Approved NSW & National Recovery Plan

Recovery Plan for the *Elaeocarpus* sp. Rocky Creek (syn E. sp. 2 'Minyon')

January 2003

Natural Heritage Trust
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Recovery Plan for the Elaeocarpus sp. *Rocky Creek* (*syn E. sp. 2 'Minyon'*)

Executive summary

Introduction

Elaeocarpus sp. Rocky Creek (Family Elaeocarpaceae) is a forest tree most commonly found in warm temperate rainforest or near the ecotone between warm temperate rainforest and sclerophyll forest associated with rhyolitic soils. It has a very restricted distribution and is endemic to the Mt Warning caldera in north-eastern New South Wales.

This Recovery Plan describes the current knowledge of *Elaeocarpus* sp. Rocky Creek, summarises the research and management actions undertaken to date, and identifies the actions required and parties responsible in addressing the conservation of the species in the wild.

Current species status

Elaeocarpus sp. Rocky Creek is listed as Endangered on Schedule 1 of the *Threatened Species Conservation Act* 1995 (New South Wales). It is also listed as Nationally Endangered under the *Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth). From the eight known populations for *Elaeocarpus* sp. Rocky Creek only four reproductive populations have been found.

Legislative context

This Recovery Plan has been prepared in accordance with the provisions of the *Threatened Species Conservation Act* 1995 (New South Wales). This Act is the legislative framework in New South Wales to protect and encourage the recovery of threatened species, populations and communities. Under the *Threatened Species Conservation Act* 1995 (New South Wales), the Director-General of National Parks and Wildlife is responsible for the preparation of Recovery Plans.

The *Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth) requires the Commonwealth Minister for the Environment to ensure the preparation of a Recovery Plan for Nationally listed species and communities or adopt plans prepared by others including those developed by State agencies. It is the intention of the Director-General of National Parks and Wildlife to forward the final version of this Recovery Plan to the Commonwealth Minister for the Environment for consideration for adoption, once it has been approved by the NSW Minister for the Environment.

Recovery objectives

The overall objective of this Recovery Plan is to maintain the viability of all existing wild populations of *Elaeocarpus* sp. Rocky Creek in the long term. Successful recovery of this species is largely dependent on identification, protection and knowledge of the biology of extant populations.

Specific objectives are to:

- identify and protect all populations of *Elaeocarpus* sp. Rocky Creek;
- obtain ecological and population dynamics information to assist with effective management of *Elaeocarpus* sp. Rocky Creek;

- determine the extent and severity of threatening processes, and remove or minimise impacts;
- inform the community about *Elaeocarpus* sp. Rocky Creek and its habitat;
- assess the need for a translocation program and/or ex-situ propagation; and
- assess known reproductive population sites for Critical Habitat within the meaning of the Threatened Species Conservation Act 1995 (New South Wales).

Recovery performance criteria

The recovery criteria are that:

- all potential habitat areas are surveyed and threatening processes identified within the life of the Recovery Plan;
- the understanding of the ecology and biology of the species is sufficient to enable management for long term survival of the species in New South Wales;
- adequate management regimes are in place to protect all known populations from human-induced disturbance;
- all known populations are protected either in conservation reserves or by other conservation mechanisms; and
- all known reproductive population sites are assessed for Critical Habitat within the meaning of the *Threatened Species Conservation Act* 1995 (New South Wales).

Recovery actions

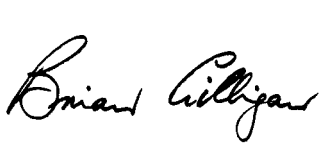
Recovery actions will be directed towards:

- implementing management programs which promote the security and survival of known wild populations;
- undertaking surveys of potential habitat for unknown occurrences of the species; and
- research on population ecology, genetics and health of the species.

Biodiversity value

Worldwide, 14 per cent of the 400 species in the family Elaeocarpaceae are considered threatened under the conservation criteria of the International Union for the Conservation of Nature and Natural Resources.

Elaeocarpus sp. Rocky Creek habitat occurs in an area of biogeographic significance that has very high biodiversity values. Protection of *Elaeocarpus* sp. Rocky Creek would also provide protection for a number of plants and animals associated with its habitat. Five Vulnerable flora species and 11 Vulnerable fauna species have been recorded in areas where *Elaeocarpus* sp. Rocky Creek populations occur (McKinley *et al.* 1996, Kooyman pers. comm.).



BRIAN GILLIGAN
Director-General

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Elaeocarpus sp. Rocky Creek (Family Elaeocarpaceae) is a forest tree most commonly found in the ecotone between warm temperate rainforest and sclerophyll forest associated with rhyolitic soils. It has a very restricted distribution and is endemic to the Mt Warning caldera in north-eastern New South Wales (NSW).

This Recovery Plan describes the current understanding of *E.* sp. Rocky Creek, summarises the research and management actions undertaken to date, and identifies the actions required and parties responsible for addressing the conservation of the species in the wild. The attainment of this Recovery Plan's objectives is subject to budgetary and other constraints affecting the parties involved.

