Draft Recovery Plan for
Corchorus cunninghamii

Foreword

The New South Wales Government established a new environment agency on 24 September 2003, the Department of Environment and Conservation, which incorporates the New South Wales National Parks and Wildlife Service. Responsibility for the preparation of Recovery Plans now rests with this new department.

This document, when finalised, will constitute the formal New South Wales State Recovery Plan for Corchorus cunninghamii. It will also constitute the formal New South Wales component of the National Recovery Plan for the species. As such, this plan considers the conservation requirements of the species across its known range within New South Wales. It identifies the actions to be taken to ensure the long-term viability of Corchorus cunninghamii in nature and the parties who will undertake these actions.


Actions outlined in this Recovery Plan will be directed towards implementation of management programs, field surveys of potential habitat, establishment of ex situ collections, research and community awareness.

It is intended that this Recovery Plan will be implemented over a five year period. Actions will be undertaken by the Department of Environment and Conservation.

LISA COBYN
Director-General
Acknowledgments

Sections of this Recovery Plan are based upon the information contained in a preliminary draft prepared by Andrew Benwell, consultant botanist.

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# Table of Contents

Foreword ..................................................................................................................... i  
Acknowledgments ........................................................................................................... ii  
Table of Contents .............................................................................................................. iii  
1 Introduction .................................................................................................................... 1  
2 Legislative Context ...................................................................................................... 1  
   2.1 Legal status ............................................................................................................... 1  
   2.2 Responsibilities under the *Threatened Species Conservation Act 1995* ....................... 1  
   2.3 Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* .... 2  
   2.4 Relationship to other NSW legislation ................................................................... 3  
3 Species Information ..................................................................................................... 4  
   3.1 Description and taxonomy ...................................................................................... 4  
   3.2 Distribution ............................................................................................................. 4  
   3.3 Habitat .................................................................................................................... 4  
   3.4 Life history and ecology ........................................................................................ 8  
4 Threats .......................................................................................................................... 9  
   4.1 Habitat loss ............................................................................................................ 9  
   4.2 Inappropriate disturbance ..................................................................................... 9  
   4.3 Weeds .................................................................................................................. 10  
   4.4 Small population size ......................................................................................... 10  
5 Species’ Ability to Recover .......................................................................................... 11  
6 Previous Recovery Actions........................................................................................... 11  
   6.1 Recovery planning ............................................................................................... 11  
   6.2 Population and habitat protection ....................................................................... 11  
   6.3 Threat abatement ................................................................................................. 12  
   6.4 Surveys ................................................................................................................ 12  
   6.5 Research .............................................................................................................. 12  
7 Proposed Recovery Objectives, Actions and Performance Criteria ......................... 12  
8 Social and Economic Consequences .......................................................................... 15  
9 Biodiversity Benefits .................................................................................................. 15  
10 Preparation Details .................................................................................................... 15  
11 Review Date ............................................................................................................... 15  
12 Implementation .......................................................................................................... 15  
13 References .................................................................................................................. 16  
14 Acronyms Used in this Document ......................................................................... 17  
Appendix 1 Submission .................................................................................................. 19  
Appendix 2 Public Authority Responsibilities ............................................................. 21
Appendix 3 Specific Conditions for Plantation Operations at Toonumbar State Forest

Appendix 4 Management Principles for Corchorus cunninghamii in NSW

Appendix 5 Research Considerations for Corchorus cunninghamii Conservation

Figures

Figure 1. Corchorus cunninghamii records in NSW

Tables

Table 1. Vegetation characteristics at Corchorus cunninghamii locations in NSW and Queensland.

Table 2. Estimated costs of implementing the actions identified in the Corchorus cunninghamii Recovery Plan.
1 Introduction

*Corchorus cunninghamii* (F. Muell.) is a perennial, semi-herbaceous shrub to 1.5 metres high with a distribution restricted to north east New South Wales (NSW) and south east Queensland. Threatening processes include displacement by weeds, inappropriate disturbance regimes and small population effects.

This document, when finalised, will constitute the formal NSW Recovery Plan for *Corchorus cunninghamii*. It will also constitute the formal NSW component of the National Recovery Plan for the species. As such, this plan considers the conservation requirements of the species across its known range within the State. It identifies the actions to be taken to ensure the long-term viability of *C. cunninghamii* in nature and the parties who will undertake these actions. The attainment of the objectives of this Recovery Plan are subject to budgetary and other constraints affecting the parties involved.

This plan was prepared by the NSW Department of Environment and Conservation (DEC).

2 Legislative Context

2.1 Legal status


2.2 Responsibilities under the Threatened Species Conservation Act 1995

Recovery Plan preparation, exhibition and implementation

The TSC Act and the NSW Threatened Species Conservation Amendment Act 2002 (hereafter referred to jointly as the TSC Act) provide 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.

This draft Recovery Plan will be placed on public exhibition and submissions invited from the public. To make your submission as effective as possible, please:

- refer to the section or action of the plan you wish to address;
- briefly explain the reasons for your comments, providing source information or examples where possible; and
- provide your name and address to enable receipt of your submission to be acknowledged.

Submissions may be made as letters or other documents, or on the DEC form ‘Submission: Draft Recovery Plan’. This is available in Appendix 1 of the plan, at DEC offices, or on the website www.environment.nsw.gov.au.

The DEC will consider all submissions to this Recovery Plan received during the exhibition period and must provide a summary of those submissions to the NSW Minister for the Environment prior to final approval of the plan. Submissions on this draft plan may contain information that is defined as ‘personal information’ under the NSW Privacy and Personal Information Act 1998, which identifies the person providing the submission. Following adoption of the Recovery Plan by the Minister copies of all submissions, including personal details, will be available for public inspection. If any person wishing to prepare a submission does not want their personal details to become public, the submission must be clearly marked that personal details are to remain confidential. All submissions are stored in the DEC records system.

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 *Corchorus cunninghamii* in NSW are the responsibility of the DEC. Other public authorities may have statutory responsibilities relevant to the conservation and protection of *C. cunninghamii*. Public authorities with core legislative responsibilities relevant to the protection and management of *C. cunninghamii* and its habitat are listed in Appendix 2.

Consultation with indigenous people

Local Aboriginal Land Councils, Elders and other groups representing indigenous people in the areas where *Corchorus cunninghamii* occurs have been identified and a copy of the draft Recovery Plan will be sent to them. Their
comments on this draft will be sought and will be 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.

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 *Corchorus cunninghamii*, although it is an option available to protect any new populations of the species (see Action 2.3).

Key Threatening Processes

As of October 2004 there are 23 Key Threatening Processes listed on the TSC Act. Of these, 'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is relevant to the conservation of *Corchorus cunninghamii*. In addition to this, a range of other processes are recognised as threatening the survival of the species in NSW.

Licensing

Any activity not requiring development consent under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) or the NSW *Native Vegetation Conservation Act 1997* (NVC Act), which is likely to pick *Corchorus cunninghamii*, or damage its habitat, requires a licence from the DEC under the provisions of the TSC Act or NSW *National Parks and Wildlife Act 1974* (NPW Act) as a defence against prosecution. If the impact is likely to be significant, a SIS is required.

Other conservation measures

The TSC Act includes provision for other measures that may be taken to conserve *Corchorus cunninghamii* or its habitat, including the making of a Stop Work Order or Joint Management Agreement.

2.3 Commonwealth 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. In preparing a Commonwealth Recovery Plan, consideration must be given to the role and interests of indigenous people in the conservation of Australia's biodiversity. The Act also seeks to impose the obligation (arising from the listing) for responsible agencies (particularly Commonwealth) to adopt protective measures. This Recovery Plan will be submitted to the Commonwealth for approval as the NSW component of the National Recovery Plan for the species 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 habitat that is critical to *Corchorus cunninghamii*. However, the distribution, habitat and ecological information included in this plan (Sections 3.2–3.4) would assist the Commonwealth Minister for the Environment and Heritage in identifying habitat that is critical to the survival of the species. The DEC does not consider it appropriate that this Recovery Plan identifies or maps the occurrence of the species in the detail that would be required to define Critical Habitat.

