

Management Plan for the Coastal Fontainea

Fontainea oraria

February 2011

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Management Plan for the Coastal Fontainea *Fontainea oraria*

Foreword

This Management Plan was developed from the draft Coastal Fontainea recovery plan. The Border Ranges Rainforest Biodiversity Management Plan, a landscape-level, regional plan, now constitutes the formal recovery plan for Coastal Fontainea, with reference to this Management Plan. As such the Management Plan refers to the conservation requirements of the species across its known range. It identifies the actions to be taken to ensure the long-term viability of the species in nature.

The Coastal Fontainea is included as Endangered on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and Critically Endangered on the NSW *Threatened Species Conservation Act 1995*. It is a rainforest tree that occurs in the littoral rainforest on krasnozem soil in the Lennox Head area and is only known from this area in far north-eastern NSW. The species has been recorded from a council reserve and freehold land.

The management actions detailed in this plan are directed toward: (i) protecting and managing the Coastal Fontainea population and its habitat; (ii) determining if Coastal Fontainea occur on other unidentified sites and collecting and managing baseline data; (iii) gaining a better understanding of the biology and ecology of the Coastal Fontainea; (iv) undertaking a translocation program for the Coastal Fontainea; (v) raising awareness and encouraging community involvement in the conservation of the Coastal Fontainea and its habitat; (vi) developing and implementing a contingency plan to ensure the long-term survival of the Coastal Fontainea; and (vii) ensuring the status of the Coastal Fontainea is appropriately reflected in relevant legislation and policy.

Management of the Coastal Fontainea is ongoing and relies on the support of landholders, land managers, the general community, and relevant government agencies.

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1 Introduction

Coastal Fontainea *Fontainea oraria* (Jessup & Guymer) is one of Australia's rarest rainforest trees. The species was discovered in 1982 by Jessup and Guymer of the Queensland Herbarium (Jessup & Guymer 1985, Hunter et al. 1992) at Lennox Head in far northern New South Wales (NSW). Over twenty years later the Coastal Fontainea remains known in small numbers in four locations at Lennox Head.

The Border Ranges Rainforest Biodiversity Management Plan, which constitutes the formal recovery plan for the Coastal Fontainea, references this Management Plan. It identifies the actions to be taken to ensure the long-term viability of the Coastal Fontainea in nature. The attainment of the objectives of this Management Plan is subject to budgetary and other constraints affecting the parties involved. It may also be necessary to review this plan in the event of new information.

This plan has been prepared by the Department of Environment, Climate Change and Water NSW (DECCW) in consultation with relevant government authorities and private landholders.

2 Legislative Context

2.1 Conservation status

The Coastal Fontainea is listed as Endangered on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Critically Endangered on the NSW *Threatened Species Conservation Act 1995* (TSC Act).

Using the International Union for the Conservation of Nature and Natural Resources (IUCN) Red List Criteria (IUCN 2001), the Coastal Fontainea warrants a listing of Critically Endangered (Appendix 1).

The 'Endangered Ecological Community' 'Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions', as listed under the TSC Act, is recognised as providing, or potentially providing, habitat for the Coastal Fontainea.

2.2 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides a legislative framework for the protection of threatened species across Australia. The Act imposes the obligation (arising from the listing) for responsible agencies (particularly Commonwealth) to adopt protective measures.

Under the EPBC Act, Critical Habitat may be registered for any nationally listed threatened 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 which 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 Australian Government Minister.

This Management Plan does not specifically identify habitat that is critical to the survival of the Coastal Fontainea. However, the distribution, habitat and ecological information included in this plan (Sections 3.4–3.5) will assist the Australian Government Minister in identifying habitat that is critical to the survival of this Coastal Fontainea.

The DECCW does not consider it appropriate that this Management Plan identifies or maps the occurrence of this species in the detail that would be required to define Critical Habitat due to the need to maintain the confidentiality of the location of the sites.

As the Coastal Fontainea 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 Australian Government Minister 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 Australian Government Department of Sustainability, Environment, Water, Population and Communities to assist proponents in determining whether their action is likely to have a significant impact.

2.3 State legislation

Responsibilities under the *Threatened Species Conservation Act 1995*

Recovery Plan preparation, exhibition and implementation

The TSC Act, the *Threatened Species Conservation Amendment Act 2002*, and the *Threatened Species Legislation Amendment Act 2004* (hereafter referred to collectively as the TSC Act) provide a legislative framework for protecting and encouraging the recovery of:

- 'Critically Endangered', 'Endangered', and 'Vulnerable' species
- 'Endangered' populations
- 'Critically Endangered', 'Endangered' and 'Vulnerable' ecological communities in NSW (hereafter referred to collectively as threatened species).

Under this legislation the Director General of DECCW may prepare recovery plans for species and ecological communities listed as 'Critically Endangered', 'Endangered' or 'Vulnerable', and populations listed as 'Endangered', on the TSC Act schedules. The TSC Act includes specific requirements for both the matters to be addressed in recovery plans and the process for preparing recovery plans. The Recovery Plan for this species has been incorporated into the Border Ranges Rainforest Biodiversity Management Plan.

The TSC Act also requires the preparation of a threatened species Priorities Action Statement (PAS). A PAS was developed, which identifies and prioritises broad recovery and threat abatement strategies for threatened species and 'Key Threatening Processes' (KTPs). Each strategy is supported by a number of species-specific priority actions. The PAS also sets out clear timetables for recovery and threat abatement planning and achievement. It identifies those threatened species and KTPs for which recovery and threat abatement plans will be prepared. Importantly, the PAS establishes performance indicators to aid in the reporting of the implementation of recovery and threat abatement strategies as well as the effectiveness of such strategies. The preparation of this plan is consistent with the PAS and the recovery actions detailed in this plan have been incorporated into the PAS.

Consultation with indigenous people

Local Aboriginal Land Councils, Elders and other groups representing indigenous people in the areas where the Coastal Fontainea occurs have been identified and a copy of the draft Recovery Plan sent to them. Their comments on the draft have been considered in the preparation of the this Management Plan. It is also the intention of DECCW 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 the Coastal Fontainea 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. However, an assessment of 'Critical Habitat' will be undertaken as an action in this plan.

Key Threatening Processes

The TSC Act provides for the identification and listing of KTPs (processes that threaten, or could threaten, the survival or evolutionary development of species, populations or ecological communities). As of August 2010 there are 34 KTPs listed on the TSC Act. Of these 'Clearing of Native Vegetation' (NSW Scientific Committee 2001), 'Invasion, Establishment and Spread of Lantana (*Lantana camara*)' (Scientific Committee 2006a) and 'Invasion and Establishment of Exotic Vines and Scramblers' (Scientific Committee 2006b) are considered to be relevant to the Coastal Fontainea and its habitat. In addition to these KTPs a range of other processes are recognised as threatening the survival of the species. These threats are discussed in Section 4.

Licensing

Any proposed works not requiring development consent or activity approval 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 Coastal

Fontainea, or damage its habitat, requires a licence from DECCW 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 the Coastal Fontainea and its habitat, including making a Stop Work Order or Joint Management Agreement.

Relationship to other state legislation

Additional legislation relevant to the conservation and recovery of the Coastal Fontainea 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.*

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

Environmental Planning and Assessment Act 1979

This Act provides for the consideration of the Coastal Fontainea in land use planning issues. Consent and determining authorities are required to consider potential impacts on the Coastal Fontainea and its habitat when considering an activity or development proposal under Part 4 or Part 5 of the EP&A Act. A species profile and Environmental Impact Assessment Guidelines are provided in Appendix 3. These are designed to assist consent and determining authorities and environmental consultants in undertaking assessments of significance.

Local Government Act 1993

The NSW *Local Government Act 1993* (LG Act) requires that Recovery Plans are taken into account when preparing Management Plans for community land. The northern site of the Coastal Fontainea occurs in a council reserve that is included in Ballina Shire Council's Plan of

Management for their community lands (Ballina Shire Council 2000).

3 Species Information

3.1 Taxonomic background, description and significance

Taxonomic background

The Coastal Fontainea is placed in the Family Euphorbiaceae. The genus *Fontainea* contains ten species that extend through northern NSW, south-east and north-east Queensland, New Guinea, New Caledonia and Vanuatu (Jessup & Guymer 1985).

Of the six species in the genus that occur in Australia, five are endemic and are considered as 'Rare', 'Vulnerable' or 'Endangered' on State and Commonwealth legislation.

Taxonomic description

The Coastal Fontainea is a small tree that grows to a height of 8–10 m. The lower trunk is fluted, twisted and commonly multi-stemmed. The bark is slightly scaly and grey-brown on older stems and smooth and light grey-brown on young plants. Inner bark layer is pea-green (Floyd 1989).

The inner bark exudes a red sap when damaged (typical of a number of species in the Euphorbiaceae). The cut bark has no smell; however, it causes a delayed 'burning' sensation in the mouth (Floyd 1989).

The branchlets are moderately thick, green but turning fawn where leafless. They are smooth but ridged below each leaf stalk (Floyd 1989).

The leaves of the Coastal Fontainea are alternate, simple, elliptic, discolourous (different coloured on each side), hairless and glossy. They are 8–15 cm long. There are two small oval glands raised 0.5–4 mm from the leaf base. Leaf shoots are hairy (Floyd 1989; Harden 1991). The mid-ribs and lateral veins are distinct and raised on both leaf surfaces. The petioles (leaf stalks) are 1–2 cm long and swollen at the junction with the leaf base. The leaves are spirally arranged up the stem. The leaf stalks exude a clear watery sap (Floyd 1989; Hunter et al. 1992).



Figure 1. Detail drawings of the Coastal Fontainea

Clockwise from top left: Female branch in flower; female flower detail; male branch in flower; male flower; fruit; leaves showing glands.

The Coastal Fontainea has small (1 cm diameter) whitish flowers with four or five petals with silky to velvety hairs (4–6 mm long). There are often 2–3 flowers on a female inflorescence occurring in the axils or at the ends of branches. The male flowers have 20–24 stamens joined into a tube at the base (Floyd 1989). The species is thought to have male and female flowers on separate plants (dioecious). Figure 1 illustrates the male and female flowers.

The fruit of the Coastal Fontainea is a 3–6 grooved pink to red globose drupe, generally ripe around March–April. They are about 2.5 cm diameter and 2–3 cm long. Within the drupe, the endocarp is hard, wrinkled and grooved with 2–3 hard sharp ridges. There are 3–4 seeds per fruit (Jessup & Guymer 1985; Floyd 1989; Hunter et al. 1992).

Taxonomic significance

Genetic studies have been undertaken into the relationship between the Coastal Fontainea and other species of *Fontainea* found in NSW and Queensland. These studies showed the Coastal Fontainea and *F. australis* as representing distinct genetic pools although they are more closely related to each other than to other *Fontainea* species (Rossetto & McNally 2000; Rossetto et al. 2000). Coastal Fontainea differs from *Fontainea australis* in having a smooth endocarp, longer floral axes and more distal gland placement (Jessup & Guymer 1985). The Coastal Fontainea is considered a distinct species and as such knowledge of this species is considered a significant part of understanding the evolutionary relationship and history of the species in the genus.

3.2 Distribution and Abundance

Current and historical distribution

The Coastal Fontainea is known in the wild in small numbers on four sites near Lennox Head on the far north coast of NSW (Figure 2). These sites occur within a 600 m radius. The total population comprises ten adults and 45 seedlings and juveniles.

It is possible that the Coastal Fontainea was more widespread within the littoral rainforest on krasnozem soil in the Lennox Head area. The majority of this vegetation has been cleared and potentially plants of the Coastal Fontainea were destroyed at the same time. Genetic research indicates that there was gene flow between these remnants prior to clearing (Rossetto & McNally 2000). It was likely that existing genotypes were connected once as a more or less continuous population. The Coastal Fontainea plants at the northern site and the southern sites form a reasonably homogenous group (Rossetto et al. 2000).

3.3 Land tenure and zoning

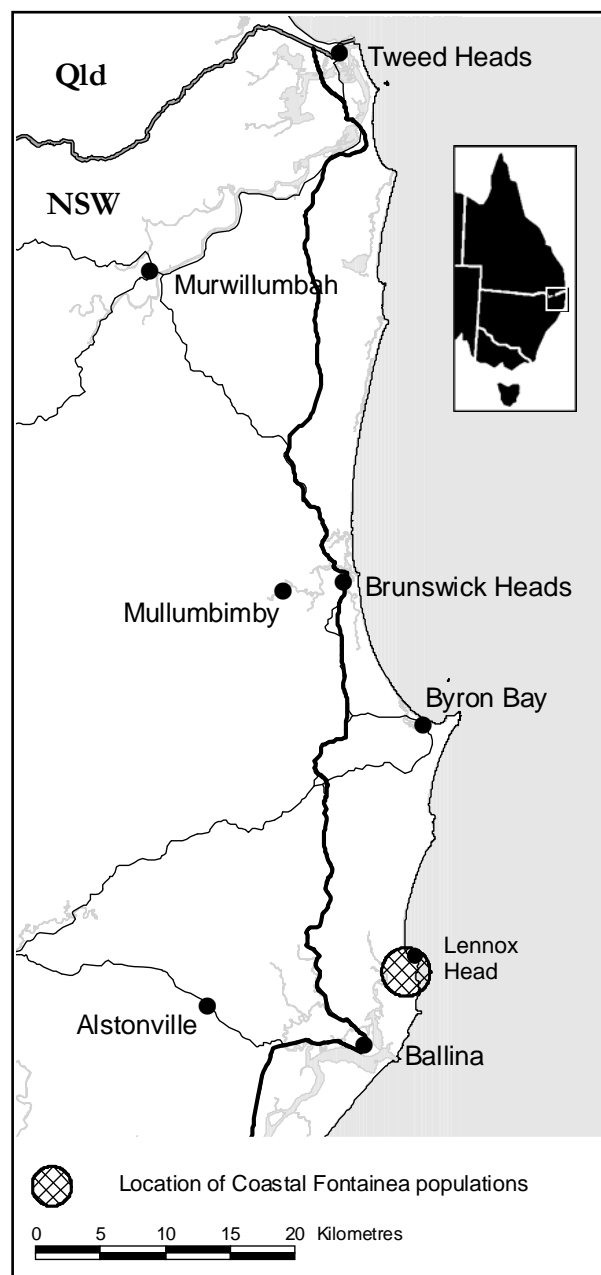
The northern site of the Coastal Fontainea grows in a Ballina Shire Council Reserve. Under the Ballina Local Environment Plan (LEP) 1987 (Ballina Shire Council 1995) this land is zoned 7(l) Environmental Protection (Habitat) Zone.

The southern sites of the Coastal Fontainea occur on privately owned land. Under the Ballina LEP 1987 this land is zoned 7(l) Environmental Protection (Habitat) and 7(d) Environmental

Protection (Scenic/Escarpment) (Ballina Shire Council 1995).

Zoning is being reviewed and standardised during the preparation of Standard Instrument LEPs. The zoning of land where Coastal Fontainea occurs is likely to translate to E2 (Environmental Conservation).

Figure 2. Location of the Coastal Fontainea sites



3.4 Habitat

Vegetation

The Coastal Fontainea grows in remnant stands of littoral rainforest dominated by *Guioa* (*Guioa semiglauc*). A list of species commonly associated with the Coastal Fontainea is provided in Appendix 4. Numerous exotic plant species have been recorded in the Coastal Fontainea remnants. A list of these weed species is provided in Appendix 5.

It appears the majority of the rainforest habitat where Coastal Fontainea occurs at Lennox Head is largely regrowth having been cleared pre-1950 (McKinley et al. 1999). The Lennox Head littoral rainforest is highly fragmented and isolated by cattle pasture and residential development. Strong windshear has worn the outer edge of the canopy smooth and there is little recruitment of native species in areas along the edges. The canopy is low within the remnants with recruitment of a diverse range of species. The mid-layer is relatively sparse. This may be related to the early stage of development of the secondary (regrowth) forest and factors such as unfavourable environmental conditions, including exposure to salt laden winds, competition from weeds, and/or the history of cattle grazing.

The habitat of the species is heavily infested by weed species and constitute a significant threat to the species.

Altitude, aspect and topographic preferences

The Coastal Fontainea occurs on moderately steep upper hill slopes and crests of northerly and easterly facing hills about 50 m above sea level. The four sites are within 1 km of the ocean.

Geology and soil characteristics

The Coastal Fontainea occurs on highly fertile, red-brown krasnozems derived from basalt. Coastal Fontainea plants are growing in areas where this soil is limited to the inter-rock spaces between an abundance of basaltic rocks.

Soil pH at the southern sites varied from 3.3–5.4 (Hunter et al. 1992) while the pH at the northern site was 5–6 in the upper horizon and 4.5 in the lower horizon. The upper horizon had a higher organic content while the lower horizon had a higher clay content (Bennetts 1999).

3.5 Life history and ecology

The life history and ecology of the Coastal Fontainea is largely unknown. The following information is based on opportunistic field observations and limited genetic research.

Growth, development and longevity

The Coastal Fontainea is considered to be an obligate seed regenerator, which means it relies on seed production and seedling establishment for continued persistence. The female tree has set fruit, and seeds have subsequently been observed to germinate (M. Matthes pers. obs.; S. Horton pers. obs.). Some adult specimens are multi-stemmed, demonstrating the species' ability to coppice.

Based on the estimated age of the rainforest habitat, the Coastal Fontainea trees are thought to be between 40 and 50 years old (J. Hunter pers. comm.).

The Coastal Fontainea generally grows in areas of relatively low light intensity beneath a continuous canopy of rainforest.

Reproductive biology

Little is known of the reproductive biology of the Coastal Fontainea. The following information is based on limited sampling. Further research is required to fill knowledge gaps.

Flowering and fruiting

Flowering of the Coastal Fontainea occurs from spring to mid-summer although flowers have been observed during other seasons.

The Coastal Fontainea is thought to primarily be dioecious (have male and female flowers on separate plants) but may also be monoecious (have separate male and female flowers on the one plant) (A. Murray pers. comm.; M. Matthes pers. obs.). The degree to which this occurs in the species is unknown.