2 Current conservation status

Elaeocarpus sp. Rocky Creek is listed as Endangered on Schedule 1 of the *Threatened Species Conservation Act* 1995 (NSW) (TSC Act) and under the *Environment Protection and Biodiversity Conservation Act* 1999 (Commonwealth) (EPBC Act). It has been assigned a Rare or Threatened Australian Plant (ROTAP) code of 2E [1] (Briggs & Leigh 1996). *E.* sp. Rocky Creek is also documented as a significant regional plant of north-eastern NSW due to its restricted distribution, low number of populations, small population size and limited number of known reproductive individuals (Sheringham & Westaway 1995).

3 Description

3.1 Taxonomic significance

The genus *Elaeocarpus* is widespread in tropical and subtropical areas with over 200 species in Australia, New Zealand, Madagascar and Japan. Currently, 29 species are considered endemic to mainland Australia, four of which are undescribed, including *E.* sp. Rocky Creek (Rich 1995). Eight species are found in NSW with two endemic to the north-east NSW; *E.* sp. Rocky Creek and another Endangered species, *E. williamsianus*, and one, E. *eumindi*, restricted to the far north-east of NSW, but extending into Queensland (Harden 1990, Kooyman pers. comm.).

The species *E.* sp. Rocky Creek is not formally described but is often referred to as '*E.* minyon', or a variation thereof. It is listed on the TSC Act and the EPBC Act schedules as *E.* sp. Rocky Creek.

The type specimen was collected in 1936 from a location recorded only as "Minyon", apparently a reference to the locality of the Rummery Park Forestry Office near Minyon Falls in Whian Whian State Forest, north-eastern NSW. The species was re-discovered nearby in 1992 when one plant was found on the shore of Rocky Creek Dam. In 1995 further populations were located nearby, hence the name *E.* sp. Rocky Creek.

3.2 Description

The species is a medium to large tree to over 30 m high with a stem diameter up to 70 cm. The trunk is fluted and can have small buttresses. The bark is reddish-brown, rough and finely fissured.

The leaves are elliptic or obovate, the apex is acute or emarginate with a cuneate base and the margins are entire, minutely recurved and have large undulations; they are alternate on the stem. The lamina length is generally twice that of the width and tends towards 10 cm with much variation in the shade leaves. The leaves are discolourous; new foliage is pale pink and densely pubescent, turning to light green then grey-green as the leaves age. Young leaves can be

[1] ROTAP 2E: the species occurs over a range of less than 100km and is in serious risk of disappearing from the wild in the next few decades if present land use and causal factors continue to operate.

irregularly dentate, with just a few 'teeth'. The underside is semi-glaucous with a distinctive white to light green appearance that is more prominent in immature plants; senescent leaves may turn yellow-orange with occasional patches of red or green.

White flowers appear in summer and blue fruit is present in winter. The fruit is a large drupe, usually bluntly triangular, and is 19–28 mm in diameter; the length is usually about 1 mm less than the diameter. The fruit falls from the tree in good condition and retains a short stem of 3–5 mm.

Species that may be confused with *E.* sp. Rocky Creek in the field include *Neolitsia dealbata, Endiandra pubens, Endiandra hayesii.* However, *N. dealbata* leaves are generally crowded in pseudo-whorls and the others lack the whitish undersides to the leaves.

More detailed descriptions of *E.* sp. Rocky Creek are given elsewhere (Rich 1995; Quinn *et al.* 1995).

4 Distribution

4.1 Tenure

The known populations of *E.* sp. Rocky Creek occur on NSW National Parks and Wildlife Service (NPWS) estate, State Forests of NSW (SFNSW) estate and Rous Water land managed as water catchment for the Rocky Creek Dam.

4.2 Historical distribution

The type specimen of *E.* sp. Rocky Creek, originally known as *E.* sp. 'Minyon', was collected in 1936 near Minyon Falls in Whian Whian State Forest. This was the only record of the species until its re-discovery in 1992.

4.3 Current distribution

In 1992, a single *E.* sp. Rocky Creek specimen was discovered growing on the western edge of Rocky Creek Dam. Since that discovery, the species has only been recorded at another seven locations despite extensive searches. All of the locations are found on the southern rim of the Mt Warning caldera in north-eastern NSW (Figure 1). Details of site locations have not been included in this Recovery Plan due to the potential threat of inappropriate collection and the inadvertent introduction or spread of potential fungal pathogens between sites.

The eight sites are:

Site 1: Whian Whian State Forest and Nightcap National Park

One sexually reproducing population of 246 individuals (including 174 seedlings) scattered over 45 ha of adjoining State Forest and National Park.

Site 2: Whian Whian State Forest

One sexually reproducing population of 25 individuals spread over five ha.

Site 3: Whian Whian State Forest

Two non-reproducing populations, each comprised of three individuals.

Site 4: Whian Whian State Forest

One isolated individual and one non-reproducing population of 14 individuals.

Site 5: Nightcap National Park

Several individuals (no seedlings) over 0.5 ha.

Site 6: Snows Gully Nature Reserve

Three scattered individuals and one sexually reproducing population of 35 individuals (including 14 seedlings) in 8 ha.

Site 7: Mt Jerusalem National Park

One sexually reproducing population of 238 individuals (including 78 seedlings) in 8 ha.

Site 8: Rocky Creek Dam

One tree located on the edge of the dam. Rous County Council has planted 70 propagated and translocated wild seedlings in the vicinity of the original tree.