As *Corchorus cunninghamii* 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 Commonwealth 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 NSW legislation

Additional legislation relevant to the conservation and recovery of *Corchorus cunninghamii* in NSW includes the following:

- **National Parks and Wildlife Act 1974**;
- **Environmental Planning and Assessment Act 1979**;
- **Native Vegetation Conservation Act 1997**;
- **Rural Fires Act 1997**;
- **Forestry and National Park Estate Act 1998**;
- **Plantations and Reafforestation Act 1999**; and
- **Rural Fires and Environmental Assessment Legislation Amendment Act 2002**.

The interaction of the above legislation with the TSC Act with respect to *Corchorus cunninghamii* is varied. The most significant implications are described below.

**National Parks and Wildlife Act 1974**

The NPW Act is administered by the DEC. Under this Act it is an offence to ‘pick’ or knowingly ‘damage the habitat of’ *Corchorus cunninghamii*. Certain circumstances may provide a defence from prosecution, including where actions are approved under the EP&A Act or NVC Act or licensed by the DEC under the NPW Act or TSC Act.

The NPW Act allows for the reservation of areas as national parks, nature reserves and other categories of protected area under the management of the DEC. Toonumbar National Park and Bungabbee Nature Reserve provide important habitat for *Corchorus cunninghamii* in NSW. The NPW Act regulates activities within these conservation areas.

**Rural Fires Act 1997**

The NSW Rural Fires Act 1997 requires that all parties involved in fire suppression and prevention must have regard to the principles of ecologically sustainable development when exercising their functions and when preparing Plans of Operations and Bush Fire Risk Management Plans. Consideration of the principles of ecologically sustainable development must include the conservation of biological diversity and ecological integrity.

With this, consideration must be given to the impact on threatened species and their habitats, including *Corchorus cunninghamii*.

**Rural Fires and Environmental Assessment Legislation Amendment Act 2002**

The NSW Rural Fires and Environmental Assessment Legislation Amendment Act 2002 amends the Rural Fires Act 1997 and several environmental assessment-related Acts. This Act provides for mapping bush fire prone lands and the development of a Bush Fire Environmental Assessment Code. This code is aimed at streamlining the assessment process for hazard reduction works. To this end, the code includes general ameliorative prescriptions and, in some cases, species specific prescriptions. Threatened species and their habitats are one of the items considered in the code.

**Forestry and National Park Estate Act 1998**

In NSW, an Integrated Forestry Operations Approval (IFOA) granted under part 4 of the NSW Forestry and National Park Estate Act 1998 (FNPE Act) regulates the carrying out of certain forestry operations, including logging, in the public forests of a region. The terms of the Threatened Species Licence (TSL) of the IFOA outlines the minimum protection measures required to limit the impact of forestry activities on threatened species and their habitats, and forms the basis for the DEC regulation of those activities. The TSL for the Upper North East Region includes measures to limit the impact of forestry activities on *Corchorus cunninghamii* (see Section 5.2).

**Plantations and Reafforestation Act 1999**

The NSW Plantations and Reafforestation Act 1999 (P&R Act) supports plantation development and reforestation that provides for improved environmental, social and economic outcomes. Under this Act, the proponent of an authorised plantation must notify the Minister administering the Act if plantation operations are likely to have a significant impact on unique or special wildlife values, including threatened species. The Minister must notify the Minister administering the NPW Act that an evaluation of the impacts of plantation operations is to be carried out so as to minimise the adverse impacts on unique or special wildlife values.
3 Species Information

3.1 Description and taxonomy

*Corchorus cunninghamii* is a perennial semi-herbaceous shrub to 1.5 metres high. Leaves are smooth, 5–15 centimetres long and 1.5–5.0 centimetres wide, with petioles (leaf stalks) 1–2 centimetres long. Leaf shape ranges from lanceolate to ovate, with a rounded or cordate (heart-shaped) base, a serrated margin and a tip that tapers to an obvious point. Leaves are arranged in an alternate pattern around the stem, which is often (but not always) reddish in colour and either smooth or sparsely covered with minute hairs. Stipules (growths at the base of leaf stalks) are up to 1 millimetre in length, red and fleshy, and have a nectar secreting pore under their surface.

Flowers consist of 4–5 yellow oval petals, 7–11 millimetres long and 3–5 millimetres wide. Clusters of 2–7 flowers form a single-stalk inflorescence that arises from opposite a leaf-base. Alternatively, single flowers arise at leaf or flower nodes. Fruit is a dark brown to black narrow, elongated capsule 1.5–3.5 centimetres long and 4–6 millimetres wide that splits along its full length. Seeds are 2–3 millimetres long and brown to black in colour.

A full taxonomic description of *Corchorus cunninghamii* is provided in Halford (1995a) and Harden (2000).

Halford (1993) noted morphological variations in individuals between populations. Simmonds (2000) found that certain morphological differences were not significant, and suggested that they might be due to variation in site conditions.

Identification of *Corchorus cunninghamii* is straightforward when flowering, but when not in flower its leaves can be confused with more common associates such as *Abutilon oxycarpum* (Flannel Weed) or *Trema aspera* (Poison Peach). Distinguishing features include the smooth, thinnish leaves of *C. cunninghamii*, which are somewhat three-veined at the base. *Corchorus* is a genus in the family Tiliaceae. The genus contains about 100 species distributed worldwide, mainly through the tropics and subtropics. There are 26 species of *Corchorus* occurring in Australia, with all but five being endemic. *C. cunninghamii* is the only native species of the genus occurring in NSW.

3.2 Distribution

*Corchorus cunninghamii* occurs from the Richmond River in north east NSW to the Brisbane River in south east Queensland.

In Queensland, the species is currently known from four disjunct populations between the Beenleigh district and the lower Brisbane River. The Queensland population is estimated to be approximately 6,000 individuals (Parr 2002).

In NSW, *Corchorus cunninghamii* has been recorded from foothill and range country north of the Richmond River between Lismore, Toonumbar and Mt Lindesay near the Queensland border (Figure 1). There are no records outside the Richmond catchment in NSW. At the time of European settlement, *C. cunninghamii* may have been more common within its known distribution in the State between Lismore and the upper Richmond Valley. Suitable habitat for *C. cunninghamii* would have existed throughout much of this area. The present sparse distribution in NSW and the disjunction between NSW and Queensland populations may indicate declining abundance due to land clearing, weed invasion and habitat alteration. There are currently two distinct populations of *Corchorus cunninghamii* in NSW.

The Toonumbar population is distributed within Toonumbar National Park and a Hoop Pine (*Araucaria cunninghamii*) plantation in Toonumbar State Forest. The Bungabbee population is located within Bungabbee Nature Reserve and Bungabbee State Forest.

The Toonumbar population is the larger of the two NSW populations of *Corchorus cunninghamii*, although this population appears to be subject to large fluctuations in numbers. Stewart (2001) reported between 600 and 700 plants within the national park and the Hoop Pine plantation, whilst more recent surveys have estimated approximately 2,000 individuals within the Hoop pine plantation alone (SFNSW 2003). This is possibly a reflection of the recent disturbance regimes associated with management of the plantation.

The Bungabbee population is estimated at approximately 50 plants (Stewart 2000, 2001).

3.3 Habitat

The landscape in which *Corchorus cunninghamii* typically occurs is a mosaic of wet sclerophyll forest and dry to dry-subtropical rainforest on sheltered slopes and gullies, and grassy open forest on exposed slopes and ridges. The species itself occurs in the ecotone
of these two vegetation communities, often on upper slopes of southerly aspect, but also in gullies and on lower slopes (e.g. Bungabee), depending on the topographic position of the sclerophyll-rainforest margin. The understorey in these margins is wet sclerophyll in character, comprising a lower stratum of ferns, grasses, herbs and shrubs and a mid stratum of secondary rainforest and mesic sclerophyll shrubs and small trees.
Figure 1. *Corchorus cunninghamii* records in NSW

In NSW, *Corchorus cunninghamii* occurs north of the Richmond River on the dissected southern flanks of the Mt Warning and Focal Peak volcanic shields. It occurs at low to mid elevation (150–450 metres) and may have originally extended to footslopes near the Richmond floodplain, which are now largely cleared. All extant sites are on moderate to steep slopes of south to south-east aspect.

