Approved NSW & National

Recovery Plan

Ripple-leaf Muttonwood (*Rapanea* species A Richmond River)

July 2004

Department of
Environment and Conservation (NSW)

Natural Heritage Trust
Helping Communities Helping Australia
A Commonwealth Government Initiative

NSW Department of Environment and Conservation
43 Bridge Street
(PO Box 1967)
Hurstville NSW 2220
Tel: 02 9585 6444
www.nationalparks.nsw.gov.au

Requests for information or comments regarding the recovery program for the Ripple-leaf Muttonwood (*Rapanea* species A Richmond River) are best directed to:

The Ripple-leaf Muttonwood Recovery Co-ordinator
Threatened Species Unit, North East Branch
NSW Department of Environment and Conservation
Locked Bag 914
Coffs Harbour NSW 2450
Tel: 02 6651 5946

Cover illustrator: Kersten Tuckey

This plan should be cited as follows:

NSW Department of Environment and Conservation (2004), Approved *Recovery Plan for the Ripple-leaf Muttonwood* (Rapanea *species A Richmond River*), NSW Department of Environment and Conservation, Hurstville.

ISBN 1741221382

Recovery Plan for the Ripple-leaf Muttonwood (*Rapanea* species A Richmond River)

Executive Summary

This document constitutes the formal National and New South Wales State Recovery Plan for the Ripple-leaf Muttonwood (*Rapanea* species A Richmond River (J.H. Maiden & J.L. Boorman NSW 26751)) and, as such, considers the conservation requirements of the species across its known range. It identifies the actions to be taken to avoid the extinction of the Ripple-leaf Muttonwood and promote its viability in the wild.

Rapanea species A Richmond River is included as Endangered on the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999, and as Endangered on the New South Wales *Threatened Species Conservation Act* 1995. The Ripple-leaf Muttonwood is a small, evergreen tree or shrub that appears to reproduce both by suckering and producing fruit. It grows in soils developed from or enriched by tertiary volcanics. It occurs in the vegetation communities of tall open sclerophyll forest with a rainforest subcanopy, swamp sclerophyll open forest and on the margins of subtropical rainforest. The species occurs only in New South Wales and is currently known from three populations within the Richmond River and Clarence River catchments. The species was thought to be extinct until it was rediscovered on the Richmond River floodplain in 1997.

The future recovery actions detailed in this Recovery Plan include: (i) the development and distribution of environmental survey guidelines and a field identification key; (ii) liaison between the Department of Environment and Conservation (NSW) and relevant landholders and Councils; (iii) installation of roadside markers where the species is likely to be affected by maintenance of road verges; (iv) site assessment of the most recently discovered population in Mallanganee National Park; (v) scientific monitoring and research into the biology and ecology of the species; (vi) incorporation of new information on the species into relevant management plans; (vii) continuation of weed control and bush regeneration programs in known Ripple-leaf Muttonwood habitat in conservation reserves; (viii) exclusion of fire from known Ripple-leaf Muttonwood habitat; (ix) targeted surveys; and (x) maintenance of an *ex-situ* living and seed bank collection.

It is intended that this Recovery Plan will be implemented over a five year period. The New South Wales Department of Environment and Conservation (NSW) will be the agency responsible for implementing the proposed actions.

LISA CORBYN

Director-General

BOB DEBUS MP

Minister for Environment

Acknowledgments

The Department of Environment and Conservation (NSW) would like to thank:

Lyn McRae (Department of Environment and Conservation (NSW)) for preparation of the Draft Recovery Plan.

Stephanie Horton (Botanist) for survey work and rediscovery of the species, development of a field identification key, preparation of an early version of the Draft Recovery Plan and comments on the final Recovery Plan.

Kersten Tuckey for review and edit of the final Recovery Plan. Maria Matthes, Dave Charley and Lynn Baker from the Department of Environment and Conservation (NSW), for assisting with the preparation of the Draft Recovery Plan.

Katrina McKay and Deirdre Rogers (Department of Environment and Conservation (NSW)) for final editing and publication design.

The Department of Environment and Heritage for contributing funds for the preparation of this plan and for the implementation of previous actions to enhance the recovery of the species.

Alex Floyd (Botanist), Betsy Jackes (Associate Professor, James Cook University), Dr Geoff Williams (Associate of the Australian Museum), John Hunter, Graham Reid, Rosemary Joseph, Dennis Sellars (Department of Environment and Conservation (NSW)) and Department of Environment and Conservation (NSW) Northern Rivers Region staff for discussions.

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1 Introduction

The Ripple-leaf Muttonwood (*Rapanea* sp. A Richmond River, J.H. Maiden & J.L. Boorman NSW 26751) is a small, evergreen tree or shrub that grows to 5 metres high and occurs in tall open sclerophyll forest with a rainforest subcanopy, swamp sclerophyll open forest and on the margins of subtropical rainforest. It occurs in north-eastern New South Wales (NSW) and is currently only known from three populations within the Richmond River and Clarence River catchments. The species was thought to be extinct until it was rediscovered on the Richmond River floodplain in 1997. The species has not yet been formally described, the scientific name for the species will change when this occurs.

This document constitutes the formal National and State Recovery Plan for the Ripple-leaf Muttonwood and, as such, considers the conservation requirements of the species across its known range. It identifies the actions to be taken over the next five years by the Department of Environment and Conservation (NSW) (DEC) to enhance the long-term viability of the Ripple-leaf Muttonwood in nature. The implementation of the proposed actions of this plan is subject to budgetary and other constraints affecting the DEC.

2 Legislative Context

2.1 Legal Status

The Ripple-leaf Muttonwood is listed as Endangered in the NSW *Threatened Species Conservation Act* 1995 (TSC Act). It is listed as Endangered in the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) under the name *Rapanea* sp. Richmond River (J.H. Maiden & J.L. Boorman NSW 26751). Prior to 19 December 1997, *Rapanea* sp. A Richmond River was listed on Part 4 of Schedule 1 of the TSC Act as a species that was presumed to be extinct.

In this plan, *Rapanea* sp. A Richmond River; *Rapanea* sp. Richmond River; *Rapanea* sp. 1; *Rapanea* sp. A "Myrsine richmondi" m/s B Jackes ; Lismore Muttonwood and Purple-leaf Muttonwood are all synonymous with Ripple-leaf Muttonwood.

2.2 Responsibilities under the *Threatened Species Conservation Act* 1995

Recovery plan preparation, exhibition and implementation

The TSC Act provides a legislative framework to protect and encourage the recovery of Endangered and Vulnerable Species, Endangered Populations and Endangered Ecological Communities in NSW. Under this legislation the Director-General of the DEC has a responsibility to prepare Recovery Plans for all species, populations and ecological communities listed as Endangered or Vulnerable on the TSC Act schedules. The TSC Act includes specific requirements for both the matters to be addressed by Recovery Plans and the process for preparing Recovery Plans. This Recovery Plan satisfies these provisions.

The TSC Act requires that a government agency must not undertake actions inconsistent with a Recovery Plan. The actions identified in this plan for the recovery of the Ripple-leaf Muttonwood in NSW are the responsibility of the DEC. Other public authorities may have statutory responsibilities relevant to the conservation and protection of Ripple-leaf Muttonwood. Public authorities with core legislative responsibilities relevant to the protection and management of Ripple-leaf Muttonwood and its habitat are listed in Appendix 1.

Consultation with indigenous people

Local Aboriginal Land Councils, Elders and other groups representing indigenous people in the areas where the Ripple-leaf Muttonwood occurs have been identified and a copy of the Recovery Plan sent to them. Their comments on this draft have been sought and have been considered in the preparation of the final Recovery Plan. It is also the intention of the DEC to consider the role and interests of these indigenous communities in the implementation of the actions identified in this plan.

Endangered Ecological Communities

The listing under the TSC Act of Lowland Rainforest on Floodplain in the NSW North Coast bioregion as an Endangered Ecological Community also affords a level of protection to some areas of Ripple-leaf Muttonwood habitat.

Critical Habitat

The TSC Act makes provision for the identification and declaration of Critical Habitat for species, populations and ecological communities listed as Endangered. Once declared, it becomes an offence to damage Critical Habitat (unless the action is specifically exempted by the TSC Act) and a Species Impact Statement (SIS) is mandatory for all

developments and activities proposed within Critical Habitat.

To date, Critical Habitat has not been declared for the Ripple-leaf Muttonwood under the TSC Act. The declaration of Critical Habitat in NSW is not considered to be a priority for this species at this stage, as other mechanisms provide for its protection.

Key Threatening Processes

As of May 2004, 22 Key Threatening Processes have been identified and listed on the TSC Act. Of these, the 'Clearing of Native Vegetation' (NSW Scientific Committee 2001) is relevant to the Ripple-leaf Muttonwood and its habitat. In addition to this, a range of other processes are recognised as threatening the survival of the species. These are discussed in section 4.