The Coastal Fontainea appears to have variable periods of fruiting, with ripe fruit being observed mainly in autumn (Floyd 1989; Hunter et al. 1992).

Only one female is known, from the main southern site. Work by Rossetto & McNally (2000) and Rossetto et al. (2000) indicate that a few male plants are contributing to future generations.

Pollination

The pollination of the Coastal Fontainea is not understood.

As the plant has small flowers and inflorescences, it is possible that it is insect or wind pollinated (Williams & Adam 1999). A preliminary genetic study based on one reproductive event has indicated that pollen travels only over short distances (Rossetto & McNally 2000). Further work is required to better understand these processes. No self-pollination was recorded by Rossetto & McNally (2000).

Seed production, predation and viability

From observations of fruit on the ground, it appears that the single female plant produces a relatively small number of fruit.

One fruit was observed with a hole containing insect eggs (L. Bennetts pers. comm.). The identity of the insect was unknown and was the only record of pre-dispersal seed predation.

Over ten years of observations, limited seedlings have established relative to the number of fruit produced. Seed viability is unknown, although propagation from collected seed indicates that seed produced can be viable. *Ex situ* seed germination took between 3–4 months after sowing (L. Bennetts pers. comm.).

Seed dispersal, germination and seedling establishment

The dynamics of seed dispersal, germination and establishment is poorly understood.

There is no specific information on the dispersal of the Coastal Fontainea, however, based on the fruit morphology, it is likely to be dispersed locally by wind, gravity or ballistic methods over short distances (Hunter *et al.* 1992). Dispersal may also be assisted by birds or rodents. Seedlings and seed observed on the ground are all within 5 m from the female parent tree, indicating short dispersal distances.

In 1989, 33 seedlings were recorded near the female tree. By 1991, the number of seedlings had increased to 51. In 2007, 40 seedlings and juveniles were located.

Population structure

The population structure¹ of the Coastal Fontainea comprises four sites: the main site of seven adults and 40 seedlings and juveniles; and three sites each with one adult.

The three southern sites occur in the same rainforest remnant. Two sites occur as single specimens, isolated from the main site by about 80 m and 200 m respectively.

The northern site is comprised of one naturally-occurring adult, and eight juveniles that were planted from seed collected from the main site in 1995.

Reasonable levels of genetic diversity were detected within the Coastal Fontainea population with all parental trees belonging to the same genetic provenance. However, substantial over-contribution from the female and a few males was detected (Rossetto & McNally 2000; Rossetto *et al.* 2000), which is likely to be a result of their proximity to the female plant. These results indicate that inbreeding will potentially be an issue in the remaining natural population.

The genetic studies show that seedlings are related to the known adult plants and, therefore it is unlikely that an unknown specimen is contributing to the current seedlings (Rossetto & McNally 2000; Rossetto *et al.* 2000). The genetic diversity recorded for the Coastal Fontainea was similar to values of other rare outcrossing species such as *Grevillea scapigera*, where a successful translocation program was conducted, despite the very limited source material (Rossetto *et al.* 1995).

Research has shown that the two southern single specimens, and plants from the northern site, are not currently contributing to the future generation of plants at the main southern site. Therefore, each of the four sites where the Coastal Fontainea occurs are distinct.

Conservation actions based on the findings of the genetic research conducted to date are focused on the translocation of suitable genetic material to recombine currently isolated individuals and sites with the only reproducing site.

Disturbance ecology

The response of the Coastal Fontainea to disturbance is poorly understood.

¹ The following definitions of “population” and “mature individuals” are consistent with the IUCN (2001)(Appendix 1).

The Lennox Head area was cleared and burnt for pasture development and banana plantations early in the twentieth century, although pockets of forest probably remained and other trees coppiced or regrew. Some patches were left as windbreaks on the steeper slopes. The persistence of the Coastal Fontainea is quite remarkable. It is thought to either have coppiced (resulting in the multi-stems present in many specimens) or the large basalt rocks protected fallen seeds, thereby allowing recolonisation following clearing.

All habitat in which the Coastal Fontainea occurs has a long history of cattle grazing. It is possible that the multiple stems are also a response to cattle grazing or trampling of seedling or juvenile plants.

The Coastal Fontainea may resprout after mild fire (Hunter *et al.* 1992). However, although this may be possible, recovery from more intense fires is not expected due to the thin bark on the trunks.

Several specimens of the Coastal Fontainea exhibit signs of being affected by the Longicorn Beetle *Mesolita lineolata* (Coleoptera: Cerambycidae), which was recorded in dead branches.

Hunter *et al.* (1992) recorded leaf rust on some seedlings. This rust has not been identified.

Propagation

The Coastal Fontainea appears to germinate readily from fresh seed. Germination success from stored seed is unknown. The use of vegetative material for cuttings has also been successful (S. Walker pers. comm.; J. Cook pers. comm.; A. Bofeldt pers. comm.).

Ballina Shire Council propagated plants from cuttings, although the success rate was low (10%), and cuttings took nine months to strike. Wollongong Botanic Gardens, however, has had almost 100% success rate of cuttings (A. Bofeldt pers. comm.).

Cutting material from juveniles was relatively more successful at establishing plants than material from adult plants (J. Cook pers. comm.).

Provided there is wind protection, established cultivated plants appear able to tolerate high light levels (Bennetts 1999; S. Walker pers. comm.; A. Bofeldt pers. comm.). Regularly applied fertiliser to potted plants and repotting six-monthly with new soil is best to maintain healthy specimens (A. Bofeldt pers. comm.).

4 Threats and Management Issues

Current threats and management issues affecting the Coastal Fontainea sites and their habitat include habitat destruction, habitat fragmentation and isolation, habitat degradation, lack of knowledge of biological and ecological requirements of the Coastal Fontainea, inbreeding, dieback, fire, physical and mechanical damage and unregulated collection for propagation. The degree of the impact of these threats on the Coastal Fontainea and its habitat varies according to their intensity and proximity to the Coastal Fontainea plants.

For the purposes of this Management Plan, threats have been prioritised following the classification developed by Keith *et al.* (1997). This classification prioritises threats according to the following criteria:

- Class I threat is a process capable of causing sudden, substantial, and possibly irreversible loss of individuals or habitat.
- Class II threat is a process capable of causing gradual, substantial and possibly irreversible loss of individuals or habitat; which may be reversible, however, mitigation may be technically difficult or expensive to achieve.

Actions to mitigate the threats are prioritised based on the class of threat. A discussion of the threatening processes is presented below.

4.1 Identified threatening processes

Habitat destruction

Clearing of littoral rainforest in the area known to contain the Coastal Fontainea is considered to be a Class I threat. Clearing of littoral rainforest containing unknown specimens of the Coastal Fontainea is a possibility given the increasing urban expansion and pressure in the Lennox Head area. For this reason, the clearing of littoral rainforest in Lennox Head may also be considered as a Class II threat.

Habitat fragmentation and isolation

Habitat fragmentation has separated the northern site from the southern sites of the Coastal Fontainea. It is presumed that these remnants may formerly have been part of a system of patches in more-or-less continuous habitat (Rossetto & McNally 2000). The species is

currently showing signs of inbreeding. Present ecological understanding is sufficient to predict that further adverse effects of fragmentation on the Coastal Fontainea sites are likely to include inbreeding and the interruption to the function of pollinators. This may have consequences for fruit production and seed dispersal and therefore the recolonisation of adjacent remnants.

The northern Coastal Fontainea remnant is less than 1 ha in size. The southern Coastal Fontainea remnant is about 18.5 ha in size and is the largest remnant of littoral rainforest in the Lennox Head area (McKinley et al. 1999). These remnants are highly exposed to edge effects, including impacts of weed invasion and from salt laden winds.

Habitat fragmentation is considered a Class II threat to this species, and continues to be exacerbated by increasing nearby development and associated activities.

Habitat degradation

Small areas of fragmented habitat are particularly prone to a suite of habitat degradation processes, especially when relatively close to human habitation, or at the interface of an agricultural-natural landscape. A discussion of the processes identified as degrading the habitat of the Coastal Fontainea is presented below.

Habitat degradation may be considered as a Class I or Class II threat to the Coastal Fontainea depending on the intensity, frequency and duration of the process causing the degradation.

Weed infestation

The Coastal Fontainea occurs in vegetation that is particularly prone to exotic weed competition, due to highly fertile soils, disturbance and increased edge effects. Some of the potential impacts of weed invasion on the Coastal Fontainea include smothering or strangling plants, competing for space, nutrients and light, and altering soil structure and composition.

Over forty weed species have been recorded in the habitat of the Coastal Fontainea sites (Appendix 5), with the most dominant weed species being Lantana (*Lantana camara*), Ground Asparagus (*Asparagus aethiopicus*) and Camphor Laurel (*Cinnamomum camphora*).

Weed invasion is currently considered a Class II threat as the progress achieved by the habitat restoration program removed the immediate threat to the species. Should weeds be allowed

to reinfest the habitat then it may be reconsidered as a Class I threat.

Weed control activities

Coastal Fontainea plants may be at risk if bush regeneration activities are not undertaken in a sensitive manner. Potential impacts include:

- trampling of seedlings
- herbicide spray drift or absorption by plants
- over-removal of Camphor Laurel plants that provide protection for the Coastal Fontainea.

The damage of plants either directly or indirectly is considered a Class II threat. It is anticipated that through appropriate guidance, as well as site-specific management plans, weed control activities would not become a Class I threat to the species.

Cattle grazing

The possible impacts of cattle grazing in the vicinity of the Coastal Fontainea sites include:

- trampling of habitat leading to compaction of soil, thus limiting regeneration of seedlings
- direct damage or destruction of individuals
- introduction of weed propagules and increased nutrients from cattle waste.

The northern site is fenced. At the southern sites, low numbers of cattle have been grazing sporadically in Coastal Fontainea habitat. There is no evidence to suggest they graze on this species.

Cattle grazing is considered as a Class II threat due to the low numbers of cattle within the remnant and the intention to fence the remnant. However, should cattle grazing pressure increase then it may be reconsidered as a Class I threat. Removing cattle must be done in conjunction with targeted and systematic weed control.

Ocean wind sheer

Ocean wind sheer is reducing the health of rainforest plants on the edge of the remnants. The Coastal Fontainea is within close proximity to the edge of both remnants. Wind sheer may be an additional pressure to the plants already exhibiting signs of stress.

This process is considered to be a Class I threat for plants that are already under stress and a Class II threat for plants that are not stressed. Should the habitat edge continue to erode, the

Coastal Fontainea could be placed at the frontline to ocean winds.

Increased development pressure

Residential developments, adjacent to the habitat of the Coastal Fontainea sites, generate varying uses of the remnant littoral rainforest by, and impacts from, adjacent occupants including recreational use, garden refuse dumping and stormwater run off.

Within the fenced area at the northern site, a mature Guioa was observed felled (A. Murray pers. comm.), a makeshift tree-house was constructed near the Coastal Fontainea (Gross 1994) and garden rubbish was dumped on *Macadamia* seedlings next to the Coastal Fontainea (Bennetts 1999). Evidence of garden refuse and rubbish are regularly observed at this remnant.

Where inappropriate stormwater management occurs, remnant vegetation often becomes degraded. There is a stormwater outlet on the western side of the northern site, immediately upslope of the Coastal Fontainea plants. This drain has facilitated vigorous weed growth at the end of the pipe where the water disperses.

A drain also runs into the littoral rainforest in the southern Coastal Fontainea remnant from an adjacent residential subdivision (S. Fay pers. comm.).

Increased pressure from adjacent developments is considered a Class II threat as the habitat of the Coastal Fontainea is slowly degrading. However, stormwater management could be considered a Class I threat should the stormwater contain substances that are toxic to the Coastal Fontainea.

Lack of biological and ecological knowledge

In the absence of relevant information about a species' biological and ecological requirements, management is based on generalised assumptions. Where small populations occur, such as the Coastal Fontainea, poor management decisions may be made. In some cases, such decisions may have dire consequences for the long term conservation of the species.

Current knowledge of all aspects of the biology and ecology of Coastal Fontainea is described in Section 3. Further knowledge, particularly in relation to the causes of the observed breakdown in ecological and evolutionary processes, is considered to be essential to the effective management of the Coastal Fontainea (refer to Actions 3.1–3.3).

The lack of knowledge about the species is currently considered a Class II threat. However, should no action be taken to increase the understanding of the species while the existing adult plants are still alive then it would be considered a Class I threat.

Inbreeding

The genetic research has revealed that the population of the Coastal Fontainea consists of genetically distinct individuals. The reduced genetic variability in the new generations of the Coastal Fontainea, with its apparent inability to colonise new areas, may represent a reduced ability to respond to alterations in its environment, including climate change. Therefore, the evolutionary potential of the species is limited and inbreeding is likely to continue to future generations if appropriate action is not undertaken.

Inbreeding is considered a Class II threat to this species. Management actions proposed are designed to maintain the genetic diversity in the species. However, should no action be taken to improve genetic diversity in the four sites while the existing adult plants are still alive then it would be considered a Class I threat.

Dieback

The remaining adult plant at the northern site was approximately 5 m high before dieback occurred. After the dead wood was removed it was 2 m high (Bennetts 1999). The beetle *M. lineolata* may be contributing to the dieback, although another organism is likely to be responsible for the mortality of some branches (see Section 3.5).

The presence of the beetle *M. lineolata* on the plant is considered to be a Class II threat to the Coastal Fontainea.

Leaf rust

Hunter *et al* (1992) noted leaf rust on seedlings of the Coastal Fontainea. The species of rust is unknown. The impact on the Coastal Fontainea to the rust is unknown. Rust species are fungi that reduce the photosynthetic ability of the plant, which can have follow-on effects, such as reduced seed set, size of seed and seed viability (B. Summerall pers. comm.). Therefore, the rust is unlikely to cause plant mortality but may weaken the health of a plant and increase its susceptibility to additional stresses.

Given that all the individuals of the Coastal Fontainea are considered important to the long term health of the species, any process that

causes the loss of any individual can be considered a Class I threat that requires management.

The presence of the rust on the plant is considered to be a Class II threat to the Coastal Fontainea.

Fire

Fire is considered an inappropriate management tool for conservation and management of rainforest. It is possible that the Coastal Fontainea will recover from infrequent and low intensity fires but moderate to high intensity fires are likely to destroy plants and the littoral rainforest habitat in which they occur. These types of fires could lead to extinction of the species in the wild.

Arson is the most likely potential fire source, although during extremely prolonged dry periods glass or lightning strike may be potential sources of ignition.

Fire in the habitat of the Coastal Fontainea is considered a Class I threat.

Collection for the nursery industry

The Coastal Fontainea fruit has allegedly been collected from the main site for the nursery industry (L. Bennetts pers. comm.). Fruit collection may damage or destroy the Coastal Fontainea plants. This could be catastrophic if the only known female Coastal Fontainea were to be irreversibly damaged or destroyed during the collection. Additionally, the unauthorised collection could introduce pathogens, such as *Phytophthora* species, to the Coastal Fontainea habitat. This would particularly be an issue where secateurs and footwear are not properly cleaned prior to entering remnant vegetation.

Collection for the nursery industry is considered a Class II threat due to actions by the landowner of the main site to prevent illegal access to the area.

4.2 Reasons for decline and species' ability to recover

Habitat clearing and fragmentation are believed to be the primary causes of decline in the Coastal Fontainea population, followed by habitat degradation. The major consequence of this is the evidence of inbreeding in the Coastal Fontainea, also expected to be operating in many of the more common species in the remnants. The likelihood of recovery will be influenced by whether the long-term consequences of reduced

genetic variation can be reversed or reduced. This is likely to be a difficult, expensive and slow process.

In the absence of seed production at the northern site, and due to poor dispersal mechanisms, new habitat patches can only be established with artificial assistance. Apart from the location of new sites, the management of exotic weeds in Coastal Fontainea habitat and the success of the translocation program are the most critical factors in this species' recovery.

The recovery of the Coastal Fontainea will require a long-term commitment from relevant stakeholders. The Management Plan provides a series of actions directed at mitigating or removing threats and improving knowledge required to effectively manage this species.

5 Previous Actions Undertaken

5.1 Survey

Hunter et al. (1992) surveyed approximately 25 ha of suitable habitat and did not locate any new sites of Coastal Fontainea. Surveys of littoral rainforest on krasnozem soil between the Richmond River and the Queensland border were undertaken in the known habitat, and a limited part of the potential habitat of Coastal Fontainea (McKinley et al. 1999). They did not locate additional Coastal Fontainea specimens.

Limited surveys in littoral rainforest have also been undertaken as part of the environmental assessments for the numerous developments in the Lennox Head area without locating Coastal Fontainea.

5.2 On-ground management

A habitat restoration program has been implemented at Coastal Fontainea remnants since 1994 by the NPWS (now DECCW). This program included primary and secondary weed control and planting of local rainforest species. The program resulted in recruitment of native species and a significant reduction in weed regeneration. Continued weed control is required to maintain and improve upon works completed thus far.

A preliminary draft Plan of Management for bush regeneration has been prepared for the northern remnant owned by Ballina Shire Council (Bennetts 1999).

In 1997 actions were undertaken at both the northern and the main southern sites to manage the insect related dieback. All dead branches were removed to prevent the loss of further branches (Bennetts 1999).

In 1988 Ballina Shire Council undertook fencing works at the northern Coastal Fontainea site to protect the plants from interference. In addition, a sign was erected to discourage dumping of refuse.

5.3 Biological research

Research on this species has been limited to opportunistic observations and genetic research.

Preliminary genetic research was undertaken by Peakall (1994). Subsequently, detailed genetic research has been carried out on the Coastal Fontainea (Rossetto & McNally 2000; Rossetto et al. 2000). Seventy-four plants were sampled. This comprised all known plants in the wild, including the planted specimens, and some cultivated plants.

5.4 Translocation

In 1995, eight plants were planted in an effort to increase population numbers. Seed used for the propagated material used in the translocation was collected from the main site.