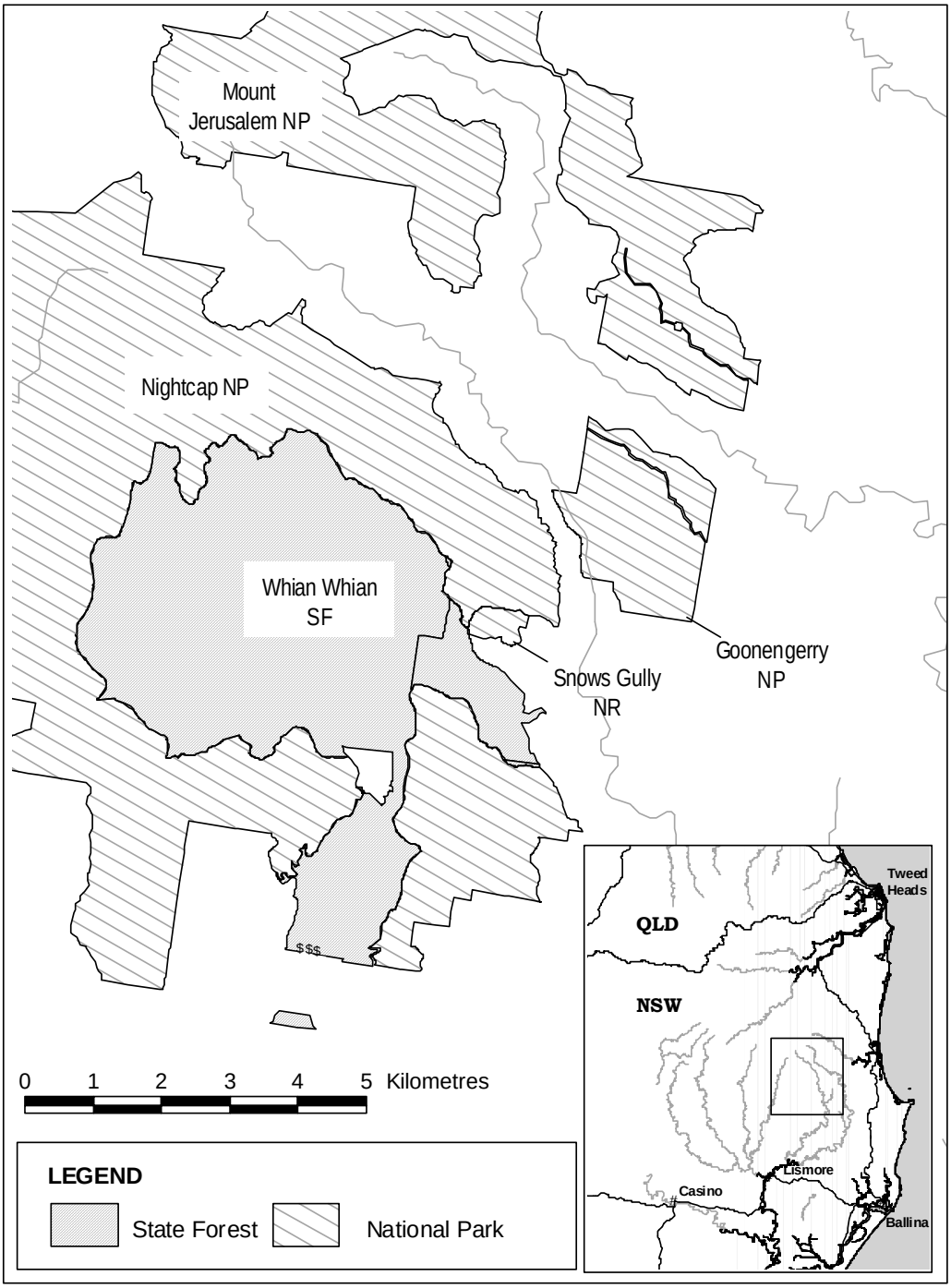

Figure 1. Distribution of *Elaeocarpus* sp. Rocky Creek in north-eastern NSW.

5 Habitat

5.1 Vegetation

The forest type in which *E.* sp. Rocky Creek is found corresponds with Floyd's (1990) warm temperate rainforest *Ceratopetalum/Schizomeria – Caldcluvia* (Suballiance No. 35) and Webb's (1978) simple notophyll vine forest (McKinley *et al.* 1996).

Species associated with *E.* sp. Rocky Creek include *Ceratopetalum apetalum, Schizomeria ovata, Flagelleria indica, Cyathea leichhardtiana, Hicksbeachia pinnatifolia, Helicia ferruginea, Caldcluvia paniculosa, Sloanea australis, S. woollsii, Archontophoenix cunninghamiana, Calamus muelleri, Cordyline rubra, Linospadix monostachya, Synoum glandulosum* and *Ripogonum elseyanum*. Most sites are in proximity to or include *Lophostemon confertus* or sclerophyll species such as *Eucalyptus pilularis, Euc. microcorys, Euc. grandis* and *Corymbia intermedia* (McKinley *et al.* 1998).