The Queensland sites have a similar topography to those in NSW, namely hilly to steep country, at altitudes of 140–350 metres and on east to south-east aspects.
Both NSW populations of *Corchorus cunninghamii* occur on basalt-derived soils. The Toonumbar population occurs on dark brown or chocolate soils characterised by a friable, porous surface horizon with scattered basalt stones, a clay subsoil and are slightly acidic. The population at Bungabee is on a similar soil type formed from basaltic colluvium overlying sedimentary rocks.

The Queensland populations occur on metasedimentary geology (Halford 1993). The red-yellow podzolic soils formed on metasediments differ significantly from the NSW basaltic soils, tending to be more acidic, shallower and stony. Metasediments are widespread in the Brunswick and Tweed Valleys on the eastern side of the Mt Warning shield in NSW, yet there are no records of *Corchorus cunninghamii* from this area.

The general climatic regime of the Richmond Valley is humid and subtropical. *Corchorus cunninghamii* occurs in areas with an average annual rainfall of 1,200–1,400 millimetres, which is typical of much of the upper Richmond River Valley and significantly drier than areas near the coast (Bureau of Meteorology 1972). The relatively narrow, lower rainfall band preferred by *C. cunninghamii* may account for its absence from metasediments in the Brunswick and Tweed Valleys, where minimum average annual rainfall is about 1,700 millimetres.

Sites within the Toonumbar Hoop Pine plantation occur along old snig tracks and log dumps in the ecotone between the open forest and the planted Hoop Pine. The natural vegetation of this area appears to have been dry rainforest but was cleared for plantation in the 1940s and *Corchorus cunninghamii* may have been present in the original vegetation or the soil seed bank.

Species occurring with *Corchorus cunninghamii* at specific locations are listed in Table 1. Common canopy species occurring in the open forest side of the ecotone are Grey Gum (*Eucalyptus propinqua*), Grey ironbark (*E. siderophloia*), Tallowwood (*E. microcorys*) and Brush Box (*Lophostemon confertus*). Typical canopy species on the rainforest side of the ecotone include Hoop Pine, Australian Teak (*Flindersia australis*), Native Elm (*Aphananthe philippinensis*), Ribbonwood (*Euroschinus falcata*), Grey Ebony (*Diospyros pentamera*), Lacebark (*Brachychiton discolor*) and Morton Bay Fig (*Ficus macrophylla*).

### Table 1. Vegetation characteristics at *Corchorus cunninghamii* locations in NSW and Queensland

<table>
<thead>
<tr>
<th>Location</th>
<th>General Description</th>
<th>Common Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bungabee Nature Reserve, NSW</td>
<td>tall wet sclerophyll forest - dry rainforest ecotone</td>
<td>*Lophostemon confertus, Araucaria cunninghamii, Endiandra pubens, Mallotus philippensis, Cryptocarya microneura, Croton verrauxii, Alpinia caerulea, *Lantana camara, Doodia aspera, Cyperus enervis, Adiantum formosum</td>
</tr>
<tr>
<td>Toonumbar State Forest, NSW</td>
<td>Hoop Pine plantation</td>
<td>*Araucaria cunninghamii, *Lantana camara, *Ageratina adenophora</td>
</tr>
<tr>
<td>Wongawallen, south of Beenleigh, Queensland</td>
<td>open forest</td>
<td>*Eucalyptus propinqua, E. microcorys, Lophostemon confertus, Rhodamnia rubescens, Omalanthus populifolius, Melia azedarach, Abutilon oxyccarpum, Solanum stelligerum, *Lantana camara, Derris involuta, Smilax australis</td>
</tr>
<tr>
<td>Ormeau, south of Beenleigh, Queensland</td>
<td>open forest</td>
<td>*Eucalyptus propinqua, E. siderophloia, E. intermedia, Lophostemon confertus, Polycias elegans, Psychotria daphnoides, Alphitonia excelsa, *Lantana camara, Derris involuta</td>
</tr>
</tbody>
</table>

Note:
* introduced species
3.4 Life history and ecology

Life cycle

Limited information exists on the breeding system of *Corchorus cunninghamii*. Flowers appear to be insect pollinated, with introduced Honey Bees (*Apis mellifera*), native bees (*Trigona* sp.) and sand wasps (*Bembix* sp.) having been recorded visiting flowers (Halford 1993; Simmonds 2000; Stewart 2001; J. Willoughby pers. comm.). Plants investigated by Halford (1993) and Simmonds (2000) were found to require pollination between individuals to set viable seed and were, therefore, assumed to be self-incompatible. Halford (1993) also reported a flowering season lasting from October to May and possibly longer.

Better data are needed on the life span of *Corchorus cunninghamii* individuals. At Ormeau in Queensland, life span was estimated to be 3–4 years (Halford 1993). At this site it was found that half of the plants recorded at the beginning of the year were dead by December, although their size was not given and starting age was unknown.

Seed ecology

*Corchorus cunninghamii* produces moderate quantities of seed with an associated high level of viability (Halford 1993). Seed is produced from December to May and, with no obvious dispersal mechanism, may be gravity dispersed. Some dispersal is also likely due to bulk soil movement or the transport of soil trapped in vehicle tyres and tracks (Stewart 2000). It is possible that seed may also be dispersed by harvester ants.

General observation and preliminary research indicate that *Corchorus cunninghamii* is an obligate seed regenerator (regeneration from seed only) with a soil seed bank and fire-stimulated seedling recruitment behaviour.

Halford (1993) found that nearly all seed of *Corchorus cunninghamii* was dormant when released from fruiting capsules. A proportion of seed appears to become buried in the soil seed bank where it remains until environmental conditions stimulate germination. Seed dormancy is broken by scarification or heat, suggesting that dormancy is due to seed coat impermeability.

The germination response of *Corchorus cunninghamii* to heat has been investigated by Halford (1993), Simmonds (2000) and Stewart (2000). Both Halford (1993) and Simmonds (2000) found that the temperature required to break dormancy ranged between 80–100°C. Halford (1993) concluded from this that fires causing significant soil heating would be likely to promote seed germination.

All soil seed banks undergo a gradual decline over time unless replenished. The rate of decline and replenishment of *Corchorus cunninghamii* seed banks is unknown. Anecdotal evidence suggests that seed remains viable for tens of years, although germination trials have so far not confirmed viability beyond three years (Simmonds 2000).

Fire and disturbance

Available information indicates that fire is probably the major form of natural disturbance affecting populations of *Corchorus cunninghamii*. Positive germination response to fire has been observed at a number of sites in Queensland (Saunders 2001) and NSW (Stewart 2001).

The only large population of *Corchorus cunninghamii* known to exist in Queensland is at Wongawallan, where there were approximately 5,500 plants when counted in 1992/1993. Significantly, the population was on a hillcrest that had been burnt by a high intensity fire three years previously. The even-aged structure of the stand and the obligate seeding fire response of *C. cunninghamii* indicate that the population resulted from fire-stimulated recruitment. By 2000, the number of individuals at this site was reduced to approximately 230. Since then another fire has burnt through the site, resulting in the number of individuals increasing to over 5,000 (Saunders 2001). Following fires in potential habitat within Toonumbar National Park, Stewart (2001) was able to locate new areas of *C. cunninghamii* regeneration.