Licensing

Any activity not requiring development consent under the NSW *Environmental Planning and Assessment Act* 1979 (EP&A Act) or the NSW *Native Vegetation Act* 2003 (NV Act), which is likely to "pick" the Ripple-leaf Muttonwood, or damage its habitat, requires a licence from the DEC under the provisions of the TSC Act or the *National Parks and Wildlife Act* 1974 (NPW Act) as a defence against prosecution. If the impact is likely to be significant, a Species Impact Statement is required.

Other conservation measures

The TSC Act includes provision for other measures that may be taken to conserve the Ripple-leaf Muttonwood and its habitat, including the making of a Stop Work Order or Joint Management Agreement.

2.3 *Environment Protection and Biodiversity Conservation Act* 1999

The EPBC Act provides a legislative framework for the protection of threatened species across Australia. An important role of the EPBC Act is to facilitate the preparation and implementation of Recovery Plans for species listed under the Act in co-operation with the States and Territories in which populations of listed species occur. The Act also seeks to impose the obligation (arising from the listing) for responsible agencies (particularly Commonwealth) to adopt protective measures. This Recovery Plan has been submitted to the Commonwealth for approval under the EPBC Act.

Under the EPBC Act, Critical Habitat may be registered for any Nationally listed threatened species or ecological community. When adopting a Recovery Plan, the Commonwealth Minister for the Environment and Heritage must consider whether to list habitat identified in the Recovery Plan as being critical to the survival of the species or ecological community. It is an offence under the EPBC Act for a person to knowingly take an action that will significantly damage Critical Habitat (unless the EPBC Act specifically exempts the action). This offence only applies to Commonwealth areas. However, an action that is likely to have a significant impact on a listed species is still subject to referral and approval under the EPBC Act. Proposed actions within Critical Habitat on non-Commonwealth areas are likely to receive additional scrutiny by the Commonwealth Minister.

This Recovery Plan does not specifically identify an area of habitat that is critical to the survival of Ripple-leaf Muttonwood. However, the distribution, habitat and ecological information included in this plan (Sections 3.2–3.5) would assist the Commonwealth Minister for the Environment in identifying habitat that is critical to the survival of this species. The DEC does not consider it appropriate that this Recovery Plan identifies or maps the occurrence of this species in the detail that would be required to define Critical Habitat.

As the Ripple-leaf Muttonwood is listed Nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on this species should refer the action to the Commonwealth Minister for the Environment and Heritage for consideration. The Minister will then decide whether the action requires EPBC Act approval. This is in addition to any State or Local Government approval required.

Administrative guidelines are available from the Department of Environment and Heritage to assist proponents in determining whether their action is likely to have a significant impact.

2.4 Relationship to other legislation

Additional legislation relevant to the conservation and recovery of the Ripple-leaf Muttonwood in NSW includes the following:

- *National Parks and Wildlife Act* 1974;
- *Environmental Planning and Assessment Act* 1979;
- *Local Government Act* 1993;
- *Native Vegetation Act* 2003;
- *Rural Fires Act* 1997;
- *Rural Fires and Environmental Assessment Legislation Amendment Act* 2002; and
- *Forestry and National Park Estate Act* 1998.

3 Species Information

3.1 Taxonomy and description

Eleven species of the genus *Rapanea* occur in subtropical and tropical (eastern) Australia of which four are known to occur in NSW. However, it is proposed to reclassify many of the *Rapanea* species into the genus *Myrsine*, including the four species in NSW (B. Jackes, pers. comm.).

The Ripple-leaf Muttonwood has not yet been formally described, however, a description for the species is currently in preparation (B. Jackes, pers. comm.).

The Ripple-leaf Muttonwood is a small evergreen tree or large shrub to 5 m high. The bark is grey to greyish-brown, smooth when young and often roughened by old leaf and fruit bases in larger specimens.

The leaves are elliptic in shape with edges that are entire and usually strongly undulating in the adult leaves (hence 'ripple leaf'). The apex of the leaf is obtuse and the base wedge-shaped. Leaves are 5-14 cm long by 1.5-3 cm wide, simple and arranged alternately on the stem. The petiole (leaf stalk) is 3-5 mm, grooved and may be crimson or purple but is usually green. The midrib is raised on the upper surface of the basal third of the leaf. Clear or cream streaks are usually visible in the leaf and red-orange dots may also be visible (NPWS 1999).

Stems are generally rounded, with scattered hairs but often hairless. The terminal leaf bud is either hairless or has glandular, rusty or white coloured hairs only along its rim. The leaf bud may also have rusty coloured scales.

The flowers of the Ripple-leaf Muttonwood are small, greenish-white with prominent glands. The inflorescence is much shorter than the leaves and is inconspicuous. The flowers are unisexual with parts in multiples of five. The calyx is deeply lobed and persistent. Flowering has been observed in spring and summer.

The fruit is a blue drupe 3-4 mm in diameter and consists of a single round seed wrapped in a very thin coating of flesh. The pedicel (fruit stem) is 2-4 mm and hairless. Orange to red glands are common on young fruits, concentrated towards the apex. Several drupes, each on its own stalk, arise from a single point.

The Ripple-leaf Muttonwood can be distinguished from the more common *Rapanea howittiana and R. variabilis*. Features used to distinguish the species are the size of the drupe which is 3-4 mm on the Ripple-leaf Muttonwood and 4-8 mm for the other species, and the leaf margin of juvenile leaves which is entire on the Ripple-leaf Muttonwood and toothed on the other species. The leaf texture is also a distinguishing feature, the texture of Ripple-leaf Muttonwood leaves is fine as opposed to being rubbery as they are for *R. howittiana* or tough like those of *R. variabilis* (Horton 2000).

3.2 Distribution and population size

The Ripple-leaf Muttonwood occurs only within the NSW North Coast Bioregion. For functional reasons the International Union for the Conservation of Nature and Natural Resources (IUCN) expresses a population number as the number of mature individuals only. "Mature individuals" is defined as the number of individuals known, estimated or inferred to be capable of reproduction (IUCN 2001). However, to indicate the relative size of the Ripple-leaf Muttonwood populations, both total number of observed plants and estimated number of mature individuals are discussed in this plan. There are three extant populations of the Ripple-leaf Muttonwood which occur within the Richmond River and Clarence River catchments.

Estimating the number of individual plants is difficult as the Ripple-leaf Muttonwood occurs in clusters with many of the stems being suckers from the lateral roots of a parent plant. Each stem or group of stems observed arising from one point in the ground is considered one plant for the purposes of indicating the relative size of the populations. The number of genetically different plants is unknown but is most probably much fewer than the number of plants observed.

One population was found in 1997, located on private property containing a tributary to the Richmond River, near the locality of Tatham. This population consists of at least four plants (Horton 1999a). All of these plants are less than 2 m high. The area of occupancy of this population is 4 m^2.

Figure 1 Locations of known populations of Ripple-leaf Muttonwood

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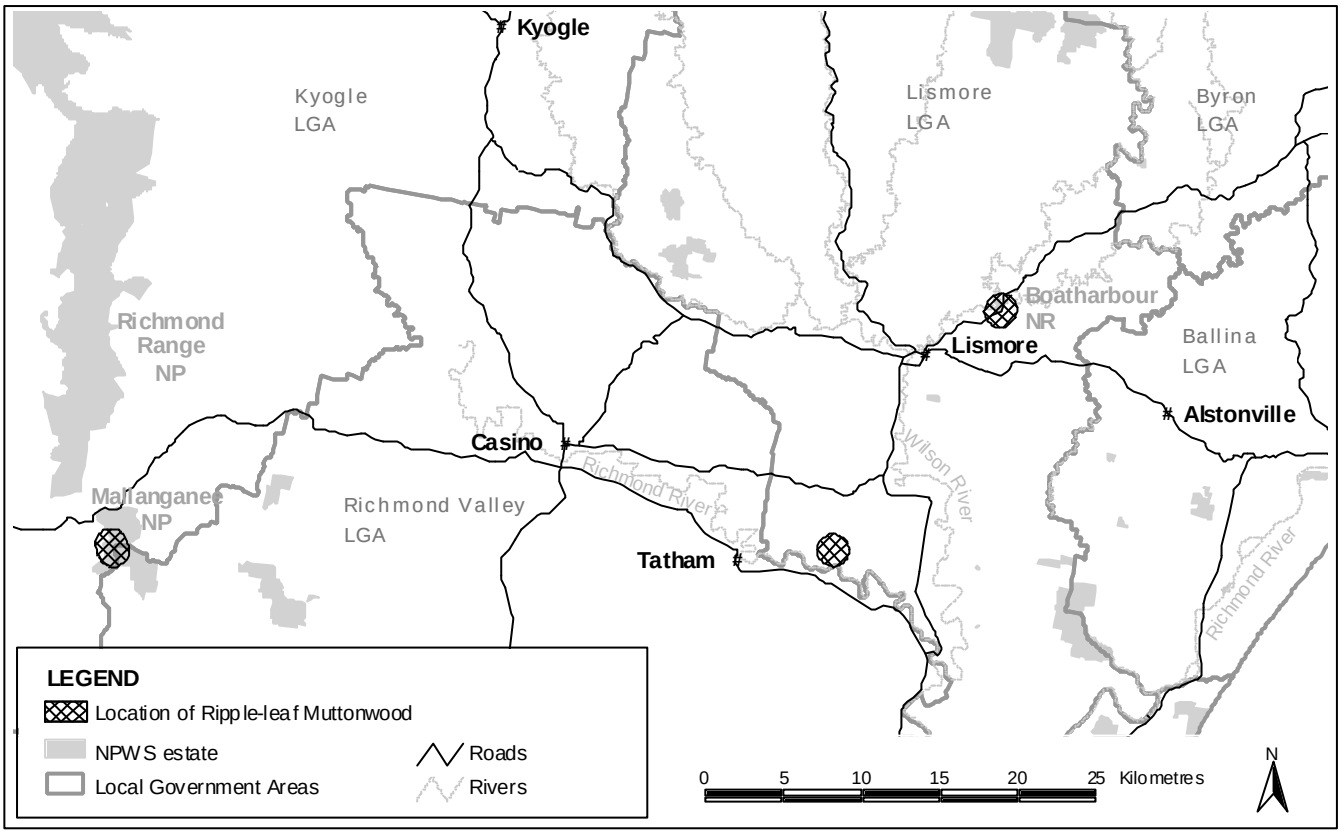