During 2010 55 cutting-grown plants representing all adult individuals were planted in a number of sites within the habitat of the species.

Additional plants are growing at Coffs Harbour Regional Botanic Gardens and at Ballina Shire Council nursery. These plants were propagated from seed from the female plant at the main site. Cutting grown plants are represented at Mt Annan Botanic Gardens and Lismore Rainforest Botanic Gardens.

5.5 Community awareness

Various articles have been published in the local newspaper (The Northern Star), and *Danthonia* (the Australian Network for Plant Conservation's newsletter) (now *Australasian Plant Conservation*).

5.6 Propagation

A number of people have successfully propagated plants of the Coastal Fontainea since its

discovery. Propagation of the species is discussed in Section 3.5.

6 Proposed Management Objectives, Actions and Performance Criteria

The overall objective of this Management Plan is to arrest the decline of the Coastal Fontainea and to move the species and its habitat towards a position of viability in nature. This is expected to extend beyond the five-year life of the actions in this plan, although this remains the overall objective of the management effort in the long term. Without appropriate action, the Coastal Fontainea is likely to become extinct in the wild.

Objective 1: To protect and manage the population of the Coastal Fontainea and its habitat.

Action 1.1

The Species Profile and Survey and Environmental Impact Assessment guidelines for the Coastal Fontainea (Appendix 3) is distributed to relevant local government, consultants and any other relevant land managers.

Determining and consent authorities should ensure the survey methodology and minimum survey effort described in the guidelines is undertaken when assessing development applications or activity proposals. Using this survey method and effort will assist in determining whether the Coastal Fontainea is present in, or near, an area of proposed development.

The guidelines should also be used by determining, consent and concurrence authorities, during assessment of the development or activity, to ensure the Coastal Fontainea is appropriately considered.

The guidelines should be used by land managers, such as local government, DECCW and the Rural Fire Service (RFS), when preparing and implementing environmental planning instruments, and during strategic land-use planning.

The presence of the Coastal Fontainea or its habitat at a proposed development or activity site should require the preparation and implementation of effective mitigation measures, to reduce the impact of the proposed development or activity. Where new sites are detected, appropriate conservation measures should be developed and applied to the management of the site.

Justification:

The Coastal Fontainea is one of the rarest rainforest trees in Australia. Without appropriate protection and management of the species and its habitat, it is likely to become extinct in nature.

Performance criteria:

Over the life of this plan, determining, consenting and concurrence authorities:

- use the Species Profile, Survey and Environmental Impact Assessment guidelines (Appendix 3) to assist in assessing development applications and activity proposals for areas containing littoral rainforest
- take a precautionary approach to the assessment of developments and activities that may impact on the known populations of the Coastal Fontainea and areas of suitable habitat for the species
- apply appropriate protective and mitigating measures to consents or approvals where any new locations of the Coastal Fontainea were recorded during flora and fauna studies
- do not approve developments or activities where translocation of Coastal Fontainea is proposed as a mitigating measure or where the development proposes to destroy individuals of the species or to degrade its habitat.

Action 1.2

Liaison with landholders is undertaken to seek long term protection of the Coastal Fontainea and its habitat.

Details of the proposed site-specific management actions are provided in Action 1.4.

- Relevant landholders or land managers are to be provided information on the conservation significance of the species and to allow informed decisions to be made regarding the long-term protection measures available, and the benefits associated with entering conservation agreements.

All protective measures applied to sites of the Coastal Fontainea will only be developed in conjunction with, and require the consent of, appropriate landowners or managers.

Justification:

DECCW can offer its experience with managing threatened species and their habitats and assist landowners to manage their lands when they request assistance. It is through fostering good relationships with landowners whose property supports significant vegetation that the

conservation benefits of such long-term protection measures are appreciated and implemented.

DECCW and the Catchment Management Authority should provide landowners with information about the financial benefits, particularly where the landholder is currently bearing the full cost of conserving the vegetation on their land.

Performance criteria:

- within the first year of implementing this plan, landowners and managers of habitat where sites of the Coastal Fontainea occur are aware of long term protection measures
- over the life of this plan, where a landowner or manager (in the case of Ballina Shire Council) wishes to enter into an agreement, the relevant agreement is established.

Action 1.3

DECCW will make specific location information available to relevant persons at Ballina Shire Council, environmental planners and managers, the RFS, and the landowners. DECCW will ensure agencies are notified of any new occurrences of the Coastal Fontainea.

Specific locality maps and location details have not been included in this plan and will not be made publicly available.

Justification:

There is a need for confidentiality of locations to be maintained to respect the privacy of the landowners and managers; limit and manage the potential threat of illegal collection; reduce opportunities for the introduction of pathogens to the sites; and minimise damage to plants and seedlings.

Performance criteria:

Over the life of this Management Plan:

- the Coastal Fontainea sites are not damaged or destroyed by people accessing the site
- no illegal collection of the Coastal Fontainea occurs
- landowners and managers do not have unauthorised people looking for the Coastal Fontainea on their property.

Action 1.4

Preparation and implementation of site management plans

Action 1.4.1

Site management plans are prepared for both the northern and southern sites of the Coastal Fontainea and its habitat, in conjunction with Ballina Shire Council and the landowner.

The plans are to include identification and delineation of weed management zones and the weed species present in each zone. A prioritised course of action with the timing and techniques to be applied to remove, control or manage the weed species, and the relevant zone to which it applies are also to be provided.

Habitat expansion to repair the effects of fragmentation and increased edge effects will be considered where opportunities are presented. For example, the landowner of the southern sites is supportive of some planting in the buffer area with rainforest species, including some for commercial use.

The site management plans will address the actions required to carry out threat abatement at each of these sites and adjacent areas. Strategies to be included in management plans for the species will consider:

- stormwater management
- protection from livestock
- pest management, including *Mesolita lineolata* and leaf rust
- fire management
- garden refuse and rubbish dumping
- the provision of a walking track through the southern remnant.

Action 1.4.2

Site management plans are implemented for both the northern and southern sites of the Coastal Fontainea and its habitat, in conjunction with Ballina Shire Council and the landowner.

The support of the landowners and managers will be critical to the successful implementation of these plans. The management of weeds in, and adjacent to, the habitat of the Coastal Fontainea will require the combination of targeted bush regeneration efforts and broader regional solutions to reducing the sources of weed propagules in the surroundings. Both short and long term actions need to be implemented.

Justification:

Weed invasion has been identified as a major threat to the Coastal Fontainea and its habitat. The effects of weed invasion are discussed in Section 4.

Control and removal of weeds will facilitate recruitment of the Coastal Fontainea by reducing competition and improving the health of the ecosystem.

Performance criteria:

- Within the first six months of implementing this plan, management plans are endorsed as suitable for implementation.
- The improved health of the habitat for the Coastal Fontainea can be observed.
- Weed species identified in the site management plans as being of major concern are controlled in the habitat of the Coastal Fontainea.
- The threat to the Coastal Fontainea from weed invasion is reduced and the threat from inappropriate regeneration techniques is avoided. Within the third year of implementing the Plan, the drains entering both the northern and southern sites are managed to ensure that the direct and indirect impacts of stormwater to the Coastal Fontainea and its habitat are removed.
- Within the second year of implementing this plan, there is no evidence of cattle impacting on the Coastal Fontainea or its habitat.
- If requested by the landowner, the proposed walking track at the southern remnant is constructed with no impact to the Coastal Fontainea and minimal impact to its surrounding habitat.
- Over the life of this Management Plan, the beetle *Mesolita lineolata* is appropriately considered and managed if it is detected in any Coastal Fontainea plants.
- Over the life of this plan, the unidentified leaf rust is appropriately considered and managed if it is detected on any Coastal Fontainea plants.

Action 1.4.3

Liaison with landowners, managers and RFS is undertaken to ensure that the “no fire in rainforest” principle is maintained in the Bush Fire Risk Management Plans.

The Bushfire Risk Management Plans should also include an approach to containing fire in the Coastal Fontainea remnants.

Justification:

It is possible that fire will destroy the plants and their habitat, particularly medium to high intensity fire.

Performance criterion:

- Over the life of the plan, the Coastal Fontainea is not impacted or threatened by fire in the remnant and that any fire is contained without damage to the Coastal Fontainea.

Objective 2: To determine if further populations of Coastal Fontainea occur and to collect and manage baseline data.

Action 2.1

Priority areas of potential habitat are identified where targeted surveys for the Coastal Fontainea will be done.

Survey effort for the Coastal Fontainea will be designed to investigate:

- the full distribution of the Coastal Fontainea within its existing known range to clarify existing distribution for management purposes, and
- whether there are any new sites in suitable habitat in adjacent catchments.

A suitably qualified person is required to co-ordinate and supervise survey efforts in suitable habitat for further populations of this species. Surveys are only to be undertaken on lands where the permission of the landowner has first been obtained. Guidelines for survey of the Coastal Fontainea are provided in Appendix 3.

Community groups may be involved in surveys. Community groups, such as Landcare, would target areas not covered by previous surveys. All participants are to be provided with sufficient instruction for the identification of the Coastal Fontainea during the implementation of this action.

Justification:

It is essential for managers of the Coastal Fontainea habitat to have a clear understanding of the actual and potential distribution of this species to make appropriate land-management decisions.

As the species is experiencing inbreeding, additional “new” genetic material may be highly important for success of the translocation program and ultimately, the recovery of the species.

Performance criterion:

- Over the life of the plan, survey efforts for the Coastal Fontainea are undertaken in suitable habitat in accordance with the survey guidelines (Appendix 3).

Action 2.2

Census and population structure data are recorded for new sites of the Coastal Fontainea, as soon as is practicable following their discovery.

The site assessment form in Appendix 6 is to be completed at each new location where Coastal Fontainea is found to occur.

A sample of any new plants is to be taken for genetic analysis by the Botanic Gardens Trust to determine the relationship of the new site to known Coastal Fontainea. Another sample should be taken as a herbarium record and also sent to the Botanic Gardens Trust for their collections.

Justification:

The information gained from the samples will assist in the understanding of the relationship between existing and new populations. New information will inform future management of the species.

Performance criteria:

- Over the life of this plan, a site assessment form is completed for any new Coastal Fontainea sites.
- As required, results of genetic samples collected are used to make management recommendations.
- Appropriate management of any new Coastal Fontainea and its habitat is recommended and provided to the relevant landmanager.

Action 2.3

Effective data management is conducted, including data organisation, data entry and data dissemination.

Action 2.3.1

Consistent data are collected for each site and recorded on an appropriate database.

The following information should be considered as the minimum data to be maintained:

- locations of known Coastal Fontainea sites
- size and approximate maturity of the Coastal Fontainea on the sites
- health of individuals
- habitat and threatening process details
- disturbance and management history of sites, including previous weed control programs
- date of last site inspection.

Action 2.3.2

Public authorities are aware of these data and will be encouraged to provide details to DECCW of any new records made of the species for inclusion in the data set.

Action 2.3.3

All records on the Atlas of NSW Wildlife of the Coastal Fontainea correlate with known records of the species.

Quality control of data is considered to be highly desirable, particularly for environmental assessment. Any inaccurate data will be corrected.

Justification:

There are numerous consequences of poor data management for natural resource management, including repeating previous work, making inappropriate decisions and overlooking threats.

Performance criterion:

- Data about the Coastal Fontainea and its habitat are managed in such a way that it has contributed to the effectiveness and efficiency of the management program.

Objective 3: To gain a better understanding of the biology and ecology of the Coastal Fontainea.

Future biological research and monitoring actions should aim to:

- investigate biological attributes which are relevant to the practical management of the Coastal Fontainea and its habitat, or which increase our understanding of the evolutionary potential of the species
- involve scientists and post-graduate students
- investigate new techniques which might be applied to the management of other threatened flora
- keep DECCW, DSEWPC, Ballina Shire Council, the landowner and the conservation community informed of major research outcomes.

Action 3.1

Site assessment forms are completed for each known site of the Coastal Fontainea.

The site assessment form is provided in Appendix 6.

Justification:

Recording of relevant site data is essential to provide baseline data from which the monitoring program identified in Action 3.4 can be properly evaluated. This information also provides the baseline information to assist in deciding the suitability of sites for the translocation program identified in Objective 4.

Performance criterion:

- Prior to beginning Actions 3.2–3.4, baseline data are gathered that can direct management and research.

Action 3.2

A research plan is to be developed for the Coastal Fontainea and its habitat.

This research plan will:

- address the priorities for research to improve and assist management of the Coastal Fontainea and its habitat, including monitoring and experimental research
- provide adequate detail of the methodologies required to carry out the research identified in Actions 3.3 and 3.4
- provide details of the data analyses and data presentation required
- provide details of the research reporting requirements
- identify which of those projects are suitable to be undertaken by contract scientist or post-graduate university students or community groups
- provide guidance for community groups to undertake research studies.

Hypotheses will be developed for testing in later stages of a research program, possibly as part of student projects.

The research plan is to include: repeated monitoring of fixed parameters (to understand what is occurring, for example, with growth and flower and fruit production); and monitoring of parameters that are to be evaluated against pre-determined criteria (to determine whether actions taken have succeeded or failed).

Monitoring forms need to be included in the Research Plan.

Justification:

If a research project on threatened species is not well designed and subjective measurements recorded, the data collected can be misleading and statistically meaningless. In some cases an

adverse change to the population may be missed. For Coastal Fontainea a missed detrimental change, could lead to the extinction of the species or an increase in the cost of management.

In addition, poorly designed research, with poor data collection, presentation and interpretation for its application to the management of the species or its habitat is often useless to management efforts.

Performance criteria:

- Within the first year of implementing this plan, a research plan will have been prepared.
- Within the second year of implementing this plan, interest is sought from community groups and students to contribute to the research on Coastal Fontainea and its habitat.

Action 3.3

Experimental research is supported in the areas where it has been determined that there is a lack of biological and ecological knowledge necessary for the species' management.

The following research on the Coastal Fontainea will be supported:

1. Pollination ecology of the species:
 - identification and biology of the pollinator(s)
 - the pollination mechanisms of the male and female plants
 - whether the lack of contribution from all males is related to a lack of pollinators
 - the degree to which insects, wind or other mechanisms pollinate flowers.
2. Seed biology:
 - germination and dormancy mechanisms
 - viability and longevity
 - dispersal and predation.
3. Recruitment and establishment:
 - recruitment including the survival of seedlings and cause(s) of mortality
 - quantification of the significance of the loss of seedlings to the long term persistence of the Coastal Fontainea
 - growth and development of individuals.
4. Translocation program (discussed further in Objective 4 and Appendix 7):
 - appropriate combinations for planting trials and full-scale translocation

- determining the sex of plants prior to producing fruit, ideally through monitoring or further genetic studies
- treatments to enhance survival of transplants.

5. Insect pests:

- identify the pest species – pre and post seed dispersal predators
- determine and assess the impact potential of the leaf rust and other possible pests
- understand the biology of the beetle *Mesolita lineolata* to determine when it may be a management issue for the Coastal Fontainea.

Such research could be combined with research on *Fontainea australis*, as much could be learned of the Coastal Fontainea by studying a related taxon, identifying differences and commonalities.

Justification:

Key aspects of the biology and ecology of the Coastal Fontainea are unknown. A program of biological research, combined with low-impact *in situ* measurement and observation is required to systematically collect and analyse biological information concerning the Coastal Fontainea and its habitat.

Performance criteria:

Over the life of the Plan:

- a greater understanding of the biology and ecology of Coastal Fontainea is achieved and applied to management;
- research is undertaken in accordance with the research plan.

Action 3.4

In situ monitoring of the Coastal Fontainea sites will be undertaken to detect changes in size, distribution and age structure and to understand the reproductive biology.

The monitoring program will be conducted by personnel with relevant qualifications and experience in plant ecology. Monitoring frequency for future years will be identified in the research plan.

The biological attributes to be investigated include:

1. The breeding system of the species:
 - whether the species is monoecious or dioecious
2. Flowering and fruiting biology:

- flower and fruit production
 - age to reproductive maturity
 - identification of male and female plants
 - ratio of dioecious:monoecious individuals
 - synchronicity of flowering and variation in flowering times.
3. Pollination ecology of the species via identification of the pollen vectors.
 4. Seedling/juvenile survival.
 5. Rate of growth.
 6. Health of individuals.
 7. Evidence of pest species.

Monitoring to be conducted annually to investigate the following ecological attributes of the Coastal Fontainea habitat:

- the degree to which competition for space and resources is impacting on the Littoral Rainforest habitat where Coastal Fontainea occur, and whether any species are displacing other species
- whether pathogens or insect pests are affecting the species in the habitat
- an assessment of the size of the common species in the habitat and their position in the landscape
- impacts of disturbances
- whether the amelioration and control of threats has been effective.

This is to include an initial assessment of the abundance and health of all species present in the remnants to provide baseline data. A monitoring score should be devised for measuring the health and condition of the remnant. Any score less than a pre-determined threshold should indicate that action is required.

Justification:

Observation of change in the site will be a preliminary step towards identifying factors that control demographic processes in the Coastal Fontainea. This should enable appropriate and timely action if a serious threat is observed that either appears to be, or is, affecting the Coastal Fontainea or its habitat.

Appropriate management of the small population of the Coastal Fontainea will be crucial to the long term survival of the species. Factors affecting reproduction such as synchronous flowering, ratio of dioecious:monoecious individuals, pollinator activity and pollen dispersal will be critical in

determining gene flow within the population and thus genetic structure (Rossetto & McNally 2000).

The monitoring of habitat is essential to identify any factors that may impact on the success of the habitat restoration. For example, it may identify species that may need to be planted for effective gene flow and pollen transfer; species that may need to be controlled, such as vines smothering seedlings; and any additional restoration works required.

Performance criteria:

Over the life of this plan:

- a greater understanding of the biology and ecology of Coastal Fontainea is achieved and applied to management
- monitoring of the Coastal Fontainea and its habitat is undertaken in accordance with the approved monitoring program.