Pre-logging vegetation maps of Whian Whian State Forest (J. G. Tracey unpublished) show that many of the known *E.* sp. Rocky Creek individuals occur at the boundary between rainforest and *Lophostemon confertus* forest type. Much of Whian Whian State Forest has since been logged, with the degree of disturbance varying from light logging to clear felling. Historical vegetation data is not available for other areas (McKinley *et al.* 1998).

5.2 Soil

Almost all populations occur on rhyolite-derived soil or soils derived from rhyolite and basalt (McKinley *et al.* 1998). The main Whian Whian State Forest and Mt Jerusalem National Park populations are on rhyolite; the Snows Gully Nature Reserve population is on rhyolite with basalt influence.

The single tree and translocated specimens on the western edge of Rocky Creek are on krasnozem soil, which is probably not indicative of the usual habitat of *E.* sp. Rocky Creek.

5.3 Other variables

Annual precipitation between 1977–1994 at Rocky Creek Dam averaged 1729 mm with a range of 963 to 3076 mm (Rous Water, unpub.). There is a dominance of high summer/autumn rainfall. The altitude of known populations of *E.* sp. Rocky Creek ranges between 187 m and 430 m above sea level.

6 Ecology

6.1 Life history and ecology

Flowering and fruiting phenology

Little is known of the phenology of *E.* sp. Rocky Creek, although flowering and fruiting are said to be erratic (R. Kooyman pers. comm.). To date, only 32 trees have been observed in fruit (McKinley *et al.* 1996).

The tree near Rocky Creek Dam fruited in July 1993, May to July 1994, late April to mid-August 1995 and in April 1996. Fruiting has been observed from September to November 1995 and April to May 1996 in the populations in Whian Whian State Forest, Snows Gully Nature Reserve and Mt Jerusalem National Park. Six individuals from Site 2 in Whian Whian State Forest produced fruit in 2000/2001(R. Kooyman pers. comm.).

Pollination ecology

Nothing is known of the pollination vectors of *E.* sp. Rocky Creek. However, the flowers are similar to others of the genus and it is likely that pollinators would include the beetles, flies, wasps and other insects that visit *E. grandis* flowers (Coode 1984).

Seed dispersal

The dispersal vectors of *E.* sp. Rocky Creek are unknown. The fruit is blue as in other members of the genus and may be adapted for dispersal by birds (Coode 1984).

Regent Bowerbirds (*Sericulus chrysocephalus*) and Green Catbirds (*Ailuroedus crassirostris*) feed on the fruit of *E. grandis* (Floyd 1989). These two species have been observed in the canopy of the large trees of *E.* sp. Rocky Creek at Snows Gully Nature Reserve, however, they were not observed to be feeding on the fruit (McKinley *et al.* 1996). The fruit is likely to be palatable to species such as the Australian Brush-turkey (*Alectura lathami*) and to other birds known to feed on *E. grandis* and *E. kirtonii,* e.g. Wompoo Fruit-Dove (*Ptilinopus magnificus*), Pied Currawong (*Strepera graculina*), Rose-crowned Fruit-Dove (*Ptilinopus regina*), and Topknot Pigeon (*Lopholaimus antarcticus*). It is possible that the Satin Bowerbird (*Ptilonorhynchus violaceus*) collect the blue fruits and may assist in dispersal through males raiding each others bowers (B. Moffatt pers. comm.).

Mammals such as the Bush Rat (*Rattus fuscipes*), the Fawn-footed Melomys (*Melomys cervinipes*), Grey-headed Flying-fox (*Pteropus poliocephalus*) and Black Flying-fox (*Pteropus alecto*) may also be responsible for fruit dispersal (McKinley *et al.* 1996). Fallen fruit beneath the canopy of individuals trees have been observed with gnaw marks consistent with those of a small mammal (A. Rich pers. comm.).

The fruit may be adapted for water dispersal. Tests carried out by Rich (1995) indicated that fruits have the ability to float for several weeks. Although the known populations are not clustered along the edge of creek banks (like *E. grandis*), most locations are in close proximity to creek systems (McKinley *et al.* 1998).

Where there is no possibility of dispersal by water, dispersal of fruit by animals is most likely to account for the occurrence of single trees where no parent tree is located nearby. At Snows Gully Nature Reserve seedlings are found about 30 m from a parent tree in an area where gravity and/or runoff are unlikely to have dispersed the fruits (McKinley *et al.* 1996).

Seed germination and other propagation

Natural germination of seed is occurring most successfully in Whian Whian State Forest (Sites 1 and 2) and the Mt Jerusalem National Park populations. Nursery attempts to propagate the species from seed have been hindered by a high percentage of infertile fruit and difficulties in inducing germination. Rich (1995) noted that only three healthy embryos were found within 73 fruit inspected from the single tree at Rocky Creek Dam. No seed from this tree has been germinated in any trial, however one seed was germinated from the Whian Whian State Forest populations (Mark Dunphy pers. comm.).

Propagation by cuttings has been more successful and has produced plants that have been re-introduced to the wild as part of remedial action post logging in Whian Whian State Forest. The Queensland Herbarium has succeeded in multiplying tissue cultured cells aseptically (Rich 1995). Rous Water planted 70 *E.* sp. Rocky Creek trees at Rocky Creek Dam between 1995 and 1997. The introduced trees included stock grown from cuttings and wild seedlings sourced from within one kilometer of the planting site. There has been 100 per cent survival of the introduced trees with the oldest stem 3–4 m high and a growth rate equivalent to *Gmelina leichhardtii* in the plot (R. Woodford pers. comm.).