A second population was found in 1998, located in Boatharbour Nature Reserve, adjacent to the Bangalow Road, near the town of Lismore. This population consists of approximately 33 plants (Horton 1999a, Joseph 2000c), including four plants that are large enough to be mature, i.e. greater than 2 m high. The area of occupancy of this population is no more than 250 m^2.

The largest known population was found in 1999, located in Mallanganee National Park, west of the town of Casino (Horton 1999b). The population is estimated to be in excess of 370 plants, including at least twelve plants that are large enough to be mature, i.e. over 2 m high. The area of occupancy of this population is no more than 1500 m^2.

The known distribution of the species has contracted significantly during the last century. Five botanical samples of the Ripple-leaf Muttonwood that were collected between 1876 and 1903 provide evidence that the species occurred in the Richmond and Tweed River catchments during this period. Two samples of Ripple-leaf Muttonwood were collected by Glen Holmes in 1986 from the Cambridge Plateau (Clarence River catchment) and Ruthven (south of Lismore), however these populations are presumed extinct (Horton 1997). The species was not found again for many years and the Ripple-leaf Muttonwood was presumed extinct until it was rediscovered on the Richmond River floodplain in 1997 (Horton 1997).

3.3 Land tenure

One of the three populations of Ripple-leaf Muttonwood occurs on private property near Tatham. The forest remnant that contains the species is Zoned 7a Environmental Protection (natural vegetation and wetlands) in the Lismore Local Environmental Plan 2000.

The other two populations occur in Boatharbour Nature Reserve and Mallanganee National Park, both of which are managed by the DEC.

3.4 Habitat

Topography

The Ripple-leaf Muttonwood is known to occur at two distinctly different topographical positions within the Richmond River and Clarence River catchments. The Mallanganee population occurs on an upper slope on the western side of the Richmond Range, in the east of the Clarence River catchment. The Boatharbour and Tatham populations occur on the alluvial flats of the floodplains of the Richmond River catchment.

The altitude of known occurrences of the Ripple-leaf Muttonwood ranges from 10 m to 400 m above sea level. Aspect does not appear to be a determining factor.

Soil and ground water

The Ripple-leaf Muttonwood is known to occur on:

- Focal Peak tertiary volcanics,

- Floodplains enriched with Focal Peak volcanics, and
- Floodplains enriched with either or both the Focal Peak and Mount Warning volcanics.

The soils of the habitat on the Richmond Range near Mallanganee are krasnozems and chocolate basalt loams, which are fertile, relatively stable and well drained. The Ripple-leaf Muttonwood has not been found on the nearby, less fertile soils that developed from the exposed sedimentary (sandstone, siltstone and shale) parent material.

The soils of the habitat on the floodplain are alluvial krasnozem, with a higher clay content than pure krasnozem thus contributing to the high water holding capacity (Floyd 1977).

All locations where the species is known to occur are subject to water stress, either that of extended dry periods and/or periods of inundation. In upland areas, soil saturation may result from extended periods of high rainfall while in lowland areas it may either be associated with localised heavy rain or widespread flooding.

Climate

The Ripple-leaf Muttonwood habitat on the Richmond Range experiences a subtropical climate characterised by relatively high rainfall and high temperatures from December to March, and a dry season with cold nights and mild days from June to September. The average annual rainfall between 1936 to 1982 for Urbenville, within the Focal Peak region of the Richmond range, was 1056 mm.

The Ripple-leaf Muttonwood habitat on the floodplain has a similar pattern of rainfall to that on the range but the floodplain populations may be subjected to frosts during winter.

Vegetation

Richmond Range

On the Richmond Range near Mallanganee, the Ripple-leaf Muttonwood is known to occur in tall open forest dominated by Brush Box (*Lophostemon confertus*), Blue Gum (*Eucalyptus saligna*) and Tallowwood (*E. microcorys*) with a rainforest subcanopy (Horton 1999b; NPWS 2002). In places this forest type abuts the subtropical (Floyd 1990) dominated by White Booyong (*Argyrodendron trifoliatum*). The Ripple-leaf Muttonwood may also occur in this vegetation community.

Richmond River Floodplain

The native vegetation of the Richmond River floodplain is a complex mosaic of alluvial subtropical and dry rainforest (lowland floodplain rainforest), swamp sclerophyll forests and tall woodland. The Ripple-leaf Muttonwood is currently known to grow on the margins of lowland floodplain rainforest, where a rainforest subcanopy or understorey is maintained. The Endangered Ecological Community of Lowland Rainforest on Floodplain is part of the habitat of the Ripple-leaf Muttonwood.

Of the two populations of the Ripple-leaf Muttonwood that occur on floodplain areas, one is known to occur in open swamp sclerophyll forest dominated by Prickly Paperbark (*Melaleuca stypheloides*) (Horton 1999a). The other population occurs in rainforest containing Whalebone tree (*Streblus brunonianus*) in association with Sweet Myrtle (*Austromyrtus fragrantissima*) (Horton 1999a). This rainforest vegetation community merges with a community characterised by Pepperberry (*Cryptocarya obovata*), *Dendrocnide exselsa*, *Ficus* spp. and Hoop Pine (*Araucaria cunninghamii*), so it is likely that this also forms part of the habitat of the Ripple-leaf Muttonwood (Floyd 1990).

A more comprehensive list of the plant species currently associated with Ripple-leaf Muttonwood can be found in Appendix 2.

Other variables - light

The Ripple-leaf Muttonwood is found in areas with high light levels (Horton 2000). This light regime is generally associated with open forest, forest margins or forest gaps but may also be associated with a regenerating forest. Forest gaps and margins are ephemeral. Over time, a denser forest canopy may develop and prevent Ripple-leaf Muttonwood from effectively flowering, this has been observed in individuals growing under a dense canopy (Horton 1999a).

3.5 Life history and ecology

The life history and ecology of the Ripple-leaf Muttonwood is largely unknown. The following information is based on limited field surveys and opportunistic field observations by botanists and DEC staff. Knowledge of other, apparently closely related, species of *Rapanea* that occur in NSW and south-east Queensland is also used to suggest how the plants may reproduce and disperse.

Life history

The Ripple-leaf Muttonwood appears to rely on both seed production and suckering for reproduction. The relative contributions of suckers and seedlings to reproduction in the wild are unknown.

Vegetative reproduction

The Ripple-leaf Muttonwood has been observed to sucker from the lateral roots of a parent plant. At the populations at Boatharbour and Mallanganee

radiating lines of younger plants have been observed clustered around a larger plant (Reid pers.comm.).

Suckering has also been observed in other species of *Rapanea*, i.e. Brush Muttonwood (*R. howittiana*) (Horton 1999a) and Variable Muttonwood (*R. variablis*) (Floyd pers. comm.).

Flower and fruit production

Flowering in Ripple-leaf Muttonwood has been recorded as occurring from October to December, but the species probably flowers as early as September (Jackes pers. comm.). No systematic records of flowering phenology of the Ripple-leaf Muttonwood have been collected.

Horton (1999a) has speculated that the Ripple-leaf Muttonwood requires a relatively high light regime to trigger flowering. It has been observed in Brush Muttonwood populations that plants growing on forest edges flowered and fruited, while at the same time healthy mature trees under a forest canopy were not reproducing (Horton 1999a).

The period of fruit production of the Ripple-leaf Muttonwood is not well known. Fruit have been recorded in November (Jackes pers. comm.) and there is anecdotal evidence of fruit on a plant in early January 2000.

Pollination

The pollination mechanisms of the Ripple-leaf Muttonwood are not understood. The species is probably insect-pollinated as it has small flowers in an inconspicuous inflorescence and others in the same genus are insect-pollinated.