Objective 4: To undertake a translocation program for the Coastal Fontainea.

Action 4.1

DECCW will approve the translocation proposal (Appendix 6) prior to the commencement of the translocation plantings.

The translocation proposal has been prepared for the Coastal Fontainea with consideration to the *Translocation Guidelines for Australian Threatened Plants* (Vallee *et al.* 2004) and includes justification for the action, consequences of not translocating the Coastal Fontainea, relevant species information, pre-translocation assessment, pre-translocation preparation, translocation, post-translocation actions and post-translocation monitoring.

Items requiring completion in the translocation proposal include: final design of the experimental treatments; additional consideration of the level of care of plants, such as fertiliser, mulch and soil wetting agents; preparation of monitoring and recording forms; and final site selection.

The final experimental treatments will consider using the most genetically distinct adult trees in the population which may be able to contribute more to the translocation program (Rossetto & McNally 1999). Cutting material will be used from parents and seedlings, and material selected for propagation will consider equal contributions of these plants for the new translocated populations. Any "new" plants located should have their usefulness to the translocation program determined.

The planted specimens at the northern site do not need to be removed to avoid any issues associated with weakening the gene pool, as they are of appropriate genetic stock. However, there are not enough to maintain a viable population. Further enhancement of this population will be required.

Justification:

Translocation is required for the Coastal Fontainea because the genetic results clearly identify that the species is inbreeding. The amount of diversity in the ten adults (parent plants) is higher than that recorded for the sixty-three seedling and juveniles sampled. There is a decrease in the genetic diversity recorded in the progeny and this is likely to be the result of over-contribution from a few individuals to the production of offspring. As a result it is likely that if this process is continued, the genetic pool available to the Coastal Fontainea will be slowly depleted (Rossetto & McNally 2000; Rossetto et al. 2000).

Performance criterion:

- Prior to beginning Action 4.2, all the relevant designs, proposals and forms for the translocation have been prepared.

Action 4.2

An approved translocation proposal is implemented (Appendix 6).

The aim of this action is to establish at least five experimental trials: two introductions (at sites to be determined) and three enhancements (at the two southern single specimen sites and at the northern site) as identified in the translocation proposal (Appendix 6). Preparation for the full-scale translocations will be planned in the future (Section 10).

Justification:

During the life of this plan it will only be appropriate and feasible to establish and undertake the translocations to the experimental trial stage.

Due to the long-lived nature of many rainforest plants, such as Coastal Fontainea, several years will be required to determine the first stages of success of the program.

Performance criteria:

- During the first three years of implementing this plan, the experimental trial translocations are planted.

- Over the life of this plan, the translocation is monitored and maintained accordingly.

Action 4.3

Experimental trials will be monitored and evaluated in preparation for the full-scale translocations.

This monitoring and evaluation will include a rigorous examination of the trials to determine their success or failure when measured against the criteria for determining the success in the translocation proposal.

Justification:

To reduce the risk of extinction to the Coastal Fontainea in nature, it is considered appropriate to have at least five viable sites in nature. The enhancement projects are designed to increase the number of individuals of the Coastal Fontainea at the sites where single plants currently occur. The creation of two new populations at alternative sites is intended to reduce the risk of stochastic events destroying the known sites.

The trials will also determine any limitations or problems with translocating the species to the site that require rectifying prior to committing and using resources for the full-scale translocation.

Performance criteria:

Over the life of this Management Plan:

- the experimental translocations are undertaken in accordance with an approved translocation proposal
- monitoring and evaluating will identify any limitations or problems with translocation of the species
- relevant changes are made to the experimental trials to improve chances of success (should the trials be evaluated to fail).

Objective 5: To raise awareness and encourage community involvement in the conservation of the Coastal Fontainea and its habitat.

Action 5.1

Targeted community awareness to be undertaken. Information packages to be developed to provide details on the identification of the species, its conservation status, the threats affecting the conservation of the species and its habitat, and recommendations for management.

Distribution of these packages is to target relevant community groups, land management agencies, approval authorities and management committees and boards.

The information packages will include pamphlets targeting threat abatement issues such as impacts of stormwater, illegal collection, garden refuse and rubbish dumping, licensing requirements and community involvement (Action 5.2).

Justification:

Among the threats to the Coastal Fontainea is unauthorised collection, habitat degradation and rubbish dumping. Through increased awareness in the community, the impacts to the Coastal Fontainea and its habitat may be subsequently minimised.

Performance criteria:

Over the life of this plan:

- there is a decrease in the indiscriminate clearing of littoral rainforest in the Lennox Head area, there is better management of stormwater entering remnants, and rubbish and garden refuse are no longer being dumped in littoral rainforest remnants;
- all collections of Coastal Fontainea plant material collected from the natural sites are licensed by DECCW and contributing toward the implementation of the Management Plan.

Action 5.2

The community will be encouraged to be involved in the targeted survey (Action 2), the site specific management (Action 1.4) and translocation programs (Action 4).

Community members participating in Coastal Fontainea management will be appropriately trained. Community members and/or groups will not be permitted to work in the habitat of the Coastal Fontainea without the permission of the landowners.

Justification:

The conservation of biodiversity is the responsibility of the whole community and to this end DECCW supports and encourages such involvement. The management of the Coastal Fontainea will rely on such support and involvement from the community.

Performance criterion:

- The management program for the Coastal Fontainea has benefited by community involvement, such as landcare groups, in survey, restoration and translocation programs.

Objective 6: To develop and implement a contingency plan to ensure the long-term survival of the Coastal Fontainea.

Action 6.1

DECCW will ensure an ex situ collection is established and maintained for the security of the population and the translocation program (Appendix 6).

Action 6.1.1

DECCW will liaise with Ballina Shire Council and an appropriate nursery facility to ensure an appropriate ex situ collection is established in accordance with the translocation proposal (Appendix 6).

Action 6.1.2

Appropriate parties are contacted to ensure the Coastal Fontainea individuals currently growing in local, regional and State botanic gardens are maintained.

Plants of Coastal Fontainea are held at Mount Warning Arboretum, Mount Annan Botanic Garden, North Coast Regional Botanic Garden and Lismore Rainforest Botanic Garden.

Action 6.1.3

Locations where specimens of the Coastal Fontainea are growing are located and, where appropriate, will be incorporated into the ex situ collection.

Ballina Shire Council, Coffs Harbour Regional Botanic Garden, local rainforest nurseries and private individuals are known to have specimens of Coastal Fontainea. It is possible that other people also have specimens of the species.

Action 6.1.4

Maintenance of the ex situ collection is undertaken in accordance with the translocation proposal (Appendix 6).

It is important that the ex situ collection is maintained under strict protocols to minimise the potential for compromising the success of the project. This should include the maintenance of information on the location, status, use, and origin of the ex situ Coastal Fontainea individuals and material used (e.g. seed, cuttings).

Action 6.1.5

The collation of information on the progress and success of the known ex situ collection is undertaken

In addition to collecting ex situ data, the data will need to be evaluated to determine the most effective methods of ex situ propagation, and identify problems with propagating the species.

Justification:

DECCW considers that the establishment of a living collection and properly maintained *ex situ* collection of the Coastal Fontainea may safeguard the population from extinction.

It is important that appropriate *ex situ* data are collected and managed to ensure that the most effective techniques are applied. This is required to maximise the efficient use of resources, and to also avoid increasing the potential for further inbreeding in Coastal Fontainea.

This system should ensure that specimens are maintained in such a way as to avoid inappropriate mixing of specimens in the collection during their time at the nursery facilities.

This contingency *ex situ* collection would aim to provide representative material for both the translocation project as well as providing a safeguard of the genetic material of the Coastal Fontainea population should the translocation project not be successful.

Performance criteria:

Over the life of this plan:

- existing *ex situ* individuals are maintained in the collection, and contingency arrangements implemented where appropriate
- an *ex situ* program is established and maintained for the translocation program, should the translocation project not be successful
- any problems with the establishment or maintenance of the *ex situ* collection are documented and rectified.

Action 6.2

An assessment of the identification of Critical Habitat under the TSC Act and EPBC Act will be undertaken to determine if current management arrangements are unlikely to adequately conserve the Coastal Fontainea.

An assessment will be undertaken to investigate the need for, and feasibility of, declaring Critical Habitat for Coastal Fontainea under the TSC Act and EPBC Act. The assessment will include the likelihood of Critical Habitat achieving additional protection for the Coastal Fontainea population. If considered appropriate, identification of Critical Habitat will be undertaken.

Justification:

The declaration of Critical Habitat for the Coastal Fontainea may offer additional protection to safeguard the population from extinction.

Performance criteria:

- Areas of suitable land at Lennox Head are assessed for their relevance as Critical Habitat, including potential benefits to the Coastal Fontainea from listing areas as Critical Habitat.
- If it is considered appropriate, these areas of Critical Habitat to be submitted to the relevant Minister to be declared as Critical Habitat for the Coastal Fontainea.

Objective 7: To prepare relevant material to assist the review of the status of the Coastal Fontainea.**Action 7.1**

Recommendations to be prepared for the Commonwealth and NSW governments to assist a review of the national conservation status of the Coastal Fontainea under the EPBC Act and the TSC Act.

Available data regarding the Coastal Fontainea and its habitat suggests that a review of its status is warranted.

Justification:

In preparing this plan, the Coastal Fontainea was assessed under the IUCN Red List Categories and Criteria Version 3.1 (IUCN 2001). Details of the criteria and assessment are in Appendix 1. The species meets the IUCN criteria of a Critically Endangered Species. This action will provide comprehensive information on the species to support the reassessment of its conservation status under the EPBC Act.

Performance criteria:

- recommendations regarding the appropriateness of the current conservation status of Coastal Fontainea have been made to the Commonwealth Government
- by the end of the life of this plan, the conservation status of Coastal Fontainea is appropriately reflected in relevant legislation and policy.

7 Implementation

Table 1 outlines the estimated cost and schedule for implementation of management actions specified in this plan.

8 Social and Economic Consequences

8.1 Consideration of economic costs and benefits

The total cost of implementing the management actions is estimated at \$306 600 (\$146 000 in cash) over the five-year period covered by this plan (Table 1). The costings for implementation of the management actions are itemised in Table 1.

It is necessary to consider the economic benefits of the proposed management program in order to determine the net economic cost or benefit to society. The following effects, although difficult to quantify in financial terms, are likely economic benefits to society as a result of implementation of the plan:

- provision of protected habitat for threatened and other significant flora and fauna species in protected Coastal Fontainea habitat
- increased value of the protected land through habitat enhancement and intrinsic value of the threatened plant community
- meeting the NSW and Australian Governments' commitment to biodiversity conservation.

This plan does however acknowledge that the presence of the Coastal Fontainea and its habitat may lead to decreased value of the private property. This is largely due to the land value at Lennox Head and the constraints on development as a result of habitat protection for Coastal Fontainea.

8.2 Consideration of social costs and benefits

The plan may have social benefits for local communities, through increasing general public awareness of natural heritage values of the areas in which it occurs.

The community will benefit from the conservation of the Coastal Fontainea through opportunities to enjoy the rare scenic beauty of the rural landscape with remnant vegetation overlooking the ocean.

The proposed involvement of the community will provide participants with the opportunity of contributing to the management of a highly endangered species.

9 Biodiversity Benefits

The appropriate ecological management of the Coastal Fontainea and its habitat will contribute to the conservation of several other threatened and rare flora species, which have been recorded in the Coastal Fontainea habitat. Species include Rough-leaved Macadamia *Macadamia tetraphylla*, Arrow-head Vine *Tinospora tinosporoides*, White Lace Flower *Archidendron hendersonii* (southern limit), Smooth Scrub Turpentine *Rhodamnia maideniana*, Veiny Lace Flower *Archidendron muellerianum*, Quassia sp. 2, Silky Cucumber *Trichosanthes subvelutina* and Peanut Tree *Sterculia quadrifida* (southern limit).

The littoral rainforests where the Coastal Fontainea is found are also habitat to fauna species of conservation significance. Threatened fauna species include White-eared Monarch *Monarcha leucotis*, Wompoo Fruit-Dove *Ptilinopus magnificus*, Superb Fruit-Dove *Ptilinopus superbus*, Rose-crowned Fruit-Dove *Ptilinopus regina*, Grey-headed Flying-fox *Pteropus poliocephalus*, Little Bentwing-bat *Miniopterus australis*, Eastern Long-eared Bat *Nyctophilus bifax*, Hoary Wattled Bat *Chalinolobus nigrogriseus*, Greater Broad-nosed Bat *Scoteanax rueppellii* and Common Blossom-bat *Syconycteris australis* (McKinley et al. 1999). In addition, conservation of littoral rainforest assists in providing winter food source for the rainforest pigeons, flying foxes and migratory birds (McKinley et al. 1999).

Littoral rainforest is listed as an Endangered Ecological Community on the TSC Act (NSW Scientific Committee 2004). Littoral rainforest is one of Australia's rarest rainforest types and probably the most threatened due to continuing pressures of urban expansion on the coastal zone. The remaining littoral rainforest occurs as scattered, and increasingly isolated, degraded stands within the influence of salty onshore sea winds. Protection of the Coastal Fontainea and its habitat will contribute to the conservation of littoral rainforest.

10 Preparation of the plan

This Management Plan was developed from the draft Recovery Plan prepared by Maria Matthes, (DECCW North East Branch), with assistance from Stephanie Horton (environmental consultant). It was updated by Gavin Seymour and Dianne Brown (DECCW North East Branch).

11 Review of the Management Plan

Review of this Management Plan is linked to review of the Border Ranges Rainforest Biodiversity Management Plan which will be implemented over a ten year period.

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13 List of Abbreviations

CMA Catchment Management Authorities
DECCW Department of Environment, Climate Change and Water

DSEWPC Department of Sustainability, Environment, Water, Population and Communities
EP&A Act NSW *Environmental Planning and Assessment Act 1979*
EPBC Act Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
KTP Key Threatening Process
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*
RFS Rural Fire Service
SIS Species Impact Statement
TSC Act NSW *Threatened Species Conservation Act 1995*
VCA Voluntary Conservation Agreement under the NPW Act

Table 1. Estimated costs of implementing the actions identified in the Coastal Fontainea Management Plan

Action no	Action Title	*Priority	Cost Estimate (\$'s/year)					Total Cost (\$)
			Year 1	Year 2	Year 3	Year 4	Year 5	
1.0	Protect and manage populations and habitat							
1.1	Environmental planning and impact assessment	1	1 500					1500
1.2	Liaison with landowners and managers	1	4 000	2 000	2 000	1 000	1 000	10 000
1.3	Security of populations	1	200	200	200	200	200	1 000
1.4	Site specific management	1						6 500
1.4.1	Preparation of site plans	1	6 500					
1.4.2	Implementation of site plans	1	30 400	15 400	15 400	15 400	6 500	83 100
1.4.3	Fire management	2	500					500
2.0	Surveys and data collection and management							
2.1	Survey	1		5 000				5 000
2.2	Data collection #	1	2 000					2 000
2.3	Data management	1						
2.3.1	Record management	1	2 000	1 000	1 000	1 000	1 000	6 000
2.3.2	Data dissemination	1	1 000					1 000
2.3.3	Data quality control	1	500					500
3.0	Improving knowledge							
3.1	Site assessment	1	2 500					2 500
3.2	Research plan	1	6 000					6 000
3.3	Experimental research	1	10 000	10 000	10 000	6 000	6 000	42 000
3.4	Monitoring	1	10 000	10 000	10 000	10 000	10 000	50 000
4.0	Translocation							
4.1	Translocation proposal *	1	4 000					4 000
4.2	Implementation of translocation proposal *	1	11 000	5 000				16 000

Action no	Action Title	*Priority	Cost Estimate (\$'s/year)					Total Cost (\$)
			Year 1	Year 2	Year 3	Year 4	Year 5	
4.3	Evaluation of trial translocation	1					5 000	5 000
5.0	Community awareness and involvement program							
5.1	Targeted information packages	1	5 500	500				6 000
5.2	Community involvement *	1	1 000					1 000
6.0	Contingency actions							
6.1	Establishment and maintenance of <i>ex situ</i> collections >	1						
6.1.1	Establishing <i>ex situ</i> collection	1	6 000	4 000				10 000
6.1.2	Liaison with collection managers							
6.1.3	Catalogue existing <i>ex situ</i> collections	1	2 000					2 000
6.1.4	Maintenance of <i>ex situ</i> collection	1	5 000	5 000	5 000	5 000	5 000	25 000
6.1.5	<i>Ex situ</i> data collation and evaluation	1	3 000	2 000	2 000	2 000	4 000	13 000
6.2	Assess Critical Habitat #	3					3 000	3 000
7.0	Conservation status review							
7.1	Documentation		2 000	2 000				4 000
Total			116 600	62 100	45 600	40 600	41 700	306 600

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 staff and current resources. The in-kind contribution for Action 1.5 includes predicted volunteer labour, such as Landcare. This work would otherwise need to be funded.

= Priority and costing of these actions will depend on the identified need for the action and would require "emergency" funding. The cost borne to identify the need is met in other actions.

* = Costs incorporated into other actions

Costs do not include administration on-costs and will be subject to funding source and purpose of expenditure.

14 Appendices

Appendix 1: IUCN Red List Categories and Criteria - Assessment of the Coastal Fontainea *Fontainea oraria*

In preparing this Management Plan, the Coastal Fontainea was assessed under the IUCN Red List Categories and Criteria Version 3.1 (2001). The species was determined to meet the criteria for a conservation status of Critically Endangered under Criteria B1, B2, C and D.

IUCN Definitions

A taxon is **Critically Endangered** when the best available evidence indicates that it meets any of the criteria A-E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

A **population** is defined as the total number of individuals of the taxon and for functional reasons is measured as numbers of mature individuals only.