There is also evidence that *Corchorus cunninghamii* can germinate in the absence of fire through a range of physical soil disturbance mechanisms. Demographic monitoring at Ormeau in Queensland found significant recruitment occurring within a population of less than 40 plants in habitat that had remained unburnt for a long time (Halford 1993). Monitoring of this population has demonstrated that: (i) seed germination was occurring between March and May without fire; (ii) 15% of seedlings matured and produced seed by the end of their first year; and (iii) 80% of plants were in areas where the ground had been disturbed by animal diggings or tracks.

Physical soil disturbance associated with human activities such as timber harvesting, track maintenance and weeding operations may also stimulate germination. The greatest
concentration of plants in NSW occur within the Toonumbar Hoop Pine plantation as small, dense stands associated with disturbed areas such as old snig tracks, log dumps and road verges (Stewart 2001; SFNSW 2003). Adjacent to the plantation, within recent additions to Toonumbar National Park, plants appear to have successfully regenerated on old snig tracks, yet they are virtually absent from the rest of the forest, possibly because of dense weed growth and lack of heavy soil disturbance.

Soil disturbance could, therefore, provide a practical management alternative to fire in stimulating seed germination and recruitment. In comparison, however, disturbance by fire has other secondary benefits for *Corchorus cunninghamii*, such as preventing the encroachment of rainforest into the ecotone habitat.

Low rates of germination have also been achieved in trials involving freshly collected untreated seed (A. Floyd pers. comm. in Stewart 2000). Germination is also known to occur in long-unburnt populations without any apparent disturbance.

In summary, it appears that seed germination in *Corchorus cunninghamii* is stimulated either by bushfire or by soil disturbance. Capacity for both fire-stimulated and fire-independent seedling recruitment is known in other plant species. Significant rates of seed germination have been recorded for a number of species between fires in fire-prone vegetation (Purdie 1977). There is also an increase in fire-independent recruitment in long-unburnt fire-prone vegetation (A. Benwell unpub. data). This may be due to differential rates of seed dormancy release within seed populations or changes in microhabitat.

**Genetic variability**

Studies to determine the level of genetic diversity within and between populations in Queensland and NSW found that genetic diversity in the species is low and that the mean number of migrants between populations was zero (Simmonds 2000). This indicates that maximisation of genetic diversity will require conservation of as many populations in NSW and Queensland as possible. Also, management should endeavour to encourage mixed age population structures over the landscape, which will tend to resist deleterious genetic processes.

### 4 Threats

#### 4.1 Habitat loss

Reasons for the current restricted distribution of *Corchorus cunninghamii* are unclear, although habitat loss is likely to have initially been a contributing cause. The disappearance of the species from around Lismore is most probably a result of settlement and land clearing. Extensive areas of open forest-dry rainforest ecotone once existed in the Lismore and Kyogle areas, although much of this habitat has either been cleared or degraded to the point where it is no longer suitable for the species. Nevertheless, extensive areas of potential habitat that have not been surveyed still exist in the Lismore and Kyogle areas. Surveys in potential habitat are urgently needed so any other populations can be appropriately managed to prevent decline.

#### 4.2 Inappropriate disturbance

Many forms of disturbance are naturally occurring processes and are a requirement for the persistence of viable populations of *Corchorus cunninghamii* across the landscape. Therefore, a one-off disturbance or fire event will not necessarily present any particular threat to the species. However, it is the entire regime, rather than the one-off event that determines the long term persistence of the species. A regime must take into account the time interval between disturbances as well as the magnitude, scale (localised or landscape-based) and type (physical or chemical/fire related) of the disturbance.

Disturbance regimes must take into account the lifecycle of *Corchorus cunninghamii* such that sites where the species occurs are allowed to germinate, flower, set seed and disperse seed prior to disturbance (and subsequent loss of the existing above ground plants). This should ensure that the seed bank of an area is not exhausted due to several mass germination events occurring close together in time. Regimes that do not account for the full lifecycle of *C. cunninghamii* can lead to the disappearance of the species at individual sites and, eventually, the extinction of populations at the landscape level.

Any artificial or managed regime must also take into account the purpose of the disturbance, as there may be secondary effects from the disturbance. For example, weeding for environmental or commercial purposes may need to be undertaken to prevent weeds taking over a *Corchorus cunninghamii* site or an area of established plantation. However, the
weeding itself may constitute a disturbance event and, in certain instances may be an inappropriate disruption to replenishment of C. cunninghamii seed banks.

Disturbance associated with changes in fire regime, some logging activities and other management activities such as road maintenance, may result in the modification of the ecotonal habitat of Corchorus cunninghamii in NSW (Stewart 2000). This may lead to an area of habitat no longer being suitable for C. cunninghamii.

**Fire**

In areas of wet sclerophyll forest subject to hazard reduction burning and fire escapes, fire intervals are commonly in the order of 5–15 years. Intensity of such fires will vary according to fuel levels and weather conditions. In more isolated areas where fires are started mainly by lightning, average fire frequency will probably be 30–100 years or more with variable fire intensity (Moore & Floyd 1994; SFNSW 1995). Therefore, fire regimes in areas of Corchorus cunninghamii habitat may vary greatly, which can have consequences for the long-term persistence of populations.

Understorey fires of low intensity seldom produce temperatures above 60–70°C in the top one centimetre of soil (Auld & O’Connell 1991). According to Halford’s data, such a low intensity fire would not be sufficient to stimulate seed germination of Corchorus cunninghamii, particularly if seed were buried deeper than one centimetre. In the case of moderate and high intensity fires, there is a much greater heat flux down the soil profile, which could be sufficient to stimulate germination.

Obligate seed regenerators tend to be more vulnerable to changes in fire regime than resprouters (Gill 1993; Keith 1996). An increase in fire frequency or a decrease in fire intensity can cause major changes in the abundance of plant species in fire-prone vegetation (McMahon 1984; Keith 1996). High frequency burning can prevent the build up of seed banks needed for regeneration and low intensity fires can inhibit seedling recruitment by failing to stimulate seed germination, both leading to a gradual decline in seed bank and species abundance.

**Forestry related disturbance**

Disturbance-related forestry activities can have a range of effects on Corchorus cunninghamii. Thinning operations may be beneficial to C. cunninghamii, although the response of the species to other forestry-related activities such as harvesting and plantation re-establishment remains largely unknown.

Regeneration gaps resulting from logging have similarities with gaps formed by natural disturbance, but also differ in many respects (Fenner 1985). Differences include litter and understorey removal without soil heating, churned and compacted soil, accumulations of organic matter from logging trash, habitat fragmentation by road networks, trails and snig tracks and potential for dispersal of exotic plants and pathogenic fungi via machinery.

Stewart (2000) reported that seedlings will not emerge through logging trash such as Hoop Pine branchlets and leaf litter.

### 4.3 Weeds

The conditions for germination of Corchorus cunninghamii may be similar to the conditions required for germination of some weed species. Therefore, disturbance may be followed by invasion of introduced species. At certain sites, dense infestations of Lantana (Lantana camara), Crofton Weed (Ageratina adenophorum) and Mist Flower (A. riparia) threaten to displace populations of C. cunninghamii by competition, smothering and habitat alteration. Lantana is the main weed of concern, as it can smother large areas of C. cunninghamii habitat with tall, dense thickets. Lantana may also alter the fire regime associated with dry rainforest margins by reducing fire intensity and frequency. This may, in turn, alter the germination response of the seed bank. Crofton Weed and Mist Flower may also alter the flammability of vegetation and have adverse effects on C. cunninghamii.

### 4.4 Small population size

A reduction in the number and extent of populations of a species can pose a genetic risk to both the short term fitness of individuals and the long-term evolutionary potential of the species itself. This may be through genetic bottlenecking, genetic drift and inbreeding depression. The degree of threat proposed by each of these is dependent upon a species biology, evolutionary stage and historical decline.

During any initial rapid reduction in a species’ habitat, the potential exists for the formation of genetic bottlenecks (Young et al. 1996). This is particularly the case where the reduction in habitat leads to all remaining individuals representing a genetic subset of the original gene pool. For species that display gravity dispersal of seed, the likelihood of gene flow between populations is reduced with the
reduction and fragmentation of habitat (Young et al. 1996).