Thrips pollinate both the Brush Muttonwood and Variable Muttonwood (Williams pers. comm.). However, these two species employ divergent breeding systems, the Brush Muttonwood being highly, and probably totally, self-incompatible, while the Variable Muttonwood is highly self-compatible.

Unfertilised flowers have been observed on Brush Muttonwood (Horton 1999a), suggesting that sometimes pollination does not occur.

Seed dispersal

The seed dispersal vectors of the Ripple-leaf Muttonwood are unknown. The fruit of the locally common Brush Muttonwood and Variable Muttonwood are eaten by Rose-crowned Fruit-doves (*Ptilinopus regina*) and Lewin's Honeyeaters (*Meliphaga lewinii*) (Floyd 1989). The fruit of Ripple-leaf Muttonwood is blue as in other members of the genus and it occurs in the habitat of the aforementioned bird vectors, so it may be dispersed by similar means to those of other Muttonwoods.

Uneaten fruit are expected to fall and germinate near the parent plant and this would contribute to the clustered distribution.

Seed germination and seedling establishment

No information is currently available on seed viability or the conditions that favour germination of the Ripple-leaf Muttonwood. The growth rate of the Ripple-leaf Muttonwood is also unknown.

Ecology

Population structure

Ripple-leaf Muttonwood is known from an estimated 407 plants distributed across three populations. The number of genetically distinct plants is unknown but most probably substantially less than the total observed due to suckering.

Height and flowering observations can be used to derive an estimate of the number of mature individuals of Ripple-leaf Muttonwood. However some of the mature plants may be suckers. Anecdotal evidence of flowering in 2002 indicates there is at least one sexually mature plant in the Boatharbour population and three sexually mature plants in the Mallanganee population. There are at least 16 Ripple-leaf Muttonwood plants greater than 2 m high across all the known populations. It is therefore estimated that there are 4 to 16 mature individuals in the known population of Ripple-leaf Muttonwood.

The variety of height classes observed at the Mallanganee and Boatharbour populations (Horton 1999a, Horton 1999b) suggests that recruitment is occurring at these populations and this may include seedlings as well as suckers. This indicates that these populations have the potential to persist in their habitat.

Competition

The Ripple-leaf Muttonwood appears to be subject to direct competition from the weed Lantana (*Lantana camara*) as both species' preferred habitat include wet forest margins in areas with fertile soil. A number of Ripple-leaf Muttonwood plants have been found under dense Lantana in Mallanganee National Park. The response of the Ripple-leaf Muttonwood to release from competition with Lantana is being monitored by the DEC as part of a bush regeneration program in Mallanganee National Park.

Native plants that have been observed in Ripple-leaf Muttonwood habitat and that have the potential to compete with Ripple-leaf Muttonwood are:

- Basket Grass (*Oplismenus* sp.)
- Cockspur (*Maclura cochinchinensis*),
- Slender Grape (*Cayratia clematidea*) and

- Water Vine/ Native Grape (*Cissus antarctica*).

As discussed previously, competition with other plant species for light may affect the ability of Ripple-leaf Muttonwood plants to flower (Horton 1999a). The dynamics of other forms of competition between Ripple-leaf Muttonwood and other native plant species is not known.

The ecological relationship between the Ripple-leaf Muttonwood and predators and parasites is unknown.

Disturbance

- Fire

The Ripple-leaf Muttonwood appears to persist on the margins of forest types that are either fire intolerant or require a relatively long time between fire events. It is unknown whether the Ripple-leaf Muttonwood would survive a fire event.

Aboriginal people have inhabited the Richmond Range for many thousands of years and are likely to have traditionally used fire to promote new growth for grazing mammals and to keep corridors open for travel (NPWS 2002). Disturbance by fire may have a role in creating habitat suitable for the establishment of the Ripple-leaf Muttonwood.

- Flood

Seasonal flooding, especially on a small scale is not uncommon in the Ripple-leaf Muttonwood habitat on the Richmond River floodplain. Inundations frequently occur in late summer and/or autumn, with rare flooding in winter and spring. The soil of Ripple-leaf Muttonwood habitat near Tatham is seasonally water-logged for some weeks after moderate rain. While the Ripple-leaf Muttonwood has been found to persist under these conditions it is difficult to determine whether flooding assists or inhibits the species.

- Grazing

The Tatham and Mallanganee populations of Ripple-leaf Muttonwood have been subjected to intermittent grazing by cattle in the past. While the Tatham population has remained suppressed with very low numbers, the Mallanganee population has clusters of many suckers around each parent plant. This may be attributed to different grazing regimes or other factors independent of grazing.

The response of the Ripple-leaf Muttonwood to grazing by other species is not known.

3.6 Ability of species to recover

Habitat clearing and fragmentation are believed to be the primary causes of past decline in the Ripple-leaf Muttonwood. Although probably never common, the species has declined to critical levels. The likelihood of the Ripple-leaf Muttonwood successfully re-colonising potential habitat is unknown at this stage. *In-situ* management of known populations and ecological research into the species are likely to prevent its extinction and promote recovery of the species, however, it is unlikely that the species will ever become common in the wild.

4 Threats and Management Issues

4.1 Known threats

Clearing of native vegetation and habitat loss

Clearing of native vegetation is a major cause of loss of biological diversity and this has been recognised by listing this process as a Key Threatening Process under the TSC Act. Clearing of large areas of native vegetation for agricultural activities and urban development in the NSW North Coast Bioregion is probably the major cause of the decline of the Ripple-leaf Muttonwood population to a critical level. Much of its lowland floodplain rainforest habitat was cleared for agriculture by the early 1900's. More recently, increased sugar cane cultivation has resulted in with clearing more land for production, including areas previously kept as shelter belts.

Boatharbour Nature Reserve is one of eleven significant remnants of lowland rainforest on the floodplain (NPWS 1997). Its proclamation as a Bird and Animal Sanctuary in March 1927 helped to prevent it being cleared.

Habitat fragmentation

Habitat fragmentation is a threat to the viability of the remaining populations of Ripple-leaf Muttonwood. The pattern of large scale dearing of native vegetation has left the habitat remnants isolated from one another. As a result of isolation, the function of pollinators and seed dispersers is likely to have been interrupted and gene flow between the populations of Ripple-leaf Muttonwood may have ceased. Fragmentation is likely to result in increased inbreeding with associated risks of genetic reduction as well as increased susceptibility of each population to encroachment by weeds and other edge effects.

Low population number

The currently known population of Ripple-leaf Muttonwood consists of a low number of individuals, including an estimated maximum of 16 mature individuals, in the wild. With a low population number, the genetic variation within the species may reduce over time and subsequently the capacity of the species to survive extreme environmental events, e.g.

severe drought, and adapt to environmental change may be gradually reduced.

Lack of knowledge of biological and ecological requirements

In the absence of relevant information concerning a species' biological and ecological requirements, management must be based on assumptions and the precautionary principle. This lack of scientific knowledge, in combination with low population numbers and only a few populations, creates a risk that a management decision or lack of action may have a significant negative impact on the survival of the species. As such, investigation into potential threats is critical to ensure the recovery of the species.

Weed infestation and competition

All known Ripple-leaf Muttonwood populations are threatened by weed invasion and competition. Exotic species compete with and interrupt the recruitment of seedlings thus preventing them from reaching reproductive maturity. In particular, the Lantana has been found to compete for light and smother mature and juvenile Ripple-leaf Muttonwood plants.

The prominent weed species threatening the Ripple-leaf Muttonwood habitat in Boatharbour Nature Reserve are:

- Asparagus Fern (*Protoasparagus africanus*)
- Climbing Nightshade (*Solanum seaforthianum*)
- Corky Passionfruit (*Passiflora suberosa*)
- *Glycine* sp.
- Small-leaved Privet (*Ligustrum sinense*)
- Lantana (*Lantana camara*)
- Madeira Vine (*Andredera cordifolia*)
- Mistweed (*Ageratina riparia*) and
- Tradescantia (*Tradescantia fluminensis*).

Prominent weed species threatening the Ripple-leaf Muttonwood habitat near Tatham are:

- Small-leaved Privet (*Ligustrum sinense*),
- Lantana (*Lantana camara*) and
- Climbing Nightshade (*Solanum seaforthianum*).

In the habitat near Tatham, weed competition will become an increasing issue now that the area is fenced to exclude cattle grazing. The Honey Loquat (*Gleditsia* species) is also present near the Tatham habitat, and poses a future threat to the Ripple-leaf Muttonwood.

Camphor Laurel (*Cinnamonum camphora)* has been recorded near both sites. This species poses a future threat to Ripple-leaf Muttonwood.

Prominent weed species threatening the Ripple-leaf Muttonwood habitat in Mallanganee National Park are:

- Bush Lemon (*Citrus* sp.)
- Cape Gooseberry (*Physalis peruviana*)
- Climbing Nightshade (*Solanum seaforthianum*)
- Crofton Weed (*Ageratina adenophora*)
- Lantana (*Lantana camara*)
- Moth Vine (*Araujia sericiflora*) and
- Smooth Senna (*Senna x floribunda*).

