agricultural sustainability	9000	12,000	22,000	22,000	22,000	87,000
3.1 Rehabilitate disturbed areas of Mabi Forest based on established priorities	5,000	15,000	15,000	15,000	15,000	65,000
3.2 Develop and implement a weed management strategy	5000	10,000	10,000	10,000	10,000	45,000
3.3 Implement feral and domestic dog control to minimise attacks on Mabi Forest wildlife	5000	5000	5000	5000	3000	23,000
3.4 Minimise the impacts of roads and vehicles on Mabi Forest wildlife	3000	5000	10,000	1000	1000	20,000
3.5 Develop and implement if required a post-cyclone response strategy	2000	2000	0	0	0	4000
3.6 Improve connectivity of Mabi Forest remnants at local and landscape scales	5000	20,000	20,000	20,000	20,000	85,000
4.1 Identify information needs and design and conduct research on Mabi Forest	3000	10,000	10,000	10,000	10,000	43,000
4.2 Monitor condition and biodiversity of key sites biannually	5000	5000	5000	5000	5000	25,000
4.3 Assess the effectiveness of rehabilitated areas in restoring ecological process	3000	5000	5000	5000	5000	23,000
4.4 Maintain an information and GIS database on Mabi Forest and dependent key species	1000	1000	1000	1000	1000	5000
5.1 Promote and facilitate community and landholder involvement in recovery actions by raising community awareness	5000	10,000	10,000	5,000	5,000	35,000
5.2 Facilitate Aboriginal participation and the use of traditional knowledge in Mabi Forest recovery	5000	10,000	10,000	10,000	5000	40,000
6.1 Ensure recovery plan implementation is coordinated effectively	2000	2000	2000	2000	2000	10,000
6.2 Review the recovery plan	0	0	0	0	5000	5000
TOTAL (\$)	105,000	159,000	162,000	143,000	141,000	710,000

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Appendix A

Recovery team membership

Representatives from each of the following groups have been involved in the preparation of this recovery plan.

Environmental Protection Agency
Department of Natural Resources and Water
Atherton Shire Council
Eacham Shire Council
Wet Tropics Management Authority
Scientific experts
Yidinji
Ngadjonji
FNQ NRM Ltd.
Tree Kangaroo and Mammal Group Inc.
Trees for Evelyn and Atherton Tablelands
School for Field Studies
Barron River Integrated Catchment Management Association
Community representatives
Private landholders