Subsequent to any decline in population size and extent, those populations that remain small and isolated for several generations may continue to show loss of genetic variation as a result of random genetic drift. Species with short generation times tend to show greater loss in variation from genetic drift than those species with long generation times. Genetic drift can cause a decrease in a species’ ability to persist in a changing environment (Ellstrand & Elam 1993).

Genetic variation can also be lost through inbreeding. Depending on the breeding system, this can happen through increased self-pollination or when remaining plants in a population are closely related through common recent ancestry (Young et al. 1996). Inbreeding depression can reduce fitness by decreasing the fecundity and seed viability of a population (Ellstrand & Elam 1993).

*Corchorus cunninghamii* exists in NSW as small scattered stands within two distinct locations, has a relatively short generation time, is self-incompatible and has seed that appears to be predominantly dispersed by gravity. Therefore, the above genetic effects will require consideration in the management of the species. These considerations will be important in ensuring the short and long-term viability of the species, particularly in relation to seed collection for storage and in the prioritisation of sites for on-ground management work.

In the event of translocation, reintroduction or *ex situ* propagation of *Corchorus cunninghamii*, another effect that may require consideration is the potential for outbreeding depression to occur. This is likely to occur if material is sourced too widely, resulting in the mixing of divergently adapted gene pools (Templeton 1986 in Young & Murray 2000). An extreme effect of this is that the resulting offspring may display low relative fitness to their environment and, therefore, may not be capable of persisting at that site in the long term.

### 5 Species’ Ability to Recover

*Corchorus cunninghamii* is subject to a number of direct threats, including inappropriate disturbance regimes, competition with weeds, forestry activities and small population effects. It exists patchily in the landscape in stands that range from single plants to hundreds of individuals.

Central to the maintenance of the species is the effective management of population disturbance across the landscape so that a balance is maintained between germination, growth, seed set and seed dispersal, such that regeneration occurs and seed banks are maintained.

This will require research to determine how the species responds to disturbance so that regimes can be established and managed. It also requires protection of sites to the extent that individuals are able to grow and set seed. In certain instances this may also require the destruction of above ground individuals at a site in order to maintain the seed bank and to provide for recruitment. Appropriate landscape-level management in association with monitoring of disturbance events will provide for the continuation of the existing populations in the form of above ground plants and below ground seed banks.

*Corchorus cunninghamii* displays several germination and recruitment strategies. Establishment of an appropriate disturbance regime that accounts for these strategies and for the species’ life cycle should ensure the maintenance of the species in the wild in NSW.

In this regard, there are several key issues that need to be understood prior to formulating appropriate disturbance regimes. The two major issues are seed viability and longevity and the ideal mode of seed dispersal.

The number and age classes of *Corchorus cunninghamii* populations will be subject to much variation through time. This variation will depend largely on disturbance history and could range from sites that are present solely as seed banks, to those that exist as dense stands of single age seedlings following disturbance, to sites that consist of one or two of mature individuals only.

### 6 Previous Recovery Actions

#### 6.1 Recovery planning

A conservation statement was prepared for *Corchorus cunninghamii* across its range in 1993 (Halford 1993). This was later expanded to include a Recovery Plan (see Halford 1995b). In 2001 a Recovery Plan was prepared for the species in Queensland on behalf of the Queensland Rainforest Ecotone Recovery Team (Saunders 2001). This plan has been adopted by the Commonwealth.

#### 6.2 Population and habitat protection

Areas of important habitat for *Corchorus cunninghamii* are contained within the existing conservation reserve system in NSW. There are
currently records for the species in one national park (Toonumbar National Park) and one nature reserve (Bungabbee Nature Reserve).

Measures for the conservation of *Corchorus cunninghamii* in native forest within state forests of the Upper North East Region are detailed in the IFOA Threatened Species Licence for the region. Under this licence, Forests NSW (formerly State Forests of NSW (SFNSW)) is required to implement conditions set out in the IFOA, whilst the DEC is required to monitor and enforce compliance with conditions. Conditions relating to the protection of *C. cunninghamii* and its habitat include:

- retention of ridge and headwater habitat;
- the protection of rainforest; and
- the provision of a 20 metre exclusion zone around all individuals or groups of *C. cunninghamii* within a compartment or within 20 metres of a compartment.

In accordance with plantation approval under the P&R Act, Forests NSW plantation operations within the Hoop Pine plantation at Toonumbar are subject to a number of conditions prepared by DIPNR. These conditions are provided in Appendix 3.

### 6.3 Threat abatement

A habitat rehabilitation plan for *Corchorus cunninghamii* has been prepared for several locations in NSW in an attempt to reduce the competitive threats imposed by weeds (Bower 2000). The plan includes rehabilitation strategies for sites within Toonumbar National Park, Bungabbee Nature Reserve and Toonumbar State Forest, and was developed with regard to the known regenerative traits of *C. cunninghamii* at the time. The rehabilitation plan will be used as a resource document and on-ground management tool for mitigating threats at known *C. cunninghamii* sites (see Action 2.2).

### 6.4 Surveys

Surveys for *Corchorus cunninghamii* were undertaken at a number of locations in 1993, but no new populations were located. Surveys for the North East NSW Comprehensive Regional Assessment in 1997 resulted in the discovery of the Bungabbee population. During these surveys the Toonumbar area was also resurveyed but no new populations were found. In 2002 a new site was discovered in Toonumbar National Park during a roadside rare plant survey. Surveys by SFNSW at Toonumbar State Forest in 2002 and 2003 substantially increased the known abundance and distribution of this population. These increases probably resulted from disturbance associated with thinning activities undertaken within the plantation.

Large areas of potential habitat exist between Lismore and the upper Richmond Valley. These areas have yet to be surveyed for the species.

### 6.5 Research

**Population dynamics and disturbance**

Research into the population dynamics and disturbance of *Corchorus cunninghamii* in NSW was initiated in 2000 and continued in 2001 (see Stewart 2000, 2001). Recommendations resulting from this research include:

- restoration of natural functioning of the rainforest/sclerophyll ecotone through natural disturbance regimes;
- surveys of potential habitat following disturbance;
- large scale disturbance trials involving weed removal and fire;
- continued census of currently marked populations and marking and census of new populations; and
- pollination, seed dispersal and seed predation trials.

As part of the research into dynamics and disturbance, a seed burial trial was initiated by Stewart (2001). For this trial six groups of 100 seeds were buried at a location in Toonumbar State Forest in February 2001. As yet, none of these seeds have been retrieved for viability analysis.

**Genetic studies**

Genetic (allozyme) comparisons of *Corchorus cunninghamii* have been undertaken on NSW and Queensland populations (Simmonds 2000). It was found that within populations of *C. cunninghamii* there were low levels of genetic variation and between populations there was absence of gene flow. This suggests that each population should be conserved.

### 7 Proposed Recovery Objectives, Actions and Performance Criteria

The overall objective of this Recovery Plan is to protect all known NSW populations of *Corchorus cunninghamii* from decline and to ensure that populations of the species remain viable in the long-term.
Specific objectives of the Recovery Plan for the species are listed below. For each of these objectives a number of recovery actions have been developed, each with a performance criterion.

**Objective 1: To co-ordinate the recovery of Corchorus cunninghamii in NSW**

*Action 1.1*

The DEC will co-ordinate the implementation of the actions outlined in this Recovery Plan.

Some of the tasks undertaken during the co-ordination of this plan (e.g. liaison with other public authorities) will overlap with other identified actions. Co-ordination of the NSW plan for *Corchorus cunninghamii* will also require liaison and information exchange with the Queensland recovery team.

**Performance Criterion:** The DEC co-ordinates the recovery actions included in this Recovery Plan.

*Action 1.2*

The DEC will integrate recovery actions of the *Corchorus cunninghamii* Recovery Plan with those of other threatened species, populations and communities.