Road verge maintenance

Road verge maintenance, i.e. slashing, herbicide spraying or drainage works, adjacent to or in Mallanganee National Park and Boatharbour Nature Reserve may directly damage individual Ripple-leaf Muttonwood plants. State Forests NSW (SFNSW) maintains selected sections of road through Mallanganee National Park to access adjoining State Forest. The DEC maintains the other roads and trails in Mallanganee National Park and Boatharbour Nature Reserve. Lismore City Council, under contract from the Roads and Traffic Authority, maintains the verges of the Bangalow Road near Boatharbour Nature Reserve.

4.2 Potential threats

Fire

It is not known whether the Ripple-leaf Muttonwood has adaptations to enable it to survive fire events. The fire regime, i.e. frequency, intensity and season of burn, within which a population could persist are also unknown.

Whilst the vegetation communities of the known Ripple-leaf Muttonwood habitat are less fire prone, they adjoin areas that could carry an intense fire under extreme fire weather conditions. In Mallanganee National Park, the wet sclerophyll forest habitat of the Ripple-leaf Muttonwood is generally adjacent to the more fire prone dry sclerophyll forest dominated by Spotted Gum (*Corymbia variegata*). On the floodplain, the habitat of the Ripple-leaf Muttonwood in places adjoins pasture and grassland which become a fire hazard during the seasonal dry period. It is necessary to consider the risk and management of fire in Ripple-leaf Muttonwood habitat in context with the adjacent vegetation communities.

Logging

The response of the Ripple-leaf Muttonwood to disturbance associated with logging is not known. Historically, logging has occurred in areas of potential

Ripple-leaf Muttonwood habitat on the Richmond Range.

The population of Ripple-leaf Muttonwood which occurs in the former Mallanganee Flora Reserve and the surrounding state forests were extensively logged in the 1920s, mainly for Hoop Pine (Joseph 2000a). Logging of the flora reserve ceased with its establishment but the state forest outside the flora reserve, which now makes up part of Mallanganee National Park, continued to be subject to selective logging since the 1920s. With the formation of the national park this area has not been logged during the last decade.

The disturbances associated with past logging practices may have impacted on the overall distribution of the Ripple-leaf Muttonwood.

Under the IFOA for the Upper North East Region, there are management prescriptions to protect known individuals and populations of Ripple-leaf Muttonwood (see Section 5.3). Private native forestry licensing also provides protection for the Ripple-leaf Muttonwood, however, there is potential for impact upon unknown individuals not identified in pre-logging surveys.

Grazing by cattle

The response of the Ripple-leaf Muttonwood to grazing by cattle is poorly understood, however, cattle grazing is likely to contribute to the introduction of weeds and may prevent seedling establishment. The Ripple-leaf Muttonwood habitat near Tatham was previously used as a cattle shelter belt. Cattle are now excluded from the Tatham population by fencing. Other remnants of native floodplain vegetation on private property are likely to be similarly used for intermittent cattle grazing and this may threaten the survival of unknown populations of the Ripple-leaf Muttonwood.

Weed control activities

Bush regeneration activities involve the clearing and removal of weeds, minimisation of soil disturbance, the selective use of herbicides and the encouragement of natural regeneration. Unskilled bush regeneration may result in direct and indirect damage to the Ripple-leaf Muttonwood and its habitat.

Illegal collecting

Illegal collection or souveniring of rare plants has occurred with other species. Illegal collection of a species such as the Ripple-leaf Muttonwood with a low population number is a possible threat to the survival of the populations and ultimately the species.

5 Previous Recovery Actions

5.1 Surveys and monitoring

Targeted surveys for threatened plant species, including the Ripple-leaf Muttonwood, were undertaken in 1997 as part of the government's Comprehensive Regional Assessment process (Horton 1997). These surveys resulted in the discovery of the population of Ripple-leaf Muttonwood near Tatham.

Further targeted surveys were commissioned by DEC, with funding from the Natural Heritage Trust Endangered Species Program in 1998 and 1999. This included an assessment of the threatening processes at each population and recording the height classes in the populations on the floodplain. All the known extant populations of Ripple-leaf Muttonwood were initially found as a result of these surveys.

5.2 Management plans

Plans of Management for reserves

Specific management actions for the protection of the Ripple-leaf Muttonwood are included in the "The Parks and Reserves of the Northern Richmond Range Plan of Management" (NPWS 2002).

Bush regeneration plans

Specific management actions for the control of weeds and restoration of Ripple-leaf Muttonwood habitat are included in the "Review and update of restoration and rehabilitation project report (1995), Boatharbour Nature Reserve" (Joseph 2000b) and "Restoration and rehabilitation project incorporating weed control strategies, Mallanganee National Park" (Joseph 2000a). The DEC prepared a Review of Environmental Factors for both of these projects.

5.3 Habitat protection and management

Fencing to exclude cattle

The immediate surrounds of the Ripple-leaf Muttonwood plants (approximately 2 x 10 m^2) in the Tatham population were fenced in 1998 to exclude cattle. This fencing was instigated by the DEC and the landholder, with funding from the Natural Heritage Trust Endangered Species Program. The majority of the remnant forest including the Ripple-leaf Muttonwood habitat was fenced off from the adjoining pasture in 1999.

The boundary fences of Mallanganee National Park have been replaced and now exclude cattle. Also, pre-existing grazing leases for the area that is now Mallanganee National Park have been terminated.

Forestry

Measures for the conservation of the Ripple-leaf Muttonwood in native timber production areas of state forest are detailed in the Threatened Species Licence under the IFOA for each region. State Forests of NSW is required to implement the conditions set out in each IFOA, whilst DEC is required to audit compliance with conditions. These conditions include:

- pre-logging and pre-roading flora and fauna surveys; and
- exclusion zones around records of threatened flora species.

The known distribution of the Ripple-leaf Muttonwood is within the area covered by the Upper North East Region IFOA. In this, Section 6.22 of the Threatened Species Licence specifically applies to the Ripple-leaf Muttonwood and requires an exclusion zone of at least 50 m radius around all individuals or around all groups of individuals of the species.

Bush regeneration and monitoring

Weed control and bush regeneration work has been undertaken to protect Ripple-leaf Muttonwood in DEC reserves. This work was undertaken in accordance with the strategies in the relevant restoration and rehabilitation project reports (Joseph 2000a, Joseph 2000b).

The Ripple-leaf Muttonwood populations were monitored and follow-up weed control undertaken as necessary. The DEC holds records of observations by staff of new sites of occurrence of Ripple-leaf Muttonwood and updated estimates of the number of plants.

Roadside marking system for sensitive areas

The DEC Northern Rivers Region has developed a roadside marking system for sensitive areas, such as areas that contain threatened plants, on DEC estate. Marker posts, with a DEC symbol, indicating the sensitive area have been installed at appropriate locations, including in the area of the Ripple-leaf Muttonwood population at Mallanganee National Park.

5.4 Other recovery actions

The DEC commissioned the preparation of an identification key for Ripple-leaf Muttonwood (Horton 2000). A key to distinguish between the *Rapanea* species in Australia is also being developed by Associate Professor B. Jackes, James Cook University.

6 Proposed Recovery Objectives, Actions and Performance Criteria

The overall objective of this Recovery Plan is to avoid the extinction of the Ripple-leaf Muttonwood and promote its viability the wild.

Achievement of the overall objective is expected to be beyond the five year life of this plan, but it is the long term purpose of the recovery effort. Specific objectives of the Recovery Plan for this species are listed below. For each of these objectives a number of recovery actions have been developed, each with a performance criterion.

Objective 1: Coordination and implementation of the Recovery Plan

Specific objective 1: Ensure a coordinated and efficient approach to implementation of the Recovery Plan.

Action 1.1:

Maintain regular communication within the DEC and with other relevant parties to ensure a coordinated approach to the implementation of the Recovery Plan.

The DEC is responsible for the implementation of this Recovery Plan. A coordinated approach to the implementation of recovery actions between DEC and private landholders and other relevant parties is required to ensure the recovery of the species.

Performance criterion: Regular communication occurs within the DEC and between the DEC and other relevant parties throughout the life of the plan.

Objective 2: Improve the detection, environmental assessment and protection of the Ripple-leaf Muttonwood.

Action 2.1

The DEC will coordinate targeted surveys for the Ripple-leaf Muttonwood.

It is possible that more populations of Ripple-leaf Muttonwood exist throughout the range of the species. Identification of new populations will allow for active management of threats at these sites.

Potential habitat for the Ripple-leaf Muttonwood exists throughout Koreelah, Mebbin, Richmond River, Tooloom, Toonumbar and Yabbra National Parks as well as Stotts Island Nature Reserve and Terrace Creek in the Border Ranges National Park.