In May 1996 two seedlings were removed from an area which is now Nightcap National Park, as they were subject to high levels of disturbance and had been uprooted. The seedlings were taken for ex-situ planting and one has been successfully established at Heritage Park, Mullumbimby (R. Kooyman pers. comm.).

7 Population structure

7.1 Population structure

Five hundred and sixty nine naturally occurring *E.* sp. Rocky Creek individuals have been recorded and are distributed unevenly across seven sites (not including Site 5). Forty nine per cent of the entire population was seedlings in 1999. There is great variation in seedling numbers between sites, with all seedlings occurring at only four of seven sites (Table 1). At Snows Gully Nature Reserve there has been high seedling mortality with only a few surviving to sapling stage.

Coppicing occurs in 35 per cent of the post-seedling population with many coppicing individuals having more than two stems (McKinley *et al.* 1996). While *E.* sp. Rocky Creek is known to coppice in response to injury, multi-stemmed individuals also appear to occur in the absence of apparent injury. This may be a useful strategy for a species with poor seed viability and slow recolonisation ability (Johnson & Lacey 1983).

Site 1 (Whian Whian State Forest and Nightcap National Park) and Site 7 (Mt Jerusalem) support relatively large populations. The sites vary greatly in their seedling and coppicing structures, and both have a history of logging. Mt Jerusalem National Park was logged in the 1960s and again in 1995, resulting in extensive damage to the *E.* sp. Rocky Creek population. The site has a high rate of coppicing and low seedling recruitment compared to the Whian Whian/Nightcap population, which was selectively logged, has fewer coppicing stems and the highest rate of seedling recruitment of any site.

Trees with large diameter at breast height (dbh) are rare with only seven per cent of all individuals recorded having a dbh greater than 25 cm (McKinley *et al.* 1996, 1998)[2]. Further research is required to confirm the extent of seedling recruitment and survival and to establish the age of many of the coppicing individuals.

Table 1. Cohort structure of *Elaeocarpus* sp. Rocky Creek populations at seven sites*

Site	Rocky Creek Dam	Whian Whian SF & Nightcap NP	Mt Jerusalem NP	Snows Gully NR	Whian Whian SF	Whian Whian SF	Whian Whian SF	Class totals
Seedlings	0	174	78	14	0	0	10	**276**
Saplings < 10 cm dbh	0	19	87	19	6	15	5	**151**
Trees 10–25 cm dbh	1	29	65	1	0	0	6	**102**
Trees 25–50 cm dbh	0	24	7	3	0	0	4	**38**
Trees 50–75 cm dbh	0	0	1	1	0	0	0	**2**
Site totals	**1**	**246**	**238**	**38**	**6**	**15**	**25**	**569**

*Based on available size class data to February 1999 (not including Site 5). Multi-stem individuals continue to be classified by the dbh of the largest stem (revision of McKinley *et al.* 1996).

[2] Multi-stem individuals have been classified according to the dbh of the largest stem.

8 Management Issues

8.1 Reasons for decline

An increase in disturbance frequency and intensity (such as clearing, logging and burning after harvesting) may have contributed to the decline of *E.* sp. Rocky Creek. The very limited range of the species suggests a lack of distribution success. It is possible that the species has highly specialised habitat requirements and it may be that both these factors combine to explain the present geographical limits.

8.2 Threats

Logging

Past logging practices may have impacted on the species' overall distribution and on population viability, particularly with respect to seedling recruitment. Historically, heavy logging has occurred in extensive areas of potential habitat. Areas which were clear felled and burned more than 30 years ago in Mt Jerusalem National Park have not been recolonised by *E.* sp. Rocky Creek, despite seed sources being located nearby (Kooyman 1995). The three most recently discovered populations are possibly remnants of a formerly widespread, perhaps contiguous, population (R. Kooyman pers. comm.).

Under the Integrated Forestry Operation Approval (IFOA) for the Upper North East Region, management prescriptions apply for the known *E.* sp. Rocky Creek individuals and populations (see Section 9.6). However, there is potential for unknown individuals and potential habitat to be impacted if not identified in pre-logging surveys.

Fungal pathogens

Three *E.* sp. Rocky Creek trees died at Site 1 in Whian Whian State Forest in 1999. Pathology samples taken from the three trees found that all were infected with *Ophiostoma* sp. Two carried *Botryosphaeria ribis*, and one carried a *Hymenochaete* species. The role of these pathogens in the death of the trees is unclear (Simpson 2000). Surveys undertaken in 2001 revealed an additional seven dead trees, all in the larger size category (10–40 cm dbh). Kooyman (2001) noted that 10 dead tree stems were also recorded in the original survey of the site in 1995. The results indicate a continuing decline in the number of larger individuals in this population. The data suggests that this pattern of decline pre-dates the 'discovery' of the population in 1995 and that the recent deaths may represent a continuation of an existing trend (Kooyman 2001).