A number of other threatened species are likely to occur with, or be subject to, the same threats as *Corchorus cunninghamii*. Also, species with similar management requirements may benefit from the *C. cunninghamii* recovery program. Such species will be subject to a Recovery Plan in the future and by integrating recovery actions, limited resources can provide better conservation benefits for a range of threatened species.

**Performance Criterion:** Where practicable, recovery actions have been integrated with those of other threatened species, endangered populations or endangered ecological communities.

**Objective 2: To mitigate threats to Corchorus cunninghamii and improve the protection and management of its habitat**

*Action 2.1*

The DEC will prepare and maintain a disturbance register for all *Corchorus cunninghamii* sites in NSW.

*Corchorus cunninghamii* occurs in ecotonal areas and appears to favour regeneration by soil disturbance or fire. It is important to maintain a record of all disturbance-related events and the response of the species to them. This register will be consulted prior to works where populations are known to occur. The register will assist in maintaining a balance of sites at various life cycle stages to allow for an overall viable population at the landscape level. The register will also be used to determine when active disturbance management is required at a site to prevent loss of the seed bank population due to lack of viability. It will assist in obtaining a more complete picture on optimal disturbance regimes and will be used in combination with rehabilitation techniques and fire management (see Appendix 4).

**Performance Criterion:** A disturbance register has been initiated within the first six months of this Recovery Plan and disturbance events have been entered into the database when identified.

*Action 2.2*

The DEC will implement management programs that mitigate threats to *Corchorus cunninghamii* and improve the protection and management of its habitat on DEC estate.

The management of *Corchorus cunninghamii* should be incorporated into DEC Plans of Management to assist in disturbance and regeneration of populations as well as weed control. Plans should also ensure that general activities such as road maintenance, roadside weed control and fuel reduction burns do not conflict with the aims of this Recovery Plan. Management programs will be developed in accordance with the information contained in Bower (2000) and the principles contained in Appendix 4.

**Performance criteria:** Recruitment of *Corchorus cunninghamii* occurs and populations occurring within the landscape of DEC estate are maintained; The threat of Lantana and other competitive weeds on DEC estate is reduced.

*Action 2.3*

The DEC will undertake a small-scale disturbance trial at one known *Corchorus cunninghamii* site within DEC estate.

A disturbance trial should be carried out on at least one DEC site where *Corchorus cunninghamii* is known to be present as a seed bank only. A variety of small-scale disturbances will be trialed at this site, including mechanical soil disturbance, weed control treatments and fire. This will provide an indication of the response of the species to each disturbance type and options for future management of the species on DEC estate. Follow-up monitoring will occur, possibly as part of the demographic research proposed in Action 4.2. Follow-up weed control may also be required to ensure the persistence of *C. cunninghamii* at the site long enough to flower and set seed.
Objective 3: To determine if new populations exist and to protect their habitat

Action 3.1
The DEC will support field surveys of potential habitat to search for additional occurrences of the species in NSW.

Field surveys are needed to locate new or overlooked populations. A large area of potential habitat exists north-west of Lismore to the upper Richmond Valley. Potential areas to search include Toonumbar National Park, Border Ranges National Park, McKellar Range and Richmond Range National Park and Richmond Range State Forest. Targeted surveys may increase the known number of populations of the species and may improve its conservation status. Such surveys may also be undertaken opportunistically to take advantage of possible regeneration events in potential or historical habitat following disturbance events.

An assessment of the threats to any new population should be undertaken at the time of discovery to ensure that appropriate management actions can be undertaken as soon as possible. As a matter of course, specimens from all populations should be lodged with an appropriate herbarium to ensure that material is available at a future date for any research or verification needs.

Performance Criterion: Targeted surveys for Corchorus cunninghamii are undertaken in areas of potential habitat by the end of year 4.

Action 3.2
The DEC will investigate conservation and management options for new populations located on private land.

A range of options exist for the conservation of any new populations of Corchorus cunninghamii found on private land. The most appropriate management should be determined on an individual basis. It must be acceptable to the landowner/manager and be able to deliver the resources necessary to maintain the viability of the population and its habitat.

Any on-ground management or rehabilitation of sites on private property should be subject to the same guidelines described in the actions of this Recovery Plan and should follow the principles and protocols set out in Bower (2000).

Objective 4: To improve on the knowledge of Corchorus cunninghamii that is relevant to its conservation and management

Action 4.1
The DEC will facilitate research that is relevant to the conservation and management of Corchorus cunninghamii.

A body of research on Corchorus cunninghamii already exists in NSW and Queensland. Future research should build on this established information base. Research should focus on biology, ecology and genetics, with priority given to seed longevity (Appendix 5).

Performance Criteria: A timetable for a seed viability trial is prepared within six months of the commencement of this Recovery Plan and the resulting viability trial commenced within one year; targeted research into the biology, ecology and genetics of the species is supported by the DEC.

Objective 5: To establish ex situ collections of Corchorus cunninghamii

Action 5.1
The DEC will support the establishment of ex situ collections of Corchorus cunninghamii.

Establishment of ex situ plantings and seed storage will provide insurance against the risk of extinction of wild populations through continuing decline or catastrophic events. All NSW populations appear to be vulnerable to extinction and should be represented in ex situ collections either as living collections or stored seed.

As part of this action, the DEC will prepare a seed collection and storage strategy for the species in NSW (see Appendix 4).

Performance criteria: A seed collection and storage strategy is prepared within one year of the commencement of this Recovery Plan; ex situ plantings and/or seed storage of Corchorus cunninghamii from the NSW populations are established within 18 months of the commencement of this Recovery Plan.

Objective 6: To increase public awareness of Corchorus cunninghamii

Action 6.1
The DEC will develop a community awareness strategy that will raise the profile of Corchorus cunninghamii and its ecotonal habitat.

Information contained within a community awareness strategy should not concentrate solely on Corchorus cunninghamii but, rather, include information on the wider ecotonal habitat in which the species is found. This should include information on the dynamic nature of ecotones, the species found in them, and the role of disturbance in maintaining them.

Performance Criterion: Community awareness of the importance of the ecotonal habitat of Corchorus cunninghamii and the recovery process is increased.

8 Social and Economic Consequences

Corchorus cunninghamii is a member of the same genus as the fibre plant Jute (C. olitorius). As such, it may have potential economic uses related to fibre production.

The cost necessary to maintain Corchorus cunninghamii as part of the natural heritage of NSW is small compared to the benefits it can provide people who experience and learn about this species in the wild or in cultivation. Increased community awareness of C. cunninghamii will enhance the profile of threatened species in general. This in turn will stimulate greater opportunities for the conservation of threatened species generally and thus increased protection of biodiversity.

The total cost of implementing the plan is estimated at $123,750 over five years. Of this, $43,750 are in-kind funds, representing the salary component of permanent staff and existing resources.

The costings for implementation of the recovery actions are itemised in Table 2.

9 Biodiversity Benefits

Corchorus cunninghamii is taxonomically significant as the only species of Corchorus that is indigenous to NSW and one of only three species of the family Tiliaceae indigenous to NSW. The species is biogeographically significant as an endemic of the Mt Warning and Focal Peak shield region, which is a major refugium and centre of speciation for Australian plants and forms part of the Central-Eastern Rainforest Reserves World Heritage Area (DASET 1992).

There are a number of plant species of conservation concern that co-occur with Corchorus cunninghamii in NSW, including Sophora fraseri (Vulnerable - TSC Act and EPBC Act) and Desmodium acanthocladum (Vulnerable - TSC Act and EPBC Act). Several other threatened plant species are associated with C. cunninghamii in Queensland and may occur with it in NSW, including Choricarpia subargentea (Endangered - TSC Act), Randia moorei (Endangered - TSC Act, EPBC Act and NC Act) and Endiandra floydii (Endangered - TSC Act, EPBC Act and NC Act) (Haford 1993).

Rare plants with small populations such as Corchorus cunninghamii represent a component of biodiversity that is at high risk of extinction due to human-induced causes. Corchorus cunninghamii is, therefore, a priority species to consider in conservation efforts aimed at preventing further loss of biodiversity from our natural ecosystems.