Performance criteria: Surveys for unknown populations of the Ripple-leaf Muttonwood are undertaken within the first two years of

implementation of the Recovery Plan and the range of the species is defined.

Action 2.2

The DEC will develop survey and environmental assessment guidelines and distribute them to all relevant consent authorities, environmental consultants and landowners/managers.

A standard minimum survey effort should be undertaken when determining if the Ripple-leaf Muttonwood is present in an area of proposed development. Consent, concurrence and determining authorities should use the guidelines in their assessment of a proposed development or activity to ensure that the Ripple-leaf Muttonwood is appropriately considered and protected.

Performance criterion: Survey and assessment guidelines have been developed and distributed within one year of the commencement of this plan.

Action 2.3

The DEC will assess the grounds for the Ripple-leaf Muttonwood to be nominated for a change in status to Critically Endangered under the EPBC Act and if appropriate submit a nomination.

From the information presented in this Recovery Plan, the Ripple-leaf Muttonwood appears to meet the IUCN criteria for Critically Endangered (IUCN 2001), i.e. population estimated to number less than 50 mature individuals. Upon completion of a comprehensive site survey for the Mallanganee population of Ripple-leaf Muttonwood (Action 3.1), the DEC will assess whether the available information meets the EPBC Act requirements for a nomination for status change.

Performance criteria: Assessment of the Mallanganee population has occurred and, if appropriate, a nomination for the change in status of Ripple-leaf Muttonwood to Critically Endangered under the EPBC Act has been submitted within two years of the commencement of this plan.

Action 2.4

The DEC will liaise with landowners and managers regarding the protection of any populations of Ripple-leaf Muttonwood occurring off DEC managed estate.

The DEC can offer its experience with managing threatened species and their habitats to assist landowners and land managers. The DEC will provide information to relevant landholders and land managers on the long-term protection measures available, and the benefits associated with entering such agreements.

All protective measures on private property will only be developed in conjunction with, and require the consent of, appropriate landowners and managers. The DEC will foster co-operative relationships and ongoing communication with landowners and managers.

Performance criterion: Within six months of receiving advice of any new population of Ripple-leaf Muttonwood the DEC has contacted the relevant landowner/manager and provided information on appropriate management and protection mechanisms.

Objective 3: Avoid accidental damage to the known population of the Ripple-leaf Muttonwood.

Action 3.1

The DEC will run familiarisation sessions on the field identification the Ripple-leaf Muttonwood for staff from the DEC, SFNSW and Councils that are responsible for managing land that contains the species.

Training staff to identify the species in the field will assist in avoiding damage.

Performance criteria: Species familiarisation sessions for staff responsible for the management of land containing known populations of the Ripple-leaf Muttonwood are provided by the DEC within two years of the commencement of this plan.

No accidental damage to known populations of Ripple-leaf Muttonwood has occurred during the life of this plan.

Action 3.2

Accurate and current information on the occurrence of the Ripple-leaf Muttonwood will be maintained by DEC in the Atlas of NSW Wildlife.

The Atlas of NSW Wildlife (Wildlife Atlas) is a primary resource for researchers, developers, environmental consultants, land managers and emergency incident managers. Accurate information is necessary for appropriate consideration of the species. However, in accordance with Objective 5, the information on precise locations will be kept confidential. The DEC will require that a Wildlife Atlas record card is completed and submitted for any new occurrences of Ripple-leaf Muttonwood.

Performance criteria: Accurate, up to date records of all currently known Ripple-leaf Muttonwood populations are held in Wildlife Atlas within one year of the commencement of the life of this plan; new records are included within six months of being recorded.

Action 3.3

The DEC will implement the roadside marking system for sensitive areas in areas under its management where the Ripple-leaf Muttonwood occurs.

The implementation of the roadside marking system for sensitive areas (see section 5.3) where Ripple-leaf Muttonwood plants occur near roads, will assist DEC staff and contractors in identifying where particular road maintenance methods, e.g. herbicide spraying and slashing, are to be avoided. The signposts will be installed some distance away from the first / last plant so that their exact location will be kept confidential.

Performance criterion: Marker posts to identify roadside occurrences of Ripple-leaf Muttonwood have been erected in accordance with the DEC roadside marker system for sensitive areas within one year of the commencement of this plan.

Action 3.4

DEC will liaise with other agencies that are responsible for road maintenance in the vicinity of the Ripple-leaf Muttonwood regarding minimising the risk to Ripple-leaf Muttonwood.

The DEC will provide information on the DEC roadside marker system for sensitive areas to agencies responsible for road maintenance in the vicinity of the Ripple-leaf Muttonwood, e.g. SFNSW, Roads and Traffic Authority and Lismore City Council. The DEC will promote co-operative implementation of the system and support practical solutions that avoid damage to threatened species.

Performance criteria: Agreement between the DEC and relevant agencies responsible for road maintenance on the co-operative implementation of a roadside marker system for sensitive areas containing the Ripple-leaf Muttonwood is reached within one year of the commencement of this plan.

No accidental damage to Ripple-leaf Muttonwood plants through road and roadside maintenance occurs during the life of this plan.

Objective 4: Management practices are to incorporate the developing scientific understanding of the Ripple-leaf Muttonwood.

Action 4.1

The DEC will complete a comprehensive survey of the Mallanganee population of the Ripple-leaf Muttonwood.

Accurate and current information on the population numbers, structure and extent, as well as site specific threats, is required for management and monitoring of the species.

Performance criteria: A comprehensive survey of the Mallanganee population of the Ripple-leaf Muttonwood has been completed and recorded within one year of the commencement of this plan. This information is used to assist in the management of the species.

Action 4.2

The DEC will coordinate monitoring of Ripple-leaf Muttonwood populations to improve management of the species.

Best practice management for protecting and conserving the Ripple-leaf Muttonwood is currently constrained by lack of knowledge regarding the species' biology and ecology. The DEC will co-ordinate the development and implementation of an *in-situ* monitoring program for all currently known Ripple-leaf Muttonwood sub-populations. The monitoring program will aim to investigate and record the following attributes:

- population stability, increase or decline;
- flower and fruit production;
- seedling/juvenile survivorship;
- rate of growth;
- age to reproductive maturity and peak flowering/fruit production;
- health of individuals; and
- response to opportunistic disturbance events, such as fires, and control of threats, such as weed control.

Population monitoring is essential to understand population stability, and to assist in the early identification of and amelioration of any processes that may be threatening a population. Monitoring of biological aspects and reproductive success of individual populations will assist in determining the viability of the population and the broader population. Appropriate monitoring protocols and databases will be developed to support this program.

Performance criteria: A monitoring program investigating the above attributes has been developed within two years of the commencement of this plan. The monitoring program is implemented over the life of this Recovery Plan.

Action 4.3

The DEC will encourage research into aspects of Ripple-leaf Muttonwood biology and ecology that are likely to result in improved management of the species.

Best practice management for protecting and conserving the Ripple-leaf Muttonwood is currently constrained by lack of knowledge regarding the species biology, ecology and genetics. Appropriately designed research could significantly contribute to the

improved management practices and the long-term viability of the species. The DEC will investigate links with appropriate academic and research institutions to facilitate this research.

Key areas for investigation include:

- reproductive biology including pollination mechanisms, self compatibility, seed viability, reliance on vegetative reproduction,
- propagation techniques,
- key habitat requirements,
- response to fire, and
- conditions required for the production of flowers and fruit.

These research actions may be undertaken in conjunction with Action 4.2.

Performance criteria: A program of research to investigate the biology and ecology of the Ripple-leaf Muttonwood has commenced within four years of the commencement of this plan. Adaptive management of the Ripple-leaf Muttonwood is implemented based on the outcomes of this research.

Action 4.4

Research into the genetic diversity of known populations of Ripple-leaf Muttonwood will be facilitated.

Isolated populations, which reproduce vegetatively, may consist of a single clone (Rossetto 2003, Peakall 1995). Information on the genetic variation and geneflow within and between populations of Ripple-leaf Muttonwood is required to determine the extent of clonality and potential genetic threats to the viability of the species. This information would provide the basis upon which to assess whether a propagation and translocation program is necessary for the species' long term survival.

Performance criteria: The DEC will encourage and facilitate appropriate research into the genetics of Ripple-leaf Muttonwood, this research is initiated within the first year of implementation of the recovery plan and completed within the life of the plan.

Action 4.5

Advances in the scientific knowledge of the Ripple-leaf Muttonwood will be reviewed by the DEC and incorporated into relevant management plans and procedures.

Adaptive management of species based on new scientific evidence will provide the best recovery outcomes. Information gained through scientific investigation into the Ripple-leaf Muttonwood will be used to provide appropriate management strategies for the species.

Performance criterion: Relevant results of research and monitoring have been incorporated into DEC management plans and procedures as it becomes available.

Objective 5: Protect the Ripple-leaf Muttonwood and its known habitat from the threat of weeds.

Action 5.1

The DEC will continue to control weeds, in accordance with approved bush regeneration plans and as part of a co-ordinated program, to protect the Ripple-leaf Muttonwood where it occurs in DEC reserves.