Mature individuals are the number of individuals known, estimated or inferred to be capable of reproduction. The following IUCN (2001) points are considered relevant to estimate the quantity of mature Coastal Fontainea:

- mature individuals that will never produce new recruits should not be counted (e.g. densities are too low for fertilisation).
- in the case of populations with biased adult or breeding sex ratios, it is appropriate to use lower estimates for the number of mature individuals, which takes this into account.
- re-introduced individuals must have produced viable offspring before they are counted as mature individuals.

Severely Fragmented refers to a situation in which increased extinction risk to the taxon results from the fact that most of its individuals are found in small and relatively isolated sites. These small sites may become extinct, with a reduced probability of recolonisation.

Extent of Occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrences of a taxon.

Area of Occupancy is defined as the area with its 'extent of occurrence' which is occupied by a taxon. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats.

Location defines a geographically or ecologically distinct area in which a single threatening event can rapidly affect all individuals of the taxon present. The size of the location depends on the area covered by the threatening event and may include part of one or many sites.

Coastal Fontainea *Fontainea oraria* Assessment

Criterion B1

Extent of occurrence is estimated to be less than 100 km², and estimates indicate the species is:

- *severely fragmented or is known to exist at a single location, and continuing decline observed, inferred or projected,*
 - *in extent of occurrence or area of occupancy or area, extent and/or quality of habitat or number of sub-populations or number of mature individuals.*

The extent of occurrence of the Coastal Fontainea is estimated to be less than 1 km². The population is considered severely fragmented (with no site having more than 50 mature individuals) and three of the four sites have only one individual (that are not considered to be mature).

All the sites occur within a single locality such that random stochastic events in the locality could reduce or destroy the population.

A continuing decline in the Coastal Fontainea may occur:

- in the area of occupancy or extent of occurrence if any of the single individual sites were to become extinct. This may be a substantial decline given the overall rarity of the species.
- if the quality of the Coastal Fontainea habitat continues to be exposed to degrading processes by the nature of its location, to urban subdivision and the current level of degradation.
- as the chance of a reduction in the number of mature individuals or number of sites is relatively high, given the threats and pressure on the Coastal Fontainea, and most plants

have been affected by the insect pests (increased vulnerability).

Criterion B2

Area of occupancy estimated to be less than 10 km² and estimates indicate the species is:

- *severely fragmented or is known to exist at a single location, and continuing decline observed, inferred or projected*
 - *in extent of occurrence or area of occupancy or area, extent and/or quality of habitat or number of sub-populations or number of mature individuals.*

The area of occupancy of the Coastal Fontainea is estimated to be less than 500 m².

The population is considered severely fragmented (with no site having more than 50 mature individuals) and three of the four sites have only one individual (that are not considered to be mature).

All the sites of the Coastal Fontainea occur within a single location such that random stochastic events in the locality could reduce or destroy the population.

A continuing decline in the Coastal Fontainea may occur:

- in the area of occupancy or extent of occurrence if any of the single individual sites were to become extinct. This may be a substantial decline given the overall rarity of the species.
- if the quality of the Coastal Fontainea habitat continues to be exposed to degrading processes by the nature of its location, to urban subdivision and the current level of degradation.
- as the chance of a reduction in the number of mature individuals or number of sites is relatively high, given the threats and pressure on the Coastal Fontainea, and most plants have been affected by the insect pests (increased vulnerability).

Criterion C

Population size estimated to number fewer than 250 mature individuals, and

- *a continuing decline observed, inferred or projected in the number of mature individuals, and*

- *the population structure is in the form of*
 - *severely fragmented (no sites contain more than 50 mature individuals), and*
 - *at least 90% of mature individuals at one site.*

The Coastal Fontainea population is generously estimated to be less than seven individuals (the number of adult plants at the main site). However, the effective population size is estimated at less than four mature individuals based on the dioecious nature of the species and the number of males in the site that were found to be contributing to future generations.

A continuing decline in the Coastal Fontainea may occur:

- in the area of occupancy, or extent of occurrence, if any of the single individual sites were to become extinct. This may be a substantial decline given the overall rarity of the species.
- if the quality of the Coastal Fontainea habitat continues to be exposed to degrading processes by the nature of its location, to urban subdivision and the current level of degradation.
- as the chance of a reduction in the number of mature individuals or number of sites is relatively high, given the threats and pressure on the Coastal Fontainea, and most plants have been affected by the insect pests (increased vulnerability).

It is considered to be severely fragmented (with no site having more than 50 mature individuals) and three of the four sites have only one individual (that are not considered to be mature). All the mature individuals of the Coastal Fontainea occur in the one site.

Criterion D

Population size estimated to number fewer than 50 mature individuals.

The Coastal Fontainea population is estimated to be less than seven individuals (the number of adult plants at the main site). However, the effective population size is estimated at less than four mature individuals based on the dioecious nature of the species and the number of males in the site that were found to be contributing to future generations.

Appendix 2: Species Profile and Environmental Impact

Assessment Guidelines for the Coastal Fontainea *Fontainea oraria*

1 Background

Coastal Fontainea occurs at four sites near Lennox Head on the far north coast of New South Wales (NSW). These sites occur within a 600 m radius. The total population comprises ten adults and 45 seedlings and juveniles.

The three southern sites occur in the same rainforest remnant. Two of these sites occur as single specimens, isolated from the main clump by about 80 m and 200 m respectively. The main site is comprised of seven adults and all the seedling and juvenile plants. The northern site consists of a single specimen.

1.1 Conservation status

The Coastal Fontainea is listed as Endangered on the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and as Critically Endangered on the NSW *Threatened Species Conservation Act 1995* (TSC Act). Using the IUCN Red Book criteria, the Coastal Fontainea meets the criteria of a 'Critically Endangered' species.

2 Species Information

2.1 Description

The Coastal Fontainea is a small tree or large shrub that may grow to a height of 8–10 m. Its lower trunk is fluted, twisted and commonly multi-stemmed. The bark varies from smooth to slightly scaly and from grey-brown when older to pea-green when younger.

The leaves of the Coastal Fontainea are alternate, simple, elliptic, discolorous, glabrous (hairless) and glossy. They are 8–15 cm long. There are two small oval glands raised 0.5–4 mm from the leaf base. Leaf shoots are hairy (Floyd 1989; Harden 1991). The mid-ribs and lateral veins are distinct and raised on both leaf surfaces. The petioles (leaf stalks) are 1–2 cm long, swollen at the junction with the leaf base and exude a clear, watery sap (Floyd 1989; Hunter et al. 1992).

The leaves are spirally arranged up the stem. The Coastal Fontainea has small (1 cm diameter) whitish flowers with four or five petals with silky to velvety hairs (4–6 mm long). There are often 2–3 flowers on a female inflorescence occurring in the axils or at the ends of branches. The male flowers have 20–24 stamens joined into a tube at the base (Floyd 1989). The species is thought to be dioecious (have male and female flowers on separate plants). The Management Plan provides illustrations of the male and female flowers.

The fruit of the Coastal Fontainea is a 3–6 grooved pink to red globose drupe, generally ripe around March–April. They are about 2.5 cm diameter and 2–3 cm long. Within the drupe, the endocarp is hard, wrinkled and grooved with 2–3 hard sharp ridges. There are 3–4 seeds per fruit (Jessup & Guymer 1985; Floyd 1989; Hunter et al. 1992).

2.2 Habitat

The Coastal Fontainea grow in remnant stands of littoral rainforest dominated by *Guioa* (*Guioa semiglauc*). A list of native and exotic species commonly associated with the Coastal Fontainea is provided in the Management Plan.

The Coastal Fontainea occurs on moderately steep upper hill slopes and crests of northerly and easterly facing hills about 50 m above sea level. The four sites are within 1 km of the ocean.

The Coastal Fontainea occurs on highly fertile, shallow red-brown krasnozems soil derived from basalt. The Coastal Fontainea plants are growing in areas where soil is limited to the inter-rock spaces between basalt rocks.

2.3 Biology and ecology

The life history and ecology of the Coastal Fontainea is largely unknown. The following information is based on opportunistic field observations and genetic research. Further information is provided in the Management Plan for the species.

The Coastal Fontainea is an obligate seed regenerator, which means it relies on seed production and seedling establishment for continued persistence. It does not have other mechanisms, such as the ability to resprout or sucker, to recover from severe disturbance events. Some adult specimens, however, are multi-stemmed, demonstrating the species ability to coppice.

The Coastal Fontainea flowers mainly from spring to mid-summer. The Coastal Fontainea appears to have variable periods of fruiting, with ripe fruit being observed mainly in autumn (Floyd 1989; Hunter et al. 1992).

The sex of the adult at the northern site is unknown. Some individuals that were planted are not yet mature, therefore their sex has not been determined. One female is known at the main southern site. There is some evidence to suggest the species is capable of having both male and female flowers on the one plant (monoecious). The degree to which this phenomenon occurs in the species is unknown.

As the plant has small flowers and inflorescences, it is likely that it is insect or wind pollinated (Williams & Adam 1999). A genetic study indicated that pollen travels only over short distances (Rossetto & McNally 2000). Further work is required to better understand these processes. No self-pollination was recorded by Rossetto & McNally (2000).

One fruit has been observed with a hole containing insect eggs (Bennetts, pers. comm.). The identity of the insect is unknown and it is the only record of pre-dispersal seed predation.

Seed of the Coastal Fontainea is most likely dispersed over short distances by wind, gravity or ballistic methods (Hunter *et al.* 1992). Short distance dispersal of seed may also be assisted by birds or rodents. Seedlings and seed observed on the ground are all within close proximity, less than 5 m, from the female parent tree.

It is not known how long seed takes to germinate. Germinated seed was observed when fruit had just completed falling.

Recruitment of the Coastal Fontainea away from the parent tree appears to be limited by poor seed dispersal mechanisms.

Reasonable levels of genetic diversity were detected within the Coastal Fontainea population with all parental trees belonging to the same genetic provenance and therefore contain equally valuable genetic resources (Rossetto et al. 2000). However, substantial over-contribution from one individual (the female) and a few males was detected (Rossetto & McNally 2000; Rossetto et al. 2000). This is likely to be due to the proximity of the males to the female plant. Seedlings are related to the known adult plants and it is therefore unlikely that an unknown specimen is contributing to the current progeny (Rossetto & McNally 2000; Rossetto et al. 2000).

3 Threats and Management Issues

3.1 Threats

Current threats and management issues operating at the Coastal Fontainea sites and affecting their habitat include habitat destruction, habitat fragmentation and isolation, habitat degradation (exotic weed infestation, weed control activities, stormwater management and erosion control, cattle grazing, ocean wind sheer, increased pressure from adjacent developments), lack of knowledge of biological and ecological requirements of the Coastal Fontainea, inbreeding, dieback, potential fire events, physical and mechanical damage and collection for propagation. The degree of the impact of these on the Coastal Fontainea and its habitat varies according to their intensity and proximity to the Coastal Fontainea plants.

The Management Plan has classified threats according to the potential impact of the threat and a discussion is provided of each threat.

3.2 Recovery Plan

A National Recovery Plan has been prepared for the Coastal Fontainea, incorporated into the Border Ranges Rainforest Biodiversity Management Plan. It identified the actions required to protect and maintain known and potential sites and habitat of the Coastal Fontainea and to give direction to research to assist future management.

4 Survey

Coastal Fontainea is a relatively indistinct plant, easily blending into its surrounding rainforest habitat. There are no seasonal survey constraints for this plant. However, it is more easily detected and identified during the flowering period and when fruit are on the ground.

Surveys should have two objectives:

- to determine presence or absence of the plant
- to determine the abundance and size structure of the plants at the sites.

Surveyors should be familiar with the identification characteristics of the species as described in the Species Profile and the Management Plan.

Survey for the Coastal Fontainea should not be limited to areas within the existing distributional

limits. The recommended area to target this species is littoral rainforest on krasnozem soil between the Queensland–NSW border and the Richmond River, particularly from Byron Bay to Ballina inclusively. The majority of these remnants are identified in McKinley et al. (1999).

Targeted survey for this plant should be conducted in suitable habitat by a small team of 2–4 people. The random meander technique should be undertaken so that all areas of potential habitat are sighted. It is also recommended transects 10 m apart are undertaken so that all large shrubs and trees can be observed. Any trees sighted with trunks of similar appearance (as described in the Species Profile and Management Plan) to the Coastal Fontainea should be more closely investigated.

If the Coastal Fontainea is detected, a site assessment form included in the Management Plan should be completed. Any potential or confirmed new locations to be reported to the Department of Environment, Climate Change and Water (DECCW) at the earliest opportunity.

5 Licensing

Any proposed works not requiring development consent or activity approval 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 Coastal Fontainea, or damage its habitat, requires a licence from DECCW 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 Species Impact Statement (SIS) is required.

‘Pick’ as defined by the TSC Act includes gather, pluck, cut, pull up, destroy, poison, take, dig up, remove or injure the plant or any part of the plant. If a person is likely to or would like to ‘pick’ the Coastal Fontainea they should contact DECCW to determine what authorisation is required.

6 Environmental Impact Assessment Guidelines

The following information is provided to assist development and activity proponents, and determining and consent authorities, with the preparation or review of assessments of likely impacts on threatened species pursuant to the provisions of the EP&A Act.

6.1 Land tenure and zoning

The northern site of the Coastal Fontainea grows in a Ballina Shire Council Reserve. Under the Ballina Local Environment Plan 1987 (Ballina Shire Council 1995) this land is zoned 7(l) Environmental Protection (Habitat) Zone.

The southern sites of the Coastal Fontainea occur on privately owned land. Under the Ballina Local Environment Plan 1987 this land is zoned 7(l) Environmental Protection (Habitat) (Ballina Shire Council 1995). Development that is permissible with consent under this zoning includes: agriculture, bushfire hazard reduction, camping grounds, community buildings, dwelling-houses, environmental educational facilities, environmental protection works, forestry, home industries, open space, roads and utility installations. However, the objective of this zoning is to protect lands of particular significance and any development consent granted is not to conflict with this objective.

The buffer area is zoned 7(d) Environmental Protection (Scenic/Escarpment). Within this area any purposes other than the following (which are prohibited) are permissible with consent: bulk stores, caravan parks for permanent occupation, industries, mineral sand mining, mines, motor showrooms, recreational vehicle areas, residential buildings (other than dwelling-houses or dwellings), shops (other than general stores) and warehouses.

Zoning is being reviewed and standardised during the preparation of Standard Instrument LEPs. The zoning of land where Coastal Fontainea occurs is likely to translate to E2 (Environmental Conservation).

6.2 Legislation

Environmental Planning and Assessment Act 1979

The EP&A Act provides for the consideration of the Coastal Fontainea in land use planning issues. Areas providing important habitat for the Coastal Fontainea can be protected under appropriate environmental zoning in Local Environmental Plans prepared under Part 3 of the EP&A Act. Certain State Environmental Planning Policies (SEPPs) (Part 3) also afford a level of protection to some areas of the Coastal Fontainea habitat. These SEPPs include SEPP 26 Littoral Rainforest and SEPP 71 Coastal Protection.

Consent and determining authorities are required to consider potential impacts on the Coastal

Fontainea and its habitat when considering an activity or development proposal under Part 4 or Part 5 of the EP&A Act. When considering any development or activity that may affect the Coastal Fontainea, the relevant authorities should consider the strategy outlined in the Management Plan, including these guidelines.

Where a consent or determining authority considers that a proposed development or activity may result in a significant effect on the Coastal Fontainea or its habitat, a Species Impact Statement is required to be provided with the application or proposal, and consent or approval cannot be granted without the concurrence of the Director General of DECCW.

State Environmental Planning Policy No. 26 – Littoral Rainforest (SEPP 26)

The aim of SEPP 26 is to provide a mechanism for the consideration of applications for development that is likely to damage or destroy littoral rainforest areas with a view to preservation of these areas in their natural state.

The SEPP 26 identifies and maps discrete areas of littoral rainforest along the NSW coast.

In the case of Coastal Fontainea, it is Ballina Shire Council that is required to consider whether SEPP 26 is relevant to development applications and council activities. Other public authorities may have requirements under SEPP 26. Applications that trigger SEPP 26 require the concurrence of the NSW Minister. Where the concurrence of the NSW Minister is required, the Director General of the Department of Planning and the Minister shall consider any representation made by or on behalf of the Director General of DECCW about the likely impacts of the proposal on the environment.

Both areas of habitat where the Coastal Fontainea occurs in Littoral Rainforest are mapped under SEPP 26. They occur in SEPP 26 remnant number 37 and remnant number 36. The SEPP 26 remnants have a 100 m buffer from the edge or boundary of the vegetation.

Any proposal to erect a building, carry out work, use the land for any purpose or subdivide it, disturb, change or alter any landform, or disturb, remove damage or destroy any native flora, or dispose of or dump any liquid, gaseous or solid matter within the boundary of SEPP 26 remnants requires consent from council and the concurrence of the NSW Minister for Planning. Any proposal to erect a building, disturb, change or alter any landform or disturb, remove damage or destroy any native flora, or dispose of or dump any liquid, gaseous or solid matter within the 100

m buffers of these SEPP remnants also requires consent from council and the concurrence of the NSW Minister for Planning.

State Environmental Planning Policy No. 71 – Coastal Protection (SEPP 71)

The aim of SEPP 71 is to protect and manage the natural, cultural, recreational and economic attributes of the NSW coast and includes a mechanism for the consideration of development applications that may impact on the coastal environment.

SEPP 71 applies to the area declared as the NSW Coastal Zone under the *Coastal Protection Act 1979*. Both areas of habitat containing the Coastal Fontainea occur in the mapped coastal zone under SEPP 71.

Local government is required to consider whether SEPP 71 is relevant to development applications and council activities. Other public authorities may also have assessment requirements under SEPP 71. Where a development or activity is determined to be a State Significant Development, as defined by SEPP 71, the NSW Minister for Planning becomes the consent authority. Where a development is determined to be a Significant Coastal Development, as defined by SEPP 71, the application must be referred to the Director General of the Department of Planning for comment.

SEPP 71 defines state significant development, sensitive coastal development and sensitive coastal locations.

For some developments proposed within the coastal zone a Master Plan, adopted by the NSW Minister for Planning, is required.