Protection of Corchorus cunninghamii and maintenance of its ecotonal habitat can have several other biodiversity benefits. Ecotones are transient and represent an important seed resource for pioneer species (Tang et al. 2003), as well as providing buffers between ecosystems. Therefore, conservation of C. cunninghamii and its habitat will assist in the maintenance of ecosystems in the Mt Warning-Focal Peak region.

10 Preparation Details

Sections of this draft Recovery Plan are based on a preliminary draft prepared by Andrew Benwell, consultant botanist. The plan was updated and finalised by Shane Ruming, Conservation Programs and Planning (North East Branch), DEC. Support was provided by Dianne Brown and Bill Faulkner, Conservation Programs and Planning (North East Branch), DEC.

11 Review Date

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

12 Implementation

Table 2 outlines the implementation of recovery actions specified in this Recovery Plan to relevant government agencies and/or parties for the period of five years from publication. The DEC is only responsible party for implementing the Recovery Plan.


13 References


Simmonds, M. 2000, The ecology and conservation of the endangered species Corchorus cunninghamii F. Muell, BSc (Hons) thesis, University of Queensland, Brisbane.

State Forests of NSW 2003, Unique and Special Wildlife Values of the Toonumbar Hoop Pine Plantation State Forest of NSW, Report to the...
Department of Land and Water Conservation, unpub.


14 Acronyms Used in this Document

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>DEC</td>
<td>NSW Department of Environment and Conservation</td>
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<tr>
<td>DIPNR</td>
<td>NSW Department of Infrastructure, Planning and Natural Resources</td>
</tr>
<tr>
<td>EP&amp;A Act</td>
<td>NSW Environmental Planning and Assessment Act 1979</td>
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<tr>
<td>EPBC Act</td>
<td>Commonwealth Environment Protection and Biodiversity Conservation Act 1999</td>
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<td>FNPE Act</td>
<td>NSW Forestry and National Park Estate Act 1998</td>
</tr>
<tr>
<td>IFOA</td>
<td>Interim Forestry Operations Approval</td>
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<tr>
<td>NC Act</td>
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<td>P&amp;R Act</td>
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### Table 2. Estimated costs of implementing the actions identified in the *Corchorus cunninghamii* Recovery Plan

<table>
<thead>
<tr>
<th>Action number</th>
<th>Action Title</th>
<th>Priority</th>
<th>Estimated Cost/Year</th>
<th>Total cost ($)</th>
<th>Responsible Party/ Funding Sources</th>
<th>In-kind</th>
<th>Cash</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Year 1 Year 2 Year 3 Year 4 Year 5</td>
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<td>1.2</td>
<td>Integrate actions with other Recovery Plans</td>
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<td><strong>43,750</strong> <strong>80,000</strong></td>
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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 Submission

Recovery Plan Submission

Name Individual/Organisation:

Postal Address:

Postcode: Contact Number(s):

Date:

Draft Recovery Plan: Corchorus cunninghamii

The DEC will consider all written submissions received during the period of public exhibition and must provide a summary report of those submissions to the Minister for the Environment prior to final approval of this Recovery Plan.

Please note, that for the purposes of the NSW Privacy and Personal Information Protection Act 1998 any comments on this draft Recovery Plan, including your personal details, will be a matter of public record and will be stored in the DEC records system for a period of up to 2 years from the closing date. The submission of personal information is voluntary. Copies of submissions will be available on request at the DEC office responsible for the preparation of the Recovery Plan.

Should you not wish to have your personal details disclosed to members of the public, please indicate below whether you wish your personal details to remain confidential to the DEC. Please note that access to the details may be requested under the NSW Freedom of Information Act 1989. You will be consulted if this happens.

Further information on the Privacy and Personal Information Protection Act 1998 and the Freedom of Information Act 1989 may be obtained from the DEC or from the website: www.environment.nsw.gov.au

☐ Yes, please keep my personal details confidential to DEC

Submissions should be received no later than the advertised date. Submissions should be addressed to:

The Director-General
C/- Corchorus cunninghamii Recovery Plan Co-ordinator
Conservation Programs and Planning, North East Branch
Department of Environment and Conservation
Locked Bag 914
Coffs Harbour NSW 2450
### Appendix 2 Public Authority Responsibilities

<table>
<thead>
<tr>
<th>Public authority</th>
<th>Relevant responsibilities</th>
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| Department of Environment and Conservation          | • Assessment of Section 91 licence applications under the TSC Act.  
• Assessment of Section 120 licence applications under the NPW Act.  
• Assessment of Section 132C 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 NVC 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 NVC Act.  
• Administration of property plans under the NVC Act.  
• Management of crown land with potential habitat.  
• Co-ordination of Regional Vegetation Committees, Catchment Management Boards and Landcare programs.  
• Development of policy and strategies, including SEPPs, for land use planning and environmental assessment.  
• Advice and assistance on environmental planning matters.  
• Assessment of major development applications.  
• Plantation approval under the P&R Act.  
• Administration of the general conditions of IFOA.  
• Concurrence role under the EP&A Act for certain developments and activities.  
• Making of SEPPs 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. |
| Forests NSW                                         | • Implementation of prescriptions detailed in IFOA terms of threatened species licence granted under Part 4 of the FNPE Act. |
• 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 3 Specific Conditions for Plantation Operations at Toonumbar State Forest

The following conditions relate to the DIPNR approval of plantation operations by Forests NSW at Toonumbar State Forest in accordance with the P&R Act.

1. Plantation operations may continue in the plantation area under normal operating prescriptions provided that the following special prescriptions are implemented for the protection of the *Corchorus cunninghamii* population.

2. Clearfall of the current plantation area is to be scheduled over a period of at least 10 years commencing from 2003. Clearfall areas shall be managed such that not more than 10% of the plantation area may be clearfelled during year 1. Operations in subsequent years shall ensure that the total maximum area of the plantation that may be clearfelled shall not exceed 20% of the total plantation area during year 2 and 30% of the total plantation area during year 3 through to 100% at the end of year 10 in 2012.

3. Pre and post clearfall surveys will be carried out for the presence of *Corchorus cunninghamii* within each compartment of the plantation. Pre disturbance surveys will aim to record the location of the species and their reproductive status. Post disturbance surveys will be conducted within six months of the completion of the disturbance event.

4. Scheduling of all harvesting, establishment and management operations within the Toonumbar plantation shall account for the lifecycle of the *Corchorus cunninghamii* such that where plants are present they shall be allowed to set and disperse their seed prior any disturbance event.

5. Surveys shall be conducted using the same methodology as that used by SFNSW (2003). The results of the surveys are to be advised to the Department of Sustainable Natural Resources (now DIPNR) in form of a report on the *Corchorus cunninghamii* population within the plantation area on an annual basis commencing in 2004. (Note: DIPNR will forward a copy of the report to the DEC).

6. Forests NSW shall prepare a seed collection and storage strategy in consultation with DEC and obtain the appropriate licence to collect sufficient seed within the plantation to propagate approximately 2000 seedlings of *Corchorus cunninghamii*. The seeds are to be stored at a suitable agreed facility such as the Coffs Harbour Herbarium.

7. These prescriptions may be modified as a result of information gained from the surveys and any other research information on the species that becomes available in future years so as to ensure the viability of the *Corchorus cunninghamii* population within the Toonumbar plantation area.
Appendix 4 Management Principles for Corchorus cunninghamii in NSW

Recording disturbance events

The disturbance register provided for in Action 2.1 will contain a full disturbance history for all known sites (above ground plants and/or seed banks) of Corchorus cunninghamii in NSW. Information will be recorded on the location, timing, extent and type of disturbance (including weeding and rehabilitation). Information contained on this register should be consistent through time and staff turnover and also between populations and sites. Forests NSW will be encouraged to provide disturbance information associated with native forestry and plantation activities for sites on state forest estate.