Weed control programs require ongoing maintenance to be effective. Consolidation of regenerated areas is essential for the restoration of natural ecosystems in the long term.

To avoid damage to the Ripple-leaf Muttonwood staff undertaking bush regeneration in areas where the species occurs must be qualified and skilled in bush regeneration, including plant identification. In addition bush regeneration field supervisors must be must be confident in the field identification of the Ripple-leaf Muttonwood.

Performance criterion: Weeds threatening known populations of Ripple-leaf Muttonwood are controlled within the life of this plan.

Action 5.2

In consultation with the relevant landowner or manager, the DEC will support funding proposals for appropriate weed control to protect the Ripple-leaf Muttonwood where it is known to occur off-park.

The DEC will encourage regeneration and removal of weeds at all Ripple-leaf Muttonwood sites by supporting funding applications and providing advice to landholders and land managers to develop weed management strategies and undertake weed control works.

Performance criteria: The threat weeds pose to known populations of Ripple-leaf Muttonwood is controlled within the life of this plan.

Objective 6: Discourage illegal collection of Ripple-leaf Muttonwood.

Action 6.1

The DEC will keep information on the precise location of the Ripple-leaf Muttonwood confidential.

The precise location of the Ripple-leaf Muttonwood plants will not be made public to limit the threat of illegal collection or vandalism and to respect the privacy of private landowners and managers.

Performance criterion: The populations of Ripple-leaf Muttonwood are not damaged by vandals or illegal collection.

Objective 7: Protect known Ripple-leaf Muttonwood habitat from inappropriate fire regimes.

Action 7.1

The DEC will ensure, where possible, that fire will be excluded from known occurrences of Ripple-leaf Muttonwood, until such time as scientific information is available to determine the appropriate fire regime for the conservation of the species.

The responses of the Ripple-leaf Muttonwood to fire are unknown, however, the physical characteristics of the plants suggest that it would be killed by a high intensity or frequency fire.

A policy to exclude fire, where possible, from the areas where Ripple-leaf Muttonwood is known to occur will be included in the relevant DEC fire management plans and promoted by the DEC for inclusion in relevant plans subject to the approval of a District Bush Fire Management Committee. The DEC has a policy to exclude fire from the whole of Boatharbour Nature Reserve and a specific Reserve Fire Management Plan is not proposed for this reserve.

Performance Criterion: Appropriate policy and zoning has been incorporated into the DEC Reserve Fire Management Plan for Mallanganee National Park to protect the known areas of Ripple-leaf Muttonwood, during the life of the plan.

The DEC has provided appropriate information on Ripple-leaf Muttonwood to relevant District Bush Fire Management Committees.

Objective 8: Develop a contingency strategy to assist with the long-term survival of the Ripple-leaf Muttonwood.

It is possible that more populations of Ripple-leaf Muttonwood will be found, particularly on Focal Peak flows on the Richmond Range. Reintroduction of the species into areas of suitable habitat is not considered an appropriate option at this stage. This option may be considered in future Recovery Plans in the light of the results of further searches and studies. However, a contingency strategy to ensure the survival of genetic material as an insurance against catastrophic stochastic events should be developed.

Action 8.1

The DEC will negotiate for the maintenance of an ex-situ *representative from each genetically distinct population in an appropriate location eg. Botanic Gardens.*

The *ex-situ* populations will be established and maintained at locations that are spatially remote from each other in order to prevent the occurrence of genetic pollution. In the absence of definitive genetic data, the populations of Ripple-leaf Muttonwood on the floodplain will be assumed to be genetically distinct from those on the range. Maintenance of an *ex-situ* living collection will safeguard against extinction in the wild.

Performance criteria: *Ex-situ* representatives of each genetically distinct population are established within secure locations within the life of the plan.

Action 8.2

The DEC will investigate the option of collecting and storing representative seed stock from populations of the Ripple-leaf Muttonwood at an appropriate institution.

Seed may be stored as security against destruction of populations. Opportunities to collect and store seed from wild populations of Ripple-leaf Muttonwood may be incorporated into research projects. Seed banks should be tested regularly for viability and replenished. Any seed collection should only be undertaken under licence from the DEC.

Performance criterion: Seed samples of each genetically distinct population stored in an appropriate seed bank within the life of the plan.

7 Implementation

Table 2 outlines the implementation of recovery actions specified in this Recovery Plan for the period of five years from publication. The DEC is the responsible authority for this Recovery Plan. The DEC is committed to the objectives and actions in this plan however, implementation of this plan is subject to budgetary and other constraints.

8 Social and economic consequences

The estimated total cost of implementing the recovery actions for Ripple-leaf Muttonwood will be $96,850 over the five-year period covered by this plan. The inclusion of the Ripple-leaf Muttonwood populations in Mallanganee National Park and Boatharbour

Nature Reserve has significantly increased formal protection for the species. Management of these areas will be in accordance with the requirements of the NPW Act and any costs incurred will be met by the DEC.

Implementation of this Recovery Plan will not affect current SFNSW harvesting operations. Under current forestry practices, the IFOA applies prescriptions to harvesting operations where known individuals of Ripple-leaf Muttonwood occur.

The Ripple-leaf Muttonwood population at Tatham occurs in a vegetation remnant that has already been zoned for protection under the relevant Local Environmental Plan. Any works undertaken on private land will only be done with the consent of the relevant land owner. A number of conservation mechanisms potentially offer management support and incentives for protection on private land.

It is anticipated that there will be no significant adverse social or economic costs associated with the implementation of this Recovery Plan and that the overall benefits to our shared environment will outweigh any specific costs.

9 Biodiversity Benefits

The preparation and long term implementation of Recovery Plans for threatened species, populations and ecological communities, contributes to, and highlights the importance of, conserving biodiversity. The conservation of biodiversity has a number of wider community benefits. These include:

- provision and maintenance of a range of ecosystem processes;
- contributing to increased ecological knowledge of species, habitats and broader ecosystems; and
- cultural, aesthetic and spiritual biodiversity values.

A number of other threatened plant species are known to occur in and adjacent to Ripple-leaf Muttonwood habitat. In Mallanganee National Park they are *Tylophora woollsii* and *Senna acclinis*. In Boatharbour Nature Reserve they are *Austromyrtus fragrantissima*, *Desmodium acanthocladum*, *Floydia praealta* and *Ochrosia moorei*. In the swamp sclerophyll open forest on private property near Tatham they are *Austromyrtus fragrantissima* and *Geijera paniculata*. These species will benefit from the implementation of the proposed actions in this plan.

10 Preparation Details

This Recovery Plan has been prepared by Lyn McRae. It incorporates an earlier draft version by Stephanie Horton, Botanical Consultant. The final plan has been reviewed and edited by Kersten Tuckey.

11 Review Date

This Recovery Plan will be reviewed after five years of the date of its publication.

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13 Acronyms Used in this Document

DEC Department of Environment and Conservation (NSW)

DIPNR Department of Infrastructure, Planning and Natural Resources

EP&A Act NSW *Environmental Planning and Assessment Act* 1979

EPBC Act Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999

ESD Ecologically Sustainable Development

IFOA Integrated Forestry Operations Approval

IUCN International Union for the Conservation of Nature and Natural Resources

LG Act NSW *Local Government Act* 1993

NPW Act NSW *National Parks and Wildlife Act* 1974

NPWS NSW National Parks and Wildlife Service

NSW New south Wales

NV Act NSW *Native Vegetation Act* 2003

SFNSW State Forests NSW

TSC Act NSW *Threatened Species Conservation Act* 1995

Table 1. Estimated costs of implementing the actions identified in the Ripple-leaf Muttonwood Recovery Plan.