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.

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.

6.3 Consideration in strategic planning

In considering Coastal Fontainea in strategic planning, such as in the preparation of Local Environment Plans, Local Environment Studies or Regional Vegetation Management Plans, the threats to Coastal Fontainea identified in the Management Plan should be addressed. Efforts should be made in the design of these plans to ensure that the threats are avoided, minimised or improved upon by appropriately considering them during planning. Examples include:

- provision of appropriate Asset Protection Zone (APZ) setbacks that provide adequate safety to life and property whilst not requiring the loss of Coastal Fontainea or its habitat
- provision of appropriate buffers that reduce the effects of adjacent development
- provision for corridor connections that may contribute to the repair of impacts caused by fragmentation
- in Standard Instrument LEPs, ensuring appropriate zoning of E2 (Environmental Conservation) over land with Coastal Fontainea.

6.4 Consideration of developments and activities

Certain developments and activities may be inconsistent with the conservation of the Coastal Fontainea. Therefore, development or activities within the habitat of the Coastal Fontainea that would not compromise its conservation would be limited to sensitively constructed and appropriately located walking tracks and fencing, habitat rehabilitation and weed removal. Within the 100 m buffer of the SEPP 26 remnants in Lennox Head, development and activities that would **not** compromise the conservation of the Coastal Fontainea would be limited to:

- those that do not adversely impact on the core, including provision of hygiene precautions
- low impact and environmentally sensitive developments or activities
- those where all components of the development or activity are situated as far from the core as possible and located downslope of the core
- developments and activities that include rehabilitation of the core habitat and as much of the buffer as possible
- those that incorporate long-term conservation and management of Coastal Fontainea and its habitat into the development or activity.

Mitigating and compensatory measures

Ameliorative, mitigating and compensatory measures, or a combination of these measures are often proposed to avoid, or reduce, the impacts of the proposed development or activity to threatened species and their habitat. These measures often include, but are not limited to habitat restoration, fire management, water management, translocation, and compensatory habitat.

Habitat restoration includes the control and removal of weeds, habitat rehabilitation, habitat enhancement and habitat creation. Where restoration is proposed in the habitat of Coastal Fontainea, as part of a development or activity, DECCW checklist for bush regeneration in the habitat of threatened species and ecological communities should be adhered to by all people involved in the works.

Fire management includes planning for asset protection. The habitat of the Coastal Fontainea is littoral rainforest and has a low risk of burning except in extremely prolonged dry conditions. DECCW supports the Ballina Bush Fire Risk Management Plan (Rural Fire Service 1999) recommendation that fire be excluded from areas containing rainforest. This includes the areas of littoral rainforest in Lennox Head and is particularly relevant for the remnants known to contain the Coastal Fontainea. As Coastal Fontainea occurs near the edges of the remnants, DECCW recommends that, where APZs are required for a development or activity adjacent to habitat of Coastal Fontainea, proposed APZs:

- are consistent with the Planning for Bushfire Guidelines (2001)
- provide adequate safety to life and property whilst not requiring the loss of Coastal Fontainea or its habitat.

Measures may be undertaken, in association with ancillary works, to maintain water quality (stormwater pollution and sedimentation) and water quantity. Although the primary purpose of these works is often other than for the protection of threatened species, they may have secondary benefits to threatened species and their habitat, e.g. sediment fences placed at appropriate locations and maintained accordingly may benefit Coastal Fontainea and its habitat. Any proposed ancillary works should be designed and located to benefit Coastal Fontainea and its habitat.

Baseline data of the water quality (including pH, oxygen levels etc.), water quantity and natural flow regimes should be recorded. Identified thresholds for water quality and water quantity should be determined and maintained. The thresholds should be justified in terms of maintaining the habitat for Coastal Fontainea. There should be no reduction in the amount of water entering the Coastal Fontainea habitat as a result of stormwater or sediment management, or road design. Water quantity to adjacent habitats is to be maintained. Stormwater flows should replicate, as closely as possible, natural pre-development patterns in terms of frequency, quantity and quality.

In a development context, translocation is not considered an appropriate mitigating measure to compensate for the loss of any natural specimens of the Coastal Fontainea. *In situ* conservation is the most effective management option for the Coastal Fontainea and inappropriate planting of the Coastal Fontainea may detrimentally affect the lifecycle of the species and compromise management efforts. All individuals of the Coastal Fontainea are considered important and should be considered for their role in assisting the species move to a position of viability in nature. Translocation is an action in the Management Plan. Any translocation proposal for Coastal Fontainea is to be prepared and implemented in accordance with Action 4 and the translocation proposal (Appendix 6) of the Management Plan.

In general, compensatory habitat is considered as an option where the impacts to threatened species and their habitat cannot be avoided, or significantly reduced, by ameliorative or other compensatory measures. The extent and cost of compensatory habitat usually reflects the extent and conservation status of those habitats being impacted and the level of degradation or destruction of the habitats being compensated for. Compensatory habitat options are likely to be limited for Coastal Fontainea due to land value in Lennox Head, the small size of remaining littoral rainforest remnants in Lennox Head, and that other remnants in this area are subject to the same, or similar, threats as the remnants known to contain Coastal Fontainea.

All proposed avoidance, ameliorative, mitigating and compensatory actions or measures are to have

an associated monitoring program to evaluate the effectiveness of the actions or measures. The monitoring program should provide details of each action or measure, the objectives of the monitoring, the method of the monitoring, the reporting framework, the duration and frequency, and a feedback loop to refine and improve management actions.

6.5 Assessment of significance

This section is designed to assist with the assessment of developments, activities or actions that may impact on Coastal Fontainea, particularly with assessments under Section 5A of the EP&A Act. Any guidelines, prepared by DECCW, to assist with consideration of the factors to be considered when determining whether the proposal is likely to significantly affect a threatened species, population or ecological community, or its habitat.

Limit of known distribution

The distribution of the Coastal Fontainea is highly restricted, with four sites distributed less than 1 km apart near Lennox Head in northern NSW. The population occurs within 1 km of the coast.

The species is likely to have always had a restricted distribution. However, its rarity within potential habitat is likely to be the result of large-scale clearing of littoral rainforest on krasnozem soil, and its inability to colonise potential habitat. The remaining habitat is fragmented and degraded.

Life cycle of the species

The limited understanding of the biology and ecology of the Coastal Fontainea is described in the Management Plan and summarised in the Species Profile. The lifecycle of the Coastal Fontainea is already disrupted such that the species has been placed at risk of extinction. Any action that further disrupts the lifecycle of the species should be considered significant, as it will increase the existing risk to the species. The lifecycle of the Coastal Fontainea is likely to be disrupted should any of the following occur.

Physical destruction

The physical destruction of plants is considered as the removal of the plant, or at least of the above ground portion of the plant. On current knowledge, the Coastal Fontainea is capable of reproducing vegetatively, by way of coppicing after disturbance. The degree (frequency, duration, intensity, season) of disturbance from which it is capable of responding is unknown.

The species primarily relies on seed to regenerate. Viable seeds are produced when a reproductively mature male and female plant occur within close proximity and both are fecund at the same time. The plant's persistence is likely to depend on the appropriate management of its habitat at known locations.

Physical damage

Physical damage to plants may result from trampling by humans or stock, or inadvertently during the removal of exotic weeds such as lantana from the habitat of the Coastal Fontainea, or during the removal of branches to undertake integrated pest management.

Generally, the significance of a particular action which physically destroys individual plants will require (i) an examination of the number of plants to be destroyed in relation to the proportion of the relevant site numbers²; and (ii) a discussion of the possibility of recovery from the disturbance. However, given the situation of the Coastal Fontainea, the loss of any individuals is considered to be significant in maintaining the species' genetic diversity and for its long-term persistence.

Habitat modification

Habitat modification may affect the lifecycle of the Coastal Fontainea by altering the ecological processes that underpin the fitness of suitable habitat. Habitat modification may include: fire events, weed invasion, alteration to drainage, and soil compaction. The effects of habitat modification are further discussed in the Management Plan.

Threatening processes

The Key Threatening Processes listed in the TSC Act that has been identified as likely to affect the Coastal Fontainea are "Clearing of Native Vegetation", 'Invasion, Establishment and Spread of Lantana (*Lantana camara*)' (Scientific Committee 2006a) and "Invasion and Establishment of Exotic Vines and Scramblers" (Scientific Committee 2006b). Additional threats to sites of the Coastal Fontainea have been identified in the Species Profile and are further discussed in the Management Plan.

The main threat to the long-term viability of the Coastal Fontainea is reduced genetic variation

due to low numbers and lack of genetic exchange within and between the four sites.

Viable local population

The minimum size of a viable local population of the Coastal Fontainea is unknown. However, given that the species is exhibiting signs of inbreeding, any reduction in local population size should be avoided as a precautionary measure. All known individuals, including those in cultivation, are considered to be part of the local population and contribute to the genetic diversity within, and viability of, the species.

Significant area of habitat

In assessing whether a significant area of habitat is to be modified or removed, the focus of the assessment should be with reference to the areas of known habitat within the current distribution (that is, whether the area of habitat is significant in relation to the existing distribution). The following factors should be considered in relation to determining whether a significant area of the Coastal Fontainea habitat exists:

- whether suitable Coastal Fontainea habitat is present and the area (dimensions) of habitat present
- whether the habitat in question is located within or outside of the current distributional limits³
- whether the habitat in question supports a Coastal Fontainea site, and the number, density and age structure of the individuals occurring there
- the proximity of the subject habitat to existing Coastal Fontainea sites
- whether the subject habitat is continuous between existing Coastal Fontainea individuals or sites, and facilitates pollinator movement
- whether the subject habitat will be permanently or temporarily modified or removed or both.

The effects of habitat modification and removal are discussed in the Management Plan for Coastal Fontainea.

Isolation and fragmentation

Four sites of the Coastal Fontainea have been described. Habitat fragmentation has separated

² A description of the sites, including estimates of numbers of individuals is provided in the Recovery Plan.

³ Generally, if a species is located outside of the current distributional limits, it is likely that such habitat would be considered significant. However, in the case of Coastal Fontainea all areas where the species is detected must be considered as a significant area of habitat.

the northern site from the southern sites of the Coastal Fontainea. It is presumed that these remnants may have been part of a system of patches in more or less continuous habitat (Rossetto & McNally 2000). The southern sites are not demonstrating any evidence of interaction. The species is currently showing signs of inbreeding.

Fragmentation also leads to increases in the edge to core ratio and the subsequent effects are experienced by the Coastal Fontainea remnants, including impacts of weed invasion and windshear from salt laden winds.

Present ecological understanding is sufficient to predict that further adverse effects of fragmentation and isolation on the Coastal Fontainea sites are likely to include inbreeding and the interruption to the function of pollinators and herbivores. To this end, fragmentation effects may have consequences for fruit production, seed dispersal and therefore recolonisation of adjacent remnants.

Regional distribution of the habitat

The habitat of Coastal Fontainea consists of littoral rainforest on krasnozem soil. This vegetation community is extremely scarce within the range of the Coastal Fontainea, having largely been cleared for agriculture and development. All littoral rainforest, including regrowth, on land which formerly supported this community, within and surrounding the range of the Coastal Fontainea should be regarded as potential and suitable habitat. The potential regional distribution of the Coastal Fontainea is considered to be consistent with the distribution of littoral rainforest on krasnozem soils between the Richmond River and the Queensland border (McKinley et al. 1999). Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions is listed as an Endangered Ecological Community on the TSC Act (NSW Scientific Committee 2004).

Adequacy of representation in conservation reserves

The Coastal Fontainea is not known from any conservation reserves. The northern-most site occurs as a single plant in a council reserve. The other sites are on private land. Therefore, the Coastal Fontainea is not considered to be adequately represented in conservation reserves.

Critical Habitat

Critical Habitat has not been declared for the Coastal Fontainea, although all areas where the

species is known to occur or where it is located should be considered vital to ensuring the species persistence in nature.

7 Further Information

Coastal Fontainea Species Co-ordinator, Biodiversity Assessment and Conservation – North East Branch, Department of Environment, Climate Change and Water, Locked Bag 914, Coffs Harbour NSW 2450.

8 Disclaimer

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Appendix 3: Native plant species commonly associated with the Coastal Fontainea

Common Name	Scientific Name
Trees	
White Bean	<i>Ailanthus triphysa</i>
Beach Alectryon	<i>Alectryon coriaceus</i>
Two-leaved Coogera	<i>Arytera distylis</i>
Coogera	<i>Arytera divaricata</i>
Native Pomegranate	<i>Capparis arborea</i>
Red Olive-Plum	<i>Cassine australis</i>
Jackwood	<i>Cryptocarya glaucescens</i>
Red-fruited Laurel	<i>Cryptocarya laevigata</i> var. <i>bowei</i>
Three-veined Laurel	<i>Cryptocarya triplinervis</i>
Coastal Tuckeroo	<i>Cupaniopsis anarcardioides</i>
Hairy Walnut	<i>Endiandra pubens</i>
Sandpaper Fig	<i>Ficus coronata</i>
Foambark Tree	<i>Jagera pseudorhus</i>
Rough-leaved Macadamia	<i>Macadamia tetraphylla</i>
Yellow Kamala	<i>Mallotus discolor</i>
Red Kamala	<i>Mallotus philippensis</i>
Smooth-barked Bolly Gum	<i>Neolitsea australiensis</i>
White Bolly Gum	<i>Neolitsea dealbata</i>
Sweet Pittosporum	<i>Pittosporum undulatum</i>
Variable Muttonwood	<i>Rapanea variabilis</i>
Shrubs, Climbers, Herbs	
Actephila	<i>Actephila lindleyi</i>
Filmy Maidenhair	<i>Adiantum diaphanum</i>
Native Ginger	<i>Alpinia caerulea</i>
Coffee Bush	<i>Breynia oblongifolia</i>
Water Vine	<i>Cissus antarctica</i>
Palm Lily	<i>Cordyline rubra</i>
Small Bolwarra	<i>Eupomatia bennettii</i>
Whip Vine	<i>Flagellaria indica</i>
Scrambling Lily	<i>Geitenoplesium cymosum</i>
Hedraianthera	<i>Hedraianthera porphyropetala</i>
Harsh Ground Fern	<i>Hypolepis muelleri</i>
Cockspur Thorn	<i>Maclura cochinchinensis</i>
Burny Vine	<i>Malaisia scandens</i>
Basket Grass	<i>Oplismenus</i> species
White Supplejack	<i>Ripogonum album</i>
Austral Sarsaparilla	<i>Smilax australis</i>
Wikstroemia	<i>Wikstroemia indica</i>
Veiny Wilkea	<i>Wilkea huegeliana</i>

Appendix 4: Exotic plant species recorded at the Coastal Fontainea habitat (modified from Bennetts 1999)

Common Name	Scientific Name
Trees	
African Boxthorn	<i>Lycium ferrossimum</i>
African Olive	<i>Olea africana</i>
Avocado	<i>Persea</i> sp.
Camphor Laurel	<i>Cinnamomum camphora</i>
Cherry Guava	<i>Psidium cattleianum</i>
Cocos Palm	<i>Syagrus romanzoffianum</i>
Large-leaved Privet	<i>Ligustrum lucidum</i>
Umbrella Tree	<i>Schleffera actinophylla</i>
Shrubs	
Cape Gooseberry	<i>Physalis peruviana</i>
Coral Berry	<i>Ardisia crenata</i>
Groundsel Bush	<i>Baccharis halimifolia</i>
Inkweed	<i>Phytolacca octandra</i>
Lantana	<i>Lantana camara</i>
Ochna	<i>Ochna serrulata</i>
Orange Jessamine	<i>Murraya paniculata</i>
Smooth Cassia	<i>Senna x floribunda</i>
Tobacco Bush	<i>Solanum mauritianum</i>
Winter Senna	<i>S. pendula</i> var. <i>glabrata</i>
Herbs	
Black Nightshade	<i>Solanum nigrum</i>
Busy Lizzie	<i>Impatiens walleriana</i>
Crofton Weed	<i>Ageratina adenophora</i>
Fern	<i>Pellaea viridis</i>
Fishbone Fern	<i>Nephrolepis cordifolia</i>
Ground Asparagus	<i>Asparagus aethiopicus</i>
Kikuyu	<i>Pennisetum clandestine</i>
Large Fishbone Fern	<i>Nephrolepis hirsutula</i>
Mist Weed	<i>Ageratina riparia</i>
Nut Grass	<i>Cyperus rotundus</i>
Paddy's Lucerne	<i>Sida rhombifolia</i>
Red Salvia	<i>Salvia coccinea</i>
Striped Wandering Jew	<i>Tradescantia zebrina</i>
Thickhead	<i>Crassocephalum crepidioides</i>
Tomato	<i>Lycopersicon esculentum</i>
Turkey Rhubarb	<i>Acetosa sagittata</i>
Wandering Jew	<i>Tradescantia fluminescens</i>
Vines	
Climbing Nightshade	<i>Solanum seaforthianum</i>
Corky Passionfruit	<i>Passiflora suberosa</i>
Madeira Vine	<i>Anredera cordifolia</i>
Siratro	<i>Macroptilium atropurpureum</i>
White Passionflower	<i>Passiflora subpeltata</i>

Appendix 5: Threatened Flora Site Assessment

SPECIES

Scientific Name		Common Name	
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Caps Code				
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RECORDER

Date			
Name/s		Organisation	
Address			
Phone		Email	

LOCATION

Map Name

Map Number

Grid Reference (from map)

- Global Positioning System (GPS) used (circle)? Y/N
 - Easting (6 digits) Northing (7 digits)
 - Accuracy

General description of location.....

Land Tenure (circle) local/state/federal government/freehold/National Park/Nature Reserve/Crown Land/Flora Reserve/State Forest/SEPP 14 wetland/SEPP 26 rainforest/reserve/environment zoning/conservation agreement/other (specify).....

Name and address of landowner, if known

Local Government Area

Precise Locality (provide a detailed description to allow population to be located)

.....

.....

.....

.....

.....