Management on DEC estate

Disturbance and regeneration

The disturbance register will be used to determine when and where disturbance management is required to maintain a population of Corchorus cunninghamii within the landscape. The type of disturbance also needs to be determined. Both fire disturbance and physical soil disturbance have their advantages. Fire offers a more ecologically-based disturbance at the landscape scale and may benefit entire vegetation communities. However, fire-based disturbance may not be compatible with management objectives of certain areas of wet sclerophyll forest or dry rainforest. In these instances, physical soil disturbance is a viable alternative to achieving regeneration. This type of disturbance is more suited to smaller, site-based patches.

For example, mass germination events are not necessarily desirable in the landscape-scale management of the population, particularly when disturbance events occur close together in time. It is the entire regime, rather than the one-off disturbance event, which is important. A regime must take into account the time interval between disturbances as well as magnitude, scale (localised, compartment based or landscape based) and type (physical or chemical/fire related) of disturbance. Any artificial or managed regime must also take into account the purpose of the disturbance. For example, weeding for environmental or commercial purposes may constitute a disturbance event but, in certain instances, may be required close to another disturbance event to prevent weeds taking over a Corchorus cunninghamii site. Such disturbance events will also prevent further reductions in population numbers, which will assist with managing potential genetic threats such as drift and inbreeding.

Disturbance management of Corchorus cunninghamii habitat should aim to maximise diversity as opposed to maximising density of C. cunninghamii within the landscape. In particular, fire-based management should not concentrate on the requirements of C. cunninghamii in isolation of other ecotonal species. Such an approach relies on the following principles (see Bradstock et al. 1995; Keith 1996; Keith et al. 2002):

- Upper and lower thresholds should be developed for each component of a regime (frequency, intensity, season and spatial pattern within the landscape). Regimes beyond these thresholds should be avoided if possible. Development of such thresholds relies on information on life history factors of the species in question. These thresholds may be based upon functional groups, rather than individual species. In this case, thresholds should be based upon the most susceptible species of a group.

- Mosaic burns should be used to provide spatial variability in age and structure of sites throughout the landscape.

- Management should be adaptive to account for unplanned factors. For example, several unplanned fires following a planned disturbance have the potential to deplete seed banks, whilst drought following a planned disturbance could reduce seedling survivorship.

- Management should be flexible enough to adapt to ongoing changes in knowledge and ecosystem response.

- Disturbance management should be compatible with other management objectives. For example, protection of dry rainforest communities from wildfire.

- Monitoring and experimentation should be used.
These principles of fire-based disturbance regimes can be adapted for other forms of disturbance management.

**Habitat rehabilitation and weed control**

Bower (2000) has provided rehabilitation and weeding strategies for sites within Toonumbar National Park and Bungabee Nature Reserve, which were developed with regard to the known regenerative traits of *Corchorus cunninghamii* at the time. The strategies contained within Bower (2000) will be used as a resource document and on-ground management tool for weeding and rehabilitation at *C. cunninghamii* sites. It may be necessary to amend these guidelines in the event of research providing new information on the species.

The strategies of Bower (2000) must be used in combination with other information, such as up to date survey and disturbance data for each location, the distribution of weed species and weed control methods. The preparation of pest control plans will facilitate the regular review and reassessment of threats, thus allowing appropriate actions to be undertaken. It will also provide a measure upon which the success of weed control can be assessed.

The threat from Lantana and other weeds at known sites is probably best controlled by manual bush regeneration techniques such as hand pulling and cut-and-paint, perhaps in combination with mechanical removal (e.g. slashing or backhoe) and spraying where infestations are dense. Provided that follow-up weeding is undertaken, this approach will help mitigate any increasing threat of displacement by weeds. Lantana should also be removed from as much of the surrounding forest as possible to maintain natural habitat conditions. Weed control methods likely to damage existing *Corchorus cunninghamii* plants should be avoided.

Lantana control in Queensland has been shown to stimulate germination of *Corchorus cunninghamii* through soil disturbance (S. Parr pers. comm.). However, this type of disturbance can also cause germination of weed species such as Mist Flower and Crofton Weed. Therefore, initial weed removal, along with all other disturbance-type activities, may require follow-up weed control.

Monitoring seedling recruitment of *Corchorus cunninghamii* in response to soil disturbance caused by weed control is desirable. Recruitment response trials could be carried out for different combinations of weed control treatments. Monitoring of these effects could be integrated with the demographic research proposed in Action 4.1.

**Seed collection**

As part of Action 5.1, the DEC will prepare a seed collection and storage strategy for *Corchorus cunninghamii* in NSW. This strategy will consider:

- timing of seed collection and seasonal variation in seed production (see Stewart 2001);
- up to date information available on *Corchorus cunninghamii* ecology, including seed germination and viability;
- storage time and conditions to ensure a certain level of seed remains viable;
- a precautionary approach to a decline in viability of stored seed;
- possible outbreeding depression and loss of genetic compatibility between stored seed and *in situ* plants; and
- surveys and monitoring in association with Action 2.1; in particular, consideration of a threshold level that will trigger consideration of seed reintroduction.
Appendix 5 Research Considerations for *Corchorus cunninghamii*
Conservation

**Biology and ecology**

Research undertaken in NSW and Queensland on fire response and regeneration behaviour provides some background for formulating an interim disturbance management strategy for *Corchorus cunninghamii* habitat. However, it would be desirable to duplicate and extend some of this research for NSW populations before defining and implementing appropriate disturbance management.

Effective disturbance management of the ecotonal habitat of *Corchorus cunninghamii* requires knowledge of the ecology and life history of the species that occur within the habitat. An understanding of the population ecology of rare species and their general life history characteristics is essential for effective conservation management (Fielder *et al.* 1997). In the particular instance of *C. cunninghamii*, better information is needed on seed longevity and dispersal mechanisms to assist in developing management programs and maintaining suitable habitat conditions for the species.

Priority should be given to seed longevity and viability. In this regard, it is desirable to extend the studies of seed dormancy undertaken by Halford (1993) and Simmonds (2000). Therefore, a timetable for a viability trial should be prepared and viability tests undertaken on the seed buried at Toonumbar State Forest in 2001 (see Stewart 2001).

Demographic studies for *Corchorus cunninghamii* sites and populations should build on the work already conducted or in progress. Such studies should include interactions between weed species and *C. cunninghamii* to clarify the level of threat from weeds. Measures of weed abundance in and surrounding *C. cunninghamii* sites and monitoring of interactions between weed seedlings and *C. cunninghamii* seedlings would be useful in this regard. Further research and monitoring of populations is also required to determine:

- rates of recruitment in burnt forest, unburnt forest and under different soil disturbance treatments;
- age/size specific mortality rates within populations;
- the range of fire frequency and fire intensity needed to promote sustainable populations of *Corchorus cunninghamii*; and
- whether periodic burning is absolutely essential for population maintenance (either as seed bank or extant plants).

It would be efficient to combine research with any monitoring undertaken as part of site management (see Action 2.2). If this is not possible because of timing considerations, methodologies used in projects should be compatible where possible to allow joint use of data. Research involving fire and weed trials under a variety of regimes is already underway in Queensland as part of the Recovery Plan for *Corchorus cunninghamii* in that State (see Saunders 2001). It is important that co-ordination of the recovery effort in NSW is undertaken in close consultation with the Queensland recovery team (see Action 1.1) so that such research is not duplicated unnecessarily. Bower (2000) has provided an outline for regeneration trials in NSW.

**Genetics**

Simmonds (2000) recommended that further genetic analysis be undertaken into the genetics of *Corchorus cunninghamii* using a more sensitive molecular (DNA) approach than was used in the isozyme analysis. At this stage, genetic research is not a priority in the management of *C. cunninghamii* in NSW. However, genetic research that produces practical outcomes to assist with the management priorities of the species should be considered toward the end of the life of this plan. Such research will provide a basis for more informed landscape-scale management when undertaking the five year review of this plan.