Action no	Action Title	*Priority	Cost Estimate ($/year)					Total Cost ($)	Responsible Party/Funding sources	#In-kind	^ Cash
			Year 1	Year 2	Year 3	Year 4	Year 5				
1.1	Recovery plan co-ordination	1	1750	1750	1750	1750	1750	8750	DEC	8750	
2.1	Targeted Survey	1	3000	3000				6000	DEC		6000
2.2	Survey and assessment guidelines	1	1750					1750	DEC	1750	
2.3	Assess Ripple-leaf Muttonwood for nomination as Critically Endangered under EPBC Act	2		400				400	DEC	400	
2.4	DEC Liason with landholders	2	400	400	400	400	400	2000	DEC	2000	
3.1	Field ID training for staff	1		700				700	DEC	600	100
3.2	Enter records into Wildlife Atlas	1	400					400	DEC	400	
3.3	Implement roadside marking system on reserves	1	1000	400				1400	DEC	800	600
3.4	Liase with SFNSW & Lismore City Council re: roadside maintenance	1	600					600	DEC	600	
4.1	Site assessment of Mallanganee population	1	5000					5000	DEC		5000
4.2	Monitor populations	1	1000	10000	5000	5000		21000	DEC	21000	
4.3	Research biology and ecology	1			1000	15000	10000	26000	DEC	1000	25000
4.4	Genetic research	2	5000			1000		6000	DEC		6000
4.5	Incorporate scientifc information into plans	1					1200	1200	DEC	1200	
5.1	Continue weed control in known habitat on reserves	1	3000	2500		2500		8000	DEC		8000
5.2	Support for off-park weed control	1	350					350	DEC	350	
7.1	Exclude fire from habitat on reserve	1	800					800	DEC	800	
8.1	Maintain ex-situ plants	2				3000	1500	4500	DEC	2000	2500

8.2	Seedbank establishment	2		1000		1000		2000	DEC	2000	
Total	**Annual cost of Recovery Program**		**24050**	**20150**	**8150**	**29650**	**14850**	**96850**	DEC	**43650**	**53200**

* Priority ratings are: 1 - action critical to meeting plan objectives; 2 - action contributing to meeting plan objectives; 3 - desirable but not essential action

'In-Kind' Funds represent salary component of permanent staff and current resources

^ 'Cash' Funds represent the salary component for temporary staff and other costs such as the purchasing of survey and laboratory equipment

Appendix 1: Public Authority responsibilities

Public authority	Relevant responsibilities
DEC	• Assessment of Section 132C licence applications under the TSC Act. • Assessment of licence applications under the NPW Act. • Assessment of proposed developments on DEC estate. • Advice to determining and consent authorities, with a possible concurrence role under the EP&A Act or NV Act. • Preparation of Recovery Plans and co-ordination of implementation. • Regulation of certain forestry operations under the Integrated Forestry Operations Approval.
Relevant local governments	• Preparation of Local Environmental Plans under Part 3 of EP&A Act. • Consent authorities for development proposals under Part 4 of EP&A Act. • Approval authorities for council works under Part 5 of EP&A Act. • Responsibilities under *Rural Fires Act* 1997. • Management of council reserves with potential habitat. • Consideration of the content of Recovery Plans when preparing plans of management for community land under *Local Government Act* 1993.
Department of Infrastructure, Planning and Natural Resources	• Approval authority for native vegetation clearance applications under the NV Act. • Administration of property plans under the NV Act. • Management of crown land with potential habitat. • Co-ordination of Regional Vegetation Committees and Landcare programs. • Advice and assistance on environmental planning matters. • Assessment of major development applications. • Administration of the general conditions of IFOA. • Concurrence role under the EP&A Act for certain developments and activities. • Making of environmental planning instruments including State Environmental Planning Policys and Local Environmental Plans under Part 3 of EP&A Act. • Determining certain development proposals under Part 4 of the EP&A Act. • Approval of certain activities under Part 5 of EP&A Act.
Catchment Management Authorities	• Development of catchment action plans. • Provision of loans, grants, subsidies or other financial assistance for the purposes of catchment activities. • Provision of assistance to landholders to fulfil the objectives of catchment action plans.
State Forests of New South Wales	• Implementation of prescriptions detailed in IFOA terms of threatened species licence granted under Part 4 of the NSW *Forestry and National Park Estate Act* 1998.
Rural Fire Service	• Preparation of Bush Fire Risk Management Plans and Plans of Operations. • Fire management.
Other State government agencies	• Management of public lands with potential habitat. • Approval authorities for activity proposals under Part 5 of EP&A Act.

Appendix 2 Native plant species associated with Ripple-leaf Muttonwood

Scientific Name	Common Name	Tatham	Boat-harbour	Mallanganee
Upper canopy				
Alphitonia excelsa	Red Ash		X	
Casuarina glauca	River Oak	X		
Callistemon salignus	Bottlebrush	X	X	
Cupaniopsis parvifolia	Small-leafed Tuckeroo		X	
Eucalyptus propinqua	Grey Gum			X
Eucalyptus saligna	Blue Gum			X
Eucalyptus tereticornis (40 m away)	Forest Red Gum		X	
Grevillea robusta	Silky Oak		X	
Lophostemon confertus	Brush Box			X
Lophostemon suaveolons	Swamp Box		X	
Melaleuca stypheloides	Prickly Paperbark	X		
Below Canopy				
Abutilon oxycarpum				X
Acacia melanoxylon	Blackwood		X	X
Acronychia oblongifolia	Common Acronychia		X	
Alecryon subcinerus				X
Alphitonia excelsa				X
Austromyrtus fragrantissima	Sweet Myrtle	X	X	
Cassine australis	Red Olive Plum	X		X
Cissus antarctica				X
Commelina cyanea	Commelina	X	X	
Cordyline petiolaris				X
Croton verreauxii	Native Cascarilla	X	X	X
Cryptocarya obovata	Pepperberry		X	X
Desmodium acanthocladum	Thorny Pea		X	
Dioscorea transversa				X
Diploglottis australis				X
Dysoxylum mollissimum				X
Eustrephus latifoius				X
Gahnia sp.				X
Geitonoplesium cymosum	Scrambling Lily		X	
Hibiscus heterophyllus	Native Hibiscus			X
Kunsteleria sp.				X
Melia azederach				X
Mischcocarpus sundaicus	Red Pear Fruit		X	
Neolitsea australis				X
Neolitsea dealbata				X
Nyssanthes sp.				X
Oplismenus undulatifolius	Basket Grass		X	
Parsonsia sp.				X
Pentaceras australis	Crows Ash		X	
Pandorea pandorana				X
Polyscias elegans				X
Pseuderanthemem variablile				X
Rapanea variabilis	Variable Muttonwood	X		
Rhodomyrtus psidoides	Native Guava		X	
Smilax australis				X
Streblus brunonianus	Whalebone Tree		X	
Tylophora paniculata				X

(Horton 1999a, Horton 1999b)

Note this list is not exhaustive.

Appendix 3: Summary of advice from the NSW Scientific Committee

Under Section 66A of the TSC Act, Recovery Plans must include a summary of any advice given by the NSW Scientific Committee, details of any amendments made to the plan to take account of that advice and a statement of reasons for any departure from that advice. The Scientific Committee's comments on the draft Ripple-leaf Muttonwood Recovery Plan and details of amendments made are tabled below.

Section	Advice	Response
2.1	Why has a new common name been coined.	The DEC has decided to utilise the common name Ripple-leaf Muttonwood for the following reasons: (a) The name Ripple-leaf Muttonwood is used by numerous people who are working with the species and is well accepted. (b) Most other species in Australia within the same genus are referred to as a type of Muttonwood, the name Ripple-leaf Muttonwood identifies a characteristic feature of this species and the genus to which it belongs. (c) The species is currently being formally described, as such, the scientific name will change after publication. This may result in a lack of recognition within the general public of the species to which the plan applies. Referring to the species by its common name may help to avoid this confusion. (d) Most members of the general public prefer to refer to species by their common name, as the species occurs on private property, a common name for the species will assist landholders when discussing issues relating to the species.
2.4	The Native Vegetation Conservation Act 1997 is now replaced by the Native Vegetation Act 2003.	Amended.
3.1	If the fruit is a drupe then the seed must be enclosed in an endocarp, separating it from the fleshy mesocarp.	Not amended. As the Recovery Plan is written for use by the general public, only a general description of the Ripple-leaf Muttonwood is provided without technical detail. Further, the mesocarp of a drupe is not always fleshy.
3.2	If specimens had been found in 1986 then the species should not have been listed as extinct on the original Schedules of the Threatened Species Conservation Act.	Noted. No text amendments required.
4.5	*Solanum seaforthianum* is given as both Climbing Nightshade and Brazilian Nightshade.	Amended.
5.1 and 5.4	Why are no further surveys proposed as an objective of the Plan.	Amended. *Action 2.1 The DEC will coordinate targeted surveys for the Ripple-leaf Muttonwood.*
Action 2.4 (1.3 in draft)	No longer the Native Vegetation Conservation Act.	Amended.
Action 3.1 (2.1 in draft)	Given the previous more extensive known distribution, from how wide an area will participants in Ripple-leaf Muttonwood	Amended. Action 3.1 states that familiarisation sessions will be undertaken in areas of known Ripple-leaf Muttonwood habitat. The distribution of the species profile and Environmental Impact

	familiarisation sessions come.	Assessment guidelines will assist in identifying new locations. Once new locations have been identified staff familiarisation can be undertaken.
Action 4.2 (3.2 in draft)	Does the agency have statistically rigorous protocols for monitoring, and is there a database for retaining monitoring data.	The monitoring protocol and database will be developed as part of the monitoring program.
Appendix 2	Needs to be modified to include CMA.	Amended.
4.5	The politically correct common name for Wandering Jew is Tradescantia	Amended.
Action 4.3 (3.3 in draft)	$25,000 has been allocated to "encourage research". What scientific questions were of interest and who might be best placed to investigate them.	Amended: Key areas for investigation include: • reproductive biology including pollination mechanisms, self compatibility, seed viability, reliance on vegetative reproduction, • propagation techniques, • key habitat requirements, • response to fire and conditions required for the production of flowers and fruit.

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