.....

Location Sketch Map (provide a detailed map to enable site to be relocated)

SITE DESCRIPTION

Topography (circle) crest/ridge/upper slope/mid slope/lower slope/gully/flat/
depression/watercourse/escarpment/other

Habitat Condition

- Remnant Size hectaresm longm wide
- Large (> 40ha) area of contiguous native vegetation
- Corridor m longm wide
- Isolated Remnant – size of nearest remnant and distance to next native vegetation
- Isolated Specimen

Vegetation Condition

- Understorey suppressed/developed/overmature/senescing
- Evidence of Dieback
- Intact largely native/partially degraded/severely degraded

Current Land Use

Past Land Use

Time Since Last Fire/Fire History (estimate or from records)

Time Since Logging/Grazing (estimate or from records)

Evidence of other disturbance e.g. erosion, slashing

Disturbance History

- Time since disturbance (estimate or from records)
- Accuracy
- Observation Types
- Overall conditions

SITE CHARACTERISTICS

Aspect		Slope		Altitude	
---------------	--	--------------	--	-----------------	--

Geology (circle) granitic/basalt/conglomerate/sandstone/siltstone-mudstone/alluvium/
limestone/metamorphic/gravel/sand/unknown/other

Soil Landscape/Type

Soil Surface Texture sand/loam/clay/organic/gravel/skeletal/unknown/other

Soil Drainage waterlogged - permanently inundated/annually/rarely/never

damp/well drained dry/well drained damp/other

Soil Depth skeletal/shallow/deep

Soil Disturbance intact/topsoil removed/landfill/other

Surface Stone/Rock %

Vegetation Structural Formation (as per NSW Wildlife Atlas)

Closed Forest/Open Forest/Woodland/Open Woodland/Grassland/Heathland/ Shrubland/Rainforest

Species Association (list full floristics within 10 m of perimeter of population)

Canopy – tallest and upper strata

Scientific Name	Common Name	CA*	Scientific Name	Common Name	CA*

*CA = cover abundance

Understorey – mid-strata

Scientific Name	Common Name	CA*

Scientific Name	Common Name	CA*

Groundcover – low strata (up to 1 m)

Scientific Name	Common Name	CA*

Scientific Name	Common Name	CA*

Vines/Climbers

Scientific Name	Common Name	CA*

Scientific Name	Common Name	CA*

<>Mark weed species with *

<> Mark other threatened flora with #

<> Mark four most dominant species in each layer with (D)

POPULATION DETAILS

Growth form (tall tree, small tree, shrub, herb, vine).....

Local Abundance (circle) frequent/occasional/rare

Area covered by sitemetres longmetres wide

Spatial Distribution small scattered clumps/large continuous clump/isolated scattered individuals/ other

Distance to nearest known site

Breeding Statusbudsflowersfruit

Plant Height (s) (cm) min.max.average

Estimated Age of Plants min.max.average.....

Vegetative Recruitment

Response after Disturbance

Is population natural (N) or planted (P)?

Population Structure

Life Stage	no. plants	min. no.	max. no.	notes
Dead				
Senescent, dying				
Mature, non-senescent				
Immature				
First year seedlings				

ASSESSMENT_METHOD (Circle correct statements)

Population Assessment

- All plants in the population were individually counted; population data is very accurate
- Plants were individually counted in small plots, and the entire population is estimated from plot data
- Entire population was inspected and population size is estimated visually
- Small parts of the population were inspected and the entire population is estimated roughly
- cursory inspection, estimate is a ball park guess or largely based on results from earlier assessments

How much time was spent assessing the population? hrsmins

THREATENING PROCESSES

	1. When is threat expected to operate?	2. How close is threat to population?	3. Degree of impact
Vegetation clearance			
Earthworks life stage			
Mining/quarrying			
Urban/industrial development/expansion			
Utilities construction/maintenance			
Road/track/trail/fence/utilities construction/maintenance			
Isolation/Fragmentation			
Erosion/Sedimentation/Drainage/Irrigation/Pollution			
Inappropriate Fire or flooding Regimes/ regimes			
Rubbish/garden refuse dumping			
Weed invasion (add detail on species and % cover below)			
Trampling/grazing stock/introduced or native herbivores			
Plant Collection			
Recreational damage (walkers, 4WD, trailbikes, etc)			
Herbicide			
Disease/Pathogens			
Pests			
Timber Harvesting/Forestry Activities			
Agriculture			
Poor recruitment			
Small population size			
Hybridisation			
Loss of Pollination Vector			
Inbreeding			

Use codes:

- a = current;
 b = <1 year;
 c = 1-5 years;
 d = > 5 years;
 e = ongoing;
 f = potential.
- a = in population;
 b = 1-10m;
 c = 10-100m;
 d = >100m;
 e = potential.
- a = low;
 b = medium;
 c = high;
 d = potential;
 e = immediate;
 f = long term

Weed Invasion - specify major species and % cover

Other threats

Threat Assessment (circle appropriate)

- All potential threats examined, assessed and recorded thoroughly and comprehensively
- All potential threats examined, assessed and recorded roughly
- Obvious threats examined and recorded thoroughly and comprehensively
- Obvious threats examined assessed and recorded roughly
- Other (provide details)
- How much time was spent assessing threatening processes? (Hrs/mins)
- Threats assessed on site only/part site/whole site
- Threats assessment off-site (provide details)

MANAGEMENT HISTORY (relevant to threatened species)

For example: fencing, signposting, fire management, grazing management, mowing/slashing, tree/shrub removal, visitor management, erosion control, weed control, pollination, seed collection, propagation, monitoring, research, translocation, liaison, reservation, enforcement, survey, other

MANAGEMENT ACTIVITIES (> 2 years old)

Activity Type	Notes	Date

MANAGEMENT ACTIVITIES (relevant to threatened species) (within last 2 years)

Activity Type	Notes	Date

SUGGESTED MANAGEMENT (for future)

Activity Type	Notes	Date

OTHER RECORDS

Collection made Yes/No

Collection type (circle) seed/cutting/plant/herbarium specimen/other

Purpose of collection

Specimen lodged with National Herbarium/other

Photographs Taken Yes/No of what (plant, flowers, fruit, seed, roots, habitat, works)

Notes

.....

Appendix 6: Coastal Fontainea Translocation Proposal

1. Background Information

Species

Coastal Fontainea *Fontainea oraria*

Threatened Status

<u>Commonwealth</u>	Endangered
<u>NSW State</u>	Critically Endangered
<u>IUCN</u>	Critically Endangered

Translocation team

The translocation team to include representatives from relevant agencies and individuals, including, at a minimum, Department of Environment, Climate Change and Water (DECCW), Ballina Shire Council, Botanic Gardens Trust and relevant landowners/managers. The Team may also include parties from relevant funding bodies (e.g. Commonwealth, CMA) and experts (e.g. ecologist, propagator, bush regenerator) as required.

The translocation team will ensure that those involved in the translocation will be sufficiently trained (see following sections), including understanding data collection and management requirements.

Species summary

The Coastal Fontainea is known in the wild from four sites near Lennox Head on the far north coast of NSW. These sites make up a single population, occurring within a 600 m radius. The total population comprises ten adults and 45 seedlings and juveniles.

The three southern sites occur in the same rainforest remnant. Two sites occur as single specimens, isolated from the main clump by about 80 m and 200 m respectively. The main site is comprised of seven adults and all the seedling and juvenile plants. Two adults originally existed at the northern site, however one specimen died in 1996. The site now persists as one adult and eight individuals that were planted in 1995 from seed collected from the main site.

It is likely that the Coastal Fontainea was more widespread within the littoral rainforest on

krasnozem soil at Lennox Head. The majority of this vegetation type has been cleared in the area and presumably Coastal Fontainea plants were destroyed at the same time. The genetic research indicates that there was gene flow between these remnants prior to clearing (Rossetto & McNally 2000).

Rationale for translocation

This translocation proposal is part of the management program for the Coastal Fontainea. It has been designed considering Vallee et al. (2004). Translocation is considered to be an essential management action for the Coastal Fontainea because the total population is critically small (under IUCN criteria less than four effective mature individuals exist in nature), resulting in inbreeding due to only a few individuals contributing to future generations.

Actions undertaken to date

Seven specimens that were planted in 1995 have survived at the northern site. Seeds used for these plants were collected from the main site. However, these individuals have not matured nor have they established second generation seedlings. Therefore, this cannot be considered as a successful translocation at this stage.

Genetic studies have been completed which have assessed the genetic variability of the population (Rossetto & McNally 2000; Rossetto et al. 2000).

Fifty five Coastal Fontainea representing all adult individuals were planted in 2010 across five separate sites within the habitat of Coastal Fontainea. All individuals to date have survived and are being monitored. Due to the immaturity of the plants, these are not currently a self-sustaining population.

Translocation proposal objectives

The objectives of the proposal are to:

- increase the number of individuals and populations of the species in a natural habitat and maximise the effective population size of a single population;
- investigate techniques that will enhance establishment and survival of translocated Coastal Fontainea plants, while not compromising the success of the translocation;
- understand the problems and limitations of translocating the Coastal Fontainea;
- reduce the risk of susceptibility to stochastic events and inbreeding; and

- have at least five self-sustaining populations in nature.

Table 1 Targets and indicative timeframes

Stages	Tasks
STAGE 1 (Year 1)	
Preparation and implementation of initial trials	propagation and maintenance of plants (<i>ex situ</i>),
	site preparation – weed control, fencing etc.,
	training,
	monitoring – biological and ecological.
STAGE 2 (Year 2-10)	
Implementation of initial trials	maintenance of plants (<i>ex situ</i>)
	on-going site maintenance
	initial plantings
Evaluation of trial translocations	debrief and additional training
	preparation of a full-scale translocation proposal
	monitoring
STAGE 3 (Year 10 on)	
	Maintenance of <i>ex situ</i> collection
	Implementation of full-scale translocation:
	Monitoring
	Evaluation of full-scale translocation(s)
	Further work, monitoring and evaluation as required

Consequences of not undertaking a translocation

The consequence of not undertaking the proposed translocation is the species is highly likely to become extinct due to:

- the population of the Coastal Fontainea not likely to be self-sustaining as not all current individuals are contributing to future generations;
- the population will continue to suffer the effects of inbreeding and is likely to be incapable of adapting to environmental changes; and
- the population will continue to be highly susceptible to stochastic events and inbreeding.

Type of translocation proposed and considerations for options

Enhancement

An enhancement translocation is an attempt to increase the population size or genetic diversity by adding individuals to an existing population

(Vallee et al. 2004). The two southern single plant sites and the northern site have been assessed as suitable enhancement sites. This is because, as they are sites with single plants, they are unlikely to be capable of reproducing without appropriate enhancement. Therefore, the Coastal Fontainea will eventually become extinct at these sites once these individuals die. The planting of the Coastal Fontainea at these sites is not considered likely to impact on the source or natural population.

Although the main site is inbreeding, it is not considered appropriate to plant additional specimens there at this stage.

Consideration needs to be given to the potential need for the pollinator/s to be introduced to the translocation sites. This may be necessary if the limited gene flow between plants was determined to be a result of the loss of the pollinator/s. Identification of pollinator/s, the potential source of pollinator/s and whether their introduction may have deleterious impacts upon the ecosystem prior to any introduction would need to be assessed.

Reintroduction

A reintroduction translocation is an attempt to establish a population in a site where it formerly occurred, but where it is now extinct (Vallee et al. 2004). This is not applicable to the Coastal Fontainea as there are no specific sites known where the Coastal Fontainea no longer occurs. The areas around the proposed introduction sites to be thoroughly searched to ensure no unknown specimens of Coastal Fontainea occur within proximity to the proposed planting area.

Conservation introduction

A conservation introduction is an attempt to establish a taxon, for the purpose of conservation, at a site where it is not known to occur now or to have occurred in historical times, but which is considered to provide appropriate habitat for the taxon (Vallee et al. 2004). The translocation proposal includes the introduction of the Coastal Fontainea to at least two new sites. A preliminary investigation has been undertaken at several sites to determine their suitability as introduction sites. The potential carrying capacity of some sites may limit the final choice of sites. These sites to be assessed in detail as part of the Management Plan implementation.

2. Pre-translocation Assessment

Biological Assessment

Numerous surveys have been undertaken in suitable habitat in the Lennox Head area and failed to locate further specimens of the Coastal Fontainea. Regardless, it is possible that scattered individuals occur that have not been detected. Thorough surveys are to be undertaken prior to planting of the Coastal Fontainea within 50 m of the boundaries of any proposed planting area. Should any specimens be found within proximity to the proposed translocation sites, an assessment will be made of their suitability to be included in the translocation project and of the impact of the proposed translocation on the natural specimens. Adverse impacts to the natural populations will be avoided to maximise the species' chance of survival.

Taxonomic assessment

Rossetto et al. (2000) revealed that the Coastal Fontainea is a genetically distinct species and that the plants on all sites are similar. Therefore, all adult plants are suitable for use in the translocation project.

Population biology

The reproductive biology of the Coastal Fontainea is poorly understood. The species is thought to be dioecious although there is some evidence to suggest that some plants may be monoecious. The sex of the individual clones must be determined prior to any planting arrangements being finalised.

The results of Rossetto et al. (2000) indicates that individuals at a distance greater than 5 m from the female plant are not contributing to future generations. The possible reasons for this are varied and poorly understood.

Population dynamics

Regeneration from seed is evident at the main site. It is expected that the translocated populations will be capable of producing seedlings when mature. However, as the growth rate of the species appears to be slow, the success of the Coastal Fontainea translocations in terms of producing seedling regeneration will not be determined for many years.

Genetic assessment

The genetic study undertaken by Rossetto et al. (2000) detected inbreeding in the seedlings due to few adults contributing to the future generations.

Genetic research will be required to determine that future generations from the planted seedlings are maintaining adequate levels of genetic diversity. Mixing material from all sites will not be deleterious to the gene pool of the Coastal Fontainea and it is likely to be of benefit in the long term.

Propagation potential

Seed germination, cuttings and air layering (marcotting) have all been successful methods of propagating the Coastal Fontainea. The success of cuttings and air layering taking root is largely dependent upon the quality of the material collected and the time of year it is collected. Some cuttings took 6–8 months before striking, however, material taken during the flush of new growth in autumn was extremely successful at striking roots. Cuttings from each adult plant will be taken during the spring or autumn flush of new growth. Cuttings will be used to establish *ex situ* plants for a living collection and the translocation trials.

Source of individual plants

Plants used for the translocation to be sourced from cuttings of all adult clones, where sufficient material is available. Plants to be propagated and

grown in nursery conditions. Plant material will be collected, raised and maintained using strict hygiene protocols.

The total number of plants required will be determined by the final design of the translocation plantings and will also depend on the sex of the various individuals.

Assessment of impact of removal of propagation material from source site

The translocation is to use vegetative material from adult plants for propagation material. Seedlings are not to be used as there is evidence they have less genetic diversity than the adults (inbreeding). The use of vegetative material will ensure the maintenance of genetic integrity in the translocated populations.

Strict hygiene protocols are to be used when collecting propagation material to avoid damage to the plants or their habitat. This includes **cleaning secateurs and footwear prior to collecting samples**, using clean bags etc. for propagation material. Care will be taken not to trample any of the Coastal Fontainea plants.

Ecological assessment of known sites

Details of the biotic and abiotic environment are provided in the Management Plan. All the proposed translocation sites are to have the same or similar abiotic characteristics as the known Coastal Fontainea habitat as defined in the Management Plan.

Issues considered relevant to the Coastal Fontainea translocation proposal are the possible absence of the pollinator(s), exposure to salt-laden winds, habitat degradation and disease and pest susceptibility.

Adult plants appear tolerant of most weed species present, however, seedlings and juveniles are not as resilient and will require active weed removal. The Coastal Fontainea has been observed to recover from insect attack.

Ecological and environmental assessment of proposed translocation site

Selection and suitability of sites

Several sites have been assessed for their suitability for translocation. Proposed sites for the

enhancement translocations must meet the biological and ecological requirements of the species. It has not been determined whether a pollinator is present at the selected sites. This requires further assessment.

The sites considered suitable for the translocation are subject to weed invasion and impacts from stormwater runoff. These have the potential to impact on the success of the translocations. It is considered that the identified threats at the proposed enhancement sites can be managed through the implementation of the Management and Rehabilitation Plan (Kooyman 2005), including the habitat restoration program.

Two or three sites are to be selected initially. Primary site selection factors are listed in Table 2. These are considered to be minimum requirements. Further considerations should be addressed where possible.

Site selection needs to consider threats to existing populations. For example,

Are the translocated specimens likely to become a “weed” in the translocation site or adjacent habitat?

- What is the potential for cross pollination between sites and for hybridisation to occur, thus potentially affecting the genetics (i.e. proximity to natural populations)?
- Is the species known or likely to host disease or pathogens?
- Is the species likely to outcompete other species for resources?
- What is the degree of disturbance and degree of rehabilitation required before translocation?
- What are the threats present (e.g. weed invasion, stormwater discharge, trampling, etc) and can they be mitigated?
- What is the adjacent land use?
- Is there suitable access to enable site works to be undertaken?
- What are the potential impacts of restocking to the genetics of the local source population?
- What is the risk that undetected plants are nearby that may have a deleterious impact on the species?

Table 2. Primary and secondary considerations for site selection

Primary site selection factors	Further considerations for site selection
<ul style="list-style-type: none"> • The site is located within 2 km of the coast at Lennox Head • The site is, or once supported, littoral rainforest on krasnozems soils • The carrying capacity of the site is able to support a translocated population • The landholder supports the proposal • There is long term security of the land 	<ul style="list-style-type: none"> • Identification of a number of alternative host sites (within range or outside range) • Will the biological and ecological requirements be satisfied at the selected site) • Is the site within known historic distribution? • Can the critical requirements of the lifecycle be met? • Does the site contain similar associated vegetation type and structure as described in the Management Plan? • Does the site contain similar abiotic characteristics (e.g. soil type) as described in the Management Plan? • Is the host pollinator species present? • Is the habitat size adequate for establishment of a self sustaining population?