Surveys of all other populations found no dead trees (Kooyman 1999). Precautionary measures will need to be implemented to ensure that any potential fungal pathogens are not transferred to these sites.

More detailed testing of trees would be required to determine whether pathogens were responsible for the deaths. Pathogenicity tests would be required on both seedlings and large trees to determine the virulence and pathogenicity of the different isolates. Currently large trees are only found in the wild populations (Simpson 2000).

Reproductive failure

Only four of the eight known populations are reproducing successfully. Two of these have low seedling recruitment and survival. Reproductive failure is potentially the greatest long-term threat to the species and further research is required.

Poaching

Populations may be at risk from illegal seed collection, removal of seedlings or taking of plant material for cuttings.

Invasive species

One of the trees in the protected population at Snows Gully Nature Reserve is covered with *Flagellaria indica*, a native vine that is inhibiting growth (A. McKinley pers. comm.). Several trees in Mt Jerusalem National Park are also being affected by the vine.

Fire

Little is known of the effects of fire on *E.* sp. Rocky Creek, or its ability to regenerate after fire. The plant community associated with *E.* sp. Rocky Creek, along with bark formation on mature trees indicates that the species may have some adaptation to infrequent fire. However, the fire ecology of this species requires further study.

Pending further research, fire should be considered a threat as the species is found on the ecotone between warm temperate rainforest and wet sclerophyll forest.

Mining

The Department of Mineral Resources has issued an Exploration Licence to Diamond Rose NL for the purpose of conducting exploration activities for the presence and extent of Group 6 minerals (Corundrum, Diamond, Ruby and Sapphire). The licence permits exploration activities to be undertaken within an area exceeding 200 km^2, containing all of the known E. sp. Rocky Creek populations and habitat.

The licence enables Diamond Rose NL to undertake exploration activities in Whian Whian State Forest and Rous Water freehold land. Under the National Parks and Wildlife Act 1974 (NPWS Act) exploration and mining is prohibited in national parks and nature reserves. Rous Water are opposed to allowing exploration within the Rocky Creek Dam water catchment and are in discussion with the Department of Mineral Resources (A. Acret pers. comm.).

Threats to *E.* sp. Rocky Creek could include site disturbance associated with access clearing, potential spread of pathogens and damage to trees and habitat by drilling equipment.

Lack of knowledge of life history

Until *E.* sp. Rocky Creek has been adequately studied, lack of knowledge will continue to hamper efforts directed toward recovery and conservation of the species.

8.3 Biodiversity value

Worldwide, 56 of the 400 species in the family Elaeocarpaceae are considered threatened under the conservation criteria of the International Union for the Conservation of Nature and Natural Resources (IUCN) (Walter & Gillett 1998).

Elaeocarpus sp. Rocky Creek habitat occurs in an area of biogeographic significance that has very high biodiversity values. Protection of *E.* sp. Rocky Creek would also provide protection for a number of plants and animals associated with its habitat. Five Vulnerable flora species and 11 Vulnerable fauna species have been recorded in areas where *E.* sp. Rocky Creek populations occur (McKinley *et al.* 1996; Kooyman pers. comm.).

Taxonomic and scientific value

Elaeocarpus sp. Rocky Creek populations in NSW represent the only known occurrence of the species and are, therefore, of high scientific and taxonomic value.

Taxonomic studies of *E.* sp. Rocky Creek would contribute significantly to the understanding of the genus. The species is distinctive among the *Elaeocarpus* for the triangular shape of its fruit and fibrous mesocarp (Rich 1995).

The Hairy Quandong (*E. williamsianus*) is an Endangered species restricted to the Mt Warning caldera in north-eastern NSW. Studies of *E.* sp. Rocky Creek are of direct value to our understanding of *E. williamsianus* and *vice versa*.

Scientific investigation of a rare and isolated species such as *E.* sp. Rocky Creek can potentially clarify the evolutionary relationships and biogeographic distribution of the family

Elaeocarpaceae and the evolution of the flowering plants (Magnoliopsida) of the Southern Hemisphere because of its Gondwanic origins.

Pharmaceutical value

No pharmaceutical values have been investigated for *E.* sp. Rocky Creek.

Commercial value

The commercial value of *E.* sp. Rocky Creek for horticultural use has had limited investigation to date, although most Australian members of the Elaeocarpaceae are worthy of, and well adapted to, cultivation (Jones 1986).

9 Legislative context

9.1 Legal status

Due to its restricted distribution and low population numbers *E.* sp. Rocky Creek is listed as Endangered under the TSC Act and the EPBC Act.

9.2 Recovery Plan preparation

The TSC Act requires that the Director-General of National Parks and Wildlife prepare Recovery Plans for all species listed as Endangered or Vulnerable, and for populations and ecological communities listed as Endangered on the TSC Act schedules. Similarly, the EPBC Act requires that the Commonwealth Minister for the Environment to ensure the preparation of a Recovery Plan for Nationally listed species and communities or adopt plans prepared by others including those developed by State agencies. Both Acts include specific requirements for the matters to be addressed by Recovery Plans and the process for preparing Recovery Plans.

This Recovery Plan has been prepared to satisfy both the requirements of the TSC Act and the EPBC Act. It is the intention of the Director-General of National Parks and Wildlife to forward the final version of this Recovery Plan to the Commonwealth Minister for the Environment for consideration for adoption, once it has been approved by the NSW Minister for the Environment.

9.3 Recovery Plan implementation

The TSC Act requires that a public authority must take any appropriate measures available to implement actions included in a Recovery Plan for which it is responsible. In addition, the TSC Act specifies that public authorities must not make decisions that are inconsistent with the provisions of the plan.

Public authorities and councils identified as responsible for the implementation of Recovery Plan actions are required by the TSC Act to report on measures taken to implementation those actions.

The public authority responsible for the implementation of this Recovery Plan is the NPWS.

The EPBC Act specifies that a Commonwealth agency must not take any action that contravenes a Recovery Plan.

9.4 Critical Habitat

The TSC Act makes provision for the identification and declaration of Critical Habitat. Under the TSC Act, Critical Habitat may be identified for any Endangered Species, Population or Ecological Community occurring on NSW lands. Once declared, it becomes an offence to damage Critical Habitat (unless the TSC Act specifically exempts the action or the action is approved under the EP&A Act). A Species Impact Statement is mandatory for all developments and activities proposed within Critical Habitat under the *Environmental Planning and Assessment Act* 1979 (NSW) (EP&A Act).

To date, Critical Habitat as defined by the TSC Act has not been declared for *E.* sp. Rocky Creek. Assessment of Critical Habitat will be undertaken as a recovery action in this plan.

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

This Recovery Plan (Sections 4 and 5) identifies those habitat features currently known to be critical to the survival of *E.* sp. Rocky Creek as required by the EPBC Act.

9.5 Environmental assessment

The EP&A Act requires that consent and determining authorities consider known and potential habitat of threatened species, biological and ecological factors and the regional significance of individual populations. The Act provides for decision-makers to consult with, or gain concurrence from, the Director-General of National Parks and Wildlife, if the development, activity or plan—under Parts 3, 4 and 5 of the EP&A Act—is likely to affect Critical Habitat, or significantly affect threatened species, populations or ecological communities or their habitats.

Any other action not requiring approval under the EP&A Act, and which is likely to result in a 'pick' of *E.* sp. Rocky Creek, will require approval from the NPWS under Part 6 of the TSC Act or under the NP&W Act.

As *E.* sp. Rocky Creek is listed Nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on *E.* sp. Rocky Creek should refer the action to the Commonwealth Minister for the Environment 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 requirement.

Administrative guidelines are available from Environment Australia to assist proponents in determining whether their action is likely to have a significant impact. In cases where the action does not require EPBC Act approval, but will result in the death or injury of an individual *E.* sp. Rocky Creek, and the individual is in or on a Commonwealth area, a permit issued by the Commonwealth Minister under the EPBC Act will be required.

9.6 Other relevant legislation

Native Vegetation Conservation Act 1997

The purpose of this act is the conservation and sustainable management of native vegetation, and in particular the protection of native vegetation of high conservation significance (Part 1, Section 3(c)). State Forests and NPWS estate are excluded from the operation of this Act (Part 1, Section 9).

The land owned by the Rous Water will be subject to the Richmond Regional Vegetation Management Plan currently in preparation. The NVC Act (Part 3, Sections 24–27) requires that the Director-General of National Parks and Wildlife be consulted in the matter of threatened species and their habitat.

Rural Fires Act 1997

A Bush Fire Management Committee must prepare a draft Bush fire Management Plan for the rural fire district (Sections 52–62). The plan may restrict or prohibit the use of fire or other particular fire hazard reduction activities in all or specified circumstances or places to which the Bush Fire Management Plan applies. The plan must have regard for biodiversity.

National Parks and Wildlife Act 1974

The NPW Act requires that a licence must be obtained to propagate and sell *E.* sp. Rocky Creek. This Act also regulates activities within national parks and nature reserves and applies to *E.* sp.

Rocky Creek sites within Snow Gully Nature Reserve, Mt Jerusalem and Nightcap National Parks.

If in the future, sites with significant habitat values for *E.* sp. Rocky Creek are located on private property, the owners may enter into Voluntary Conservation Agreements (VCAs) under the NPW Act whereby the NPWS can provide assistance in the protection and management of these values on the property. Properties under VCAs may qualify for rate exemptions.

Forestry and National Park Estate Act 1998

The *Forestry and National Park Estate* 1998 (FNPE Act) makes provision, with respect to forestry operations and the National Park estate, to transfer certain State Forest and other crown land to the NPWS estate or Aboriginal ownership following regional resource and conservation assessments. A Forestry Agreement signed in March 1999 gave effect to the land transfer and preparation of the Integrated Forestry Operations Approval (IFOA) for the Upper and Lower North East Region. The provisions resulted in the transferral of part of Nullum State Forest to Mt Jerusalem National Park and part of Whian Whian State Forest to Nightcap National Park.

The IFOA regulates the carrying out of certain forestry operations, including logging, in the public forests of a region. The terms of the Threatened Species Licence (TSL) of the IFOA outlines the minimum protection measures required to limit the impact of forestry activities on threatened species and their habitats, and forms the basis for NPWS regulation of those activities. The TSL for the Upper North East Regions (1999) include measures for the protection of *E.* sp. Rocky Creek on the NSW north coast.