Logistical assessment

Staffing

- DECCW has overall accountability for the translocation, although the translocation team will be integrally involved with the work being done.
- Administration and record keeping will be the responsibility of DECCW. However, relevant data and record management will be the responsibility of each party as relevant to their tasks.
- Propagation will be undertaken by a suitably experienced and qualified propagator.
- A taxonomist is not considered necessary for this project as the genetic research has resolved any taxonomic issues that may have needed to be understood.
- A suitably qualified ecologist will be contracted to undertake monitoring and aspects of the research.
- The local community may assist, through an appropriate organisation, with rehabilitation of the proposed enhancement and introduction sites. A qualified bush regenerator is to be on-site to ensure works are undertaken in a sensitive manner with consideration to threatened species and their habitat.

Training

Training in the general aspects of translocation is provided to all people involved in the translocations. The trainers must be familiar with the critical issues of translocating threatened

species and must also be familiar with the ANPC translocation training. Particular emphasis will be on monitoring, *ex situ* management (i.e. not mixing plants, removing flowers etc.), record management, hygiene (phytosanitary) issues and habitat restoration for threatened species.

Financial assessment and commitment

Financial commitment is required for the life of the project for propagation and maintenance, habitat restoration, monitoring and genetics. Further short to long-term funding and commitment is required.

Resource assessment and commitment

Facilities will need to be able to hold up to 1000 plants for at least 18 months. Best-practice nursery management will minimise any adverse impacts of pathogens and thus to ensure the greatest success rates of plants.

3. Pre-translocation Preparation

Translocation Design

Proposed experimental treatments

The following treatments are to be considered in the translocation trials so that a better understanding may be gained of the success or otherwise of the translocation. This will enable the most appropriate and successful treatments to

be applied to a full-scale translocation for its success.

Additional variables that require further consideration and planning include: the age of the propagated plants at planting, the use of fertiliser, the use of mulch and the use of soil wetting agents.

Table 3. Description of potential experimental treatments

Treatment	Description of Treatment
Control	Plants not given any treatment
Watered	Plants given water
Shaded	Plants grown in shade
Gro-cone	A gro-cone is placed around the plant

Determining the level of care

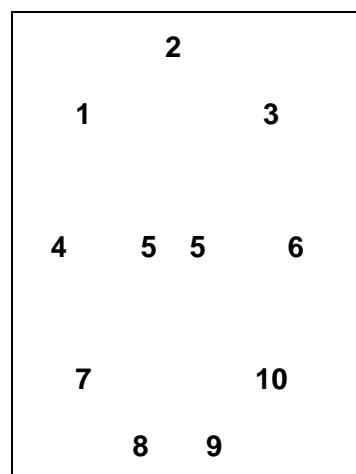
The following parameters are to be considered for each proposed treatment to determine the appropriate and necessary level of care to be applied to the full-scale translocation.

- **Watering.** Watering to be applied to half the plants assigned to the watering treatment whilst remaining plants will not be watered. Two litres of water is to be applied to the base of each plant once a week from August to March. This is to test whether watering over the first summer assists survival of the Coastal Fontainea plantings.
- **Shade.** Half the plants to be planted where there is shade of 70% cover for the group assigned to the shade treatment. The remaining plants will be planted in the open. This is to test whether protection against sun and wind increase chances of survival.
- **Gro-cones.** Gro-cones will be placed around half the plants in each group assigned to the gro-cone treatment whilst the remaining plants will be planted without. This is to test whether the use of gro-cones enhances survival of the planted specimens.
- **Fencing and weeding.** Each plot will be fenced and weeded. The fence design will need to be adequate to exclude herbivores and to ensure plants do not get trampled.
- **Fertiliser, mulch & wetting agents.** The use of fertiliser, mulch and soil wetting agents may improve the success of plants establishing, although the degree to which their use may lead to the plants adapting to such assistance is not known. For the full-scale translocations,

the level of care will be designed and applied based on the monitoring results.

Layout

A layout design has been developed which will maximise future pollination between specimens (Figure 1).



(5 = female plants)

Figure 1. Example translocation design with individual clones placed 2.5 - 3 m apart

Experimental trials

The number and size of plots to be determined following the final decision on treatments and experimental design. The location of each translocation site can then be selected. Sites will not be cleared of native vegetation and plants will be planted in gaps in the vegetation, adhering as close as possible to the final pattern.

Within each plot plantings to follow the planting layout (see figure 1).

Consideration is to be given to selective hand pollination to increase the likelihood of seed set. A detailed experimental design will be prepared for this research.

Full-scale translocation

The final design of a full-scale translocations will be dependent upon the evaluation of data gathered at the experimental stages and the results of the monitoring.

Propagation of plants

Methods of collection

A schedule will be prepared that identifies the proposed timing of plant propagation, the number of each clone required, the age plants will be grown to, the sex-ratio required for planting and the relevant genetic information.

Plants used in experimental trials are to be the same stock as those proposed to be used in the full-scale translocation. The source cuttings are to be from all the adult clones in the natural sites, where suitable and sufficient material is available. The ratio of each clone used will depend on the sex of the individuals. For example, additional clones of the known female are likely to be required to assist gene flow, particularly if the pollinator(s) is absent.

The *ex situ* collection must adhere to appropriate levels of hygiene for the collection of material, (using secateurs cleaned with methylated spirits, wearing clean sterilised footwear to the collection sites). All vegetative material will be collected above the rain-splash level to reduce the risk of soil-borne contaminants.

Detailed records must be kept of the collection (see table 4). Clonal samples must be kept separate to avoid accidentally mixing plants. Each bag is to contain a single clone only.

At least 15 cuttings will be taken from each adult plant in the wild where there is adequate material to not cause stress to the plant. The collection of material to be taken when there is a flush of new growth to increase the likelihood of success of cuttings.

The use of tissue culture for the initial propagation is not likely to be considered appropriate for maintaining the *ex situ* collection due to the high cost of maintaining this type of collection in the long term.

Raising plants

Once the cuttings have struck roots and are of a suitable size, they provide an excellent opportunity to provide additional cutting material if necessary.

The number of plants of each clone required will be determined by the final design. Sufficient time will be required to collect and grow plants on to a suitable age for planting (approximately 12 months). Following the initial monitoring to determine the sex of the individual plants, should no additional female plants be found, then it is likely that one female clone will be required for

three plants of different male clones. Should any plants in the wild or in cultivation be determined to be female then these clone(s) will also need to be propagated.

Plants are to be raised in a nursery using best practise nursery conditions, including:

- All equipment used during seedling maintenance and planting will be maintained under strict hygiene protocols.
- The pots to be new and sterile.
- The potting mix medium to be used will be treated (soaked) with a fungicide mix (e.g. Fongarid) or pasteurised (minimum 1 hour steaming to reach 60°C and a further 30 minutes at 60°C).
- There is good airflow to and drainage in pots.
- All benches to be disinfected with Phenosol (2% solution) or a similar solution.
- Clean gloves will be used for all works.
- Clean water will be used for all works.
- Any plants showing evidence of pathogens or rust will be separated from healthy plants and treated appropriately.

Plants will be labelled clearly to ensure identification or origin of clonal collections. The plant details will be transferred from the collection bag to both the pot and a tag on the plant. When plants are repotted this information will be transferred to new pots. The tag on the plant and code on the pots to correspond with the clone code, the date of collection, date of propagation, date of repotting etc. and the method of propagation.

Maintenance of plants and germplasm tissue

The careful maintenance of plants and *ex situ* material in nursery conditions can be critical to the difference between success and failure of the propagation stage. The following considerations will be applied to the *ex situ* collection for the Coastal Fontainea translocations.

Any flowers present on plants in the *ex situ* collection will be removed. No fruit will be allowed to mature on the *ex situ* plants. Specimens to be planted are to be in a non-reproductive state (i.e. no flowers or fruit present).

Plants will be maintained under strict hygiene controls as for raising plants above.

Warning: Over-replication could lead to genetic changes. If propagating numerous cycles (i.e. cuttings taken from cuttings taken from cuttings

etc. taken from an original cutting) then plants may need to have their genetics retested to reduce risk of unwanted soma-clonal variation being introduced to the collection. This concern is more relevant for plants propagated by tissue culture.

Transfer to host site

Prior to transporting plants to the translocation sites the plants will be moved into the open environment, with 50–60% shade throughout the average day, for one month to harden-off the

plants. This is to assist the plants to adjust to the planting out conditions.

A final treatment will be applied to pots to ensure plants, soil and pots are free of pathogens.

Recording

Information is to be recorded for the collection, propagation and maintenance stages of the *ex situ* collection. A proforma for recording this information is provided in Table 4.

Table 4. Coastal Fontainea translocation collection and propagation recording

Collection data:						
Clone code	Origin of plant material	Date of collection	Name of collector	Amount of cutting material taken	Quality of material	Climatic conditions during collection
Propagation data:						
Clone code	Plant code	Date of cutting	Potting media used	Hormone type used	Percentage strike of cuttings	Temperature of propagating bed
Cultural details:						
Plant nutrition	Trace elements	Type of fungal treatments & date	Type of fertiliser	Watering	Time taken for cuttings to strike	Time for plants to grow to suitable plant out size
Notes (e.g. any clones that are more or less easy/quick to strike or grow, any constraints, notable conditions)						

Habitat rehabilitation

Any threats identified at the assessment stage are to be controlled or managed prior to planting of the experimental trial. The following works need to be considered prior to planting the Coastal Fontainea:

- fencing the southern remnant and the proposed translocation sites
- weed management
- drainage issues which require appropriate stormwater management to be implemented
- planting of buffers and potential creation of corridors.

It is recommended that the area within and 50 m around the location of the translocation plots is to have weed control undertaken. Ongoing weed control will be required. Additional weed control works should be undertaken adjacent to these areas to minimise reinfestation of the areas already worked. All habitat restoration will be undertaken in accordance with DECCW bush regeneration guidelines for working in the habitat of threatened species and endangered ecological communities.

4. Translocation

The following standards are to be applied to any translocation of Coastal Fontainea:

- Plants used to be healthy and in peak condition.
- Prior to moving plants from one destination to another all plants to be labelled with a tag (including the details on the pot such as the clone code and the plant code). The plant code will relate to the clone code, the date of collection, the date of propagation, the date of repotting, date of planting, propagation methods etc.
- Prior to transporting, a final check to be undertaken to ensure no flowers or fruit are present on the plants. Planting is to be done outside the reproductive period.
- Site preparation to be completed prior to planting.
- Plants to be secured during transit and taken to the translocation sites as soon as loaded.
- Up to 10% of the leaves to be removed from the planted specimens to reduce transpiration.
- Planting is to be timed when the environmental conditions at the site of the translocation are

optimal for the plants' survival (autumn and spring and at cooler times of the day). Planting is not to be undertaken in very dry conditions, or during extremes of temperature.

- A site map showing the location of the plots at each site to be prepared.
- A map of the plant locations is also to be prepared. All plants are to be tagged inconspicuously (to avoid vandalism). The location of the plants is to be plotted on a map with the tag code indicating the plant's location.
- The level of care applied to the plants (watering, shading, use of gro-cones, mulching, fertiliser, soil wetting agents, weeding etc.) will be in accordance with the experimental treatments and additional considerations.
- Planting will be in accordance with the layout and treatments in the translocation preparation above.
- Planting will also consider the "tips" in the ANPC guidelines that assist in survival of planted individuals.
- The data to be recorded at the time of planting is to include the people involved in the planting, the tag code, the height of the plant, the width of the plant (as two measurements taken at right angles). Any obvious or likely threats are to be noted and acted on.

5. Post-Translocation Actions

Level of care

The level of care is to be determined by the pre-translocation preparation section and dependent on site conditions after the plantings have occurred. Continued, long term site management will be required including the control and management of weeds.

Post-translocation monitoring

The demise of translocated populations often occurs several years following planting. Therefore, to assist with the assessment of the success or otherwise of the translocation, a rigorously designed monitoring program is needed. This program will not assume populations have successfully established until monitoring indicates the performance criteria for success are met. Determining the success of the Coastal Fontainea translocation is likely to be greater than 50 years, given the slow growth and maturity rate of the plants.

Monitoring is to be undertaken at the main site (as the control), and the translocation sites. Monitoring should be designed to:

- detect real changes in the population with an acceptable level of precision
- use data collection techniques that can be used by different people
- collect data over a long enough period to detect long-term trends
- be cost effective and uncomplicated so that it can continue over a long period.

Monitoring intervals

Short term monitoring is to be undertaken monthly for the first six months (six visits) and then two monthly for 12 months (six visits) and then six monthly for a further two years (four visits). Long-term monitoring is to be undertaken on an annual basis until criteria for determining success are considered to have been met. Annual monitoring will be undertaken during the peak flowering period.

Monitoring the *ex situ* collection

In addition to information in table 4, the following data are to be recorded for the *ex situ* collection:

- details of the provenance origins of the collection
- establishment and survival of each clone (strike rate of cuttings, germination of seed, growth rates)
- details and assessment of techniques used or trialled (potting media, hormone treatments, temperature of propagation area, dormancy breaking mechanisms applies) and the type of material used (seed, cutting, marcot, tissue culture).

Monitoring the habitat

The following habitat attributes to be recorded at both the translocation sites and the control site:

- type and quantity of weed removal undertaken
- any stormwater run-off and drain management
- any pest management (insect and pathogens) undertaken
- any impact (either negative or positive) to other native species at the site due to the translocation
- changes to the site in relation to community composition and structure and the seral stage.

A minimum of one photo monitoring point will be established at each translocation plot, and the location of the point recorded.

Monitoring the translocations

The following data are to be recorded for the translocated plants:

- Survival of individual translocated specimens:
 - count the number of surviving plants
 - assess each plant's general health using the following codes: 1= alive 2= dead 3= plant withering 4= new growth 5= plant gone 6= tag missing. For code 3 (= plant withering), four sub-codes are to be used a) <25% of plant, b) 25-50% of plant and c) 50-75% of plant d) >75% of plant
 - relative importance in survivorship of factors such as competition, herbivory, pests and pathogens. Identify any reasons for poor health of individuals e.g. insect attack. Additional notes to be taken of other relevant details e.g. colouring of dead leaves, degree of leaf fall, leaf burn etc.
- Biology:
 - growth measurements to be taken. Measure the height of the plants and the width of the crown (in two directions)
 - assess the reproductive status, including the time taken for plants to mature and set seed. Count the number of flowers and fruit if present
 - assess the seed viability and germinability in controlled conditions if sufficient numbers of seed are produced, otherwise a general assessment will be made based on seed production and seedling presence
 - record any evidence of pollinator activity
 - record any evidence of seedling recruitment. Any seedlings observed to be tagged to monitor survival
 - new seedlings are to have their reproductive status monitored to determine the age the plants begin producing flowers and fruit
 - assessment of gene flow is to be undertaken using genetic analysis.

Long-term monitoring

Long term monitoring will be used to assess the following factors:

- longevity of individuals

- the rate of recruitment of new individuals (seedlings) into the population equals or exceeds mortality over a substantial period
- whether any second generation plants are present and self-perpetuating populations are established over a long period of time
- whether genetic variation is maintained in progeny
- whether maintenance of genetic variation (gene flow) is sufficient to reverse inbreeding occurring at the main site.

Monitoring sheets

The translocation team will prepare and complete monitoring sheets as part of implementing the Management Plan.

Criteria for determining success or failure

The criteria proposed to determine the success, or failure, of the translocation project are based on the limited biological knowledge of the species. Therefore, as ecological data is collected, these criteria may need to be modified over time.

Criteria for determining biological success

The following criteria will be used to determine the biological success of the experimental trials:

Short Term Criteria

- greater than 70% of transplants survive the first three years, with representation from the range of genetic individuals planted
- new and enhanced populations have similar characteristics as the main site, such as survival and growth of translocated individuals.

Medium-Long Term Criteria

- planted specimens have established
- planted specimens have survived to reproductive stage (producing flowers and fruit)
- production of flowers and fruit is at levels consistent with naturally occurring plants
- seed viability is consistent with naturally occurring plants
- when plants mature, new seedlings establish
- if recruiting, after one generation (juvenile transplants to seed producing adult plants) the number of individuals is being sustained or increased by natural recruitment.

Long Term Criteria

- new populations are self-sustaining
- adequate levels of biodiversity, particularly genetic variation, are maintained through generations
- seedlings are established
- if recruiting, after one generation (juvenile transplants to seed producing adult plants) the number of individuals is being sustained or increased by natural recruitment
- if recruiting, after two or more generations (seedlings from the transplants to seed producing adults), the number of individuals is sustained by natural recruitment.

Criteria for determining *ex situ* success

The following criteria will be used to determine the *ex situ* success of the experimental trials:

- material collected for establishing the *ex situ* collection has survived to a point where they are suitable for planting out
- adequate propagated plants are available for the translocation
- identification of individual plant specimens is maintained at the nursery facilities
- correct labelling is maintained through the repotting stages
- techniques for successful propagation of the taxon are developed
- a representative *ex situ* collection is maintained if necessary for the translocation.

Criteria for determining *ex situ* failure

The following criteria will be used to determine the *ex situ* failure of the experimental trials:

- plant material does not strike or establish *ex situ*
- adequate plants are not produced for the translocation
- identification of individual *ex situ* plants is unknown or cannot be confirmed.

Translocation evaluation

Brief project evaluations will be undertaken annually, with a more detailed evaluation in the fifth year of the project. Each evaluation will include:

- the date the next evaluation will be performed
- an analysis of the monitoring results

- identification of the causes of any plant mortality
- an assessment of the success or failure of the translocation against the selected criteria
- an assessment of the methodology and cost-effectiveness of the translocation strategy
- an assessment of any modifications that may be required to the original strategy
- options for ongoing monitoring, maintenance and management of the translocation site
- timeframes, and date(s) proposed, for subsequent post-translocation assessment
- recommendations for future work or improvements to the methodology.

6. References

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