The specific prescription *E.* sp. Rocky Creek requires an exclusion zone of at least 50 m radius around all individuals or groups of individuals (i.e. individuals less than 20 m apart)[3] where there is a record of *E.* sp. Rocky Creek within a compartment or within 50 m of the boundary of a compartment.

10 Social and economic consequences

The total cost of implementing the recovery actions will be $138 800 over the five-year period covered by this plan. The inclusion of the *E.* sp. Rocky Creek populations in Mt Jerusalem National Park and Nightcap National Park has significantly increased formal protection for the species. Management of these areas will be in accordance with the requirements of the NP&W Act and any costs incurred will be met by the NPWS.

Under current forestry practice, the IFOA applies prescriptions to harvesting operations where known individuals of *E.* sp. Rocky Creek occur. Implementation of this Recovery Plan would not affect current SFNSW harvesting operations.

Rous Water manages the Rocky Creek area supporting *E.* sp. Rocky Creek as a water catchment management area. The actions in the Recovery Plan are unlikely to have any adverse social or economic impact on catchment management and are more likely to assist in the protection of water quality.

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

[3] "Exclusion Zone" means a protective area where specified forestry activities, unless exempted, are prohibited under the TSL licence.

11 Previous Actions Undertaken

11.1 Research and planning

- Taxonomic description of the species has commenced and the Queensland Herbarium has undertaken tissue culture trials.
- A final year student project at Southern Cross University, Lismore, was completed in 1995 titled *A preliminary research and recovery study for the rare tree* Elaeocarpus *sp. 2 'Minyon' in north-eastern New South Wales* (Rich 1995).
- In 1996 the NPWS completed a draft Recovery Plan (McKinley *et al.* 1996). Legislative changes precluded this plan's approval.
- In 1998 the NPWS conducted targeted field surveys for undiscovered populations with very limited success (McKinley *et al.* 1998).
- The University of New England has undertaken autecological studies of the species.
- A research project on genetics of the genus *Elaeocarpus* commenced in 2000. The research is being undertaken by Southern Cross University and NPWS through a Strategic Partnerships with Industry Research and Training Scheme (Spirt) Grant (Australian Research Council/Department of Education, Training and Youth Affairs).
- Surveys for new locations of *E.* sp. Rocky Creek and tree health assessments were undertaken in 1999, 2000 and 2001 (Kooyman 1999, 2001).

11.2 Existing conservation measures

- Propagation trials, from both seed and cuttings, have been undertaken.
- The Rocky Creek Dam site has had 70 *E.* sp. Rocky Creek saplings planted by Rous County Council.
- Re-planting of displaced seedlings was undertaken by SFNSW in Nullum State Forest, now part of Mt Jerusalem National Park, after logging disturbance.
- *Flagelleria indica* vine was removed from several trees in Nullum State Forest during implementation of post-logging remedial actions. However, vines still remain on several trees.
- Exclusion zones have been applied to specified forestry activities around *E.* sp. Rocky Creek specimens on State Forest as part of the IFOA for the Upper North-East (S6.22).
- Pathology tests were undertaken in December 1999 by SFNSW on trees that died in Compartment 79, Whian Whian State Forest. A recommendation for further testing was made to ascertain whether the fungal pathogens identified were capable of killing the trees. More recent surveys in 2001 indicated another seven trees have died in Compartment 79 since 1999.

12 Species' Ability to Recover

The Snows Gully Nature Reserve population of *E.* sp. Rocky Creek is producing seedlings, however mortality of these seedlings is high. The remaining three breeding populations are successfully producing seedlings. At Rocky Creek Dam there have been 70 saplings included in regeneration planting over four years with an apparent 100 per cent survival rate (R. Woodford pers. comm.). Cuttings were taken by SFNSW, grown on and replanted Nullum State Forest, now Mt. Jerusalem National Park as part of post-logging remedial action.

The actions described above suggest that translocation and/or re-introduction of *E.* sp. Rocky Creek to suitable habitat may be a viable recovery strategy if considered warranted and appropriate. Any such strategy would need to be carefully considered and the "Guidelines for the Translocation of Threatened Plants in Australia" (Australian Network for Plant Conservation

Translocation Working Group 1997) applied. Actions in this plan will assess the necessity for, and implications of, implementing such a strategy.

The SPIRT genetics project will provide information that will enable translocation and reintroduction guidelines/ strategies to be developed if necessary.

13 Recovery Objectives and Performance Criteria

13.1 Objectives of the Recovery Plan

The overall objective of this Recovery Plan is to maintain the viability of all existing wild populations of *E.* sp. Rocky Creek in the long term. Successful recovery of this species is largely dependent on identification, protection and knowledge of the biology of extant populations.

Specific objectives are to:

- identify and protect all populations of *E.* sp. Rocky Creek either through reservation or other conservation measures;
- obtain ecological and population dynamics information to assist with effective management of *E.* sp. Rocky Creek;
- determine the extent and severity of threatening processes, and remove or minimise impacts;
- inform the community about *E.* sp. Rocky Creek and its habitat;
- assess the need for a translocation program; and
- assess known *E.* sp. Rocky Creek reproductive population sites for Critical Habitat within the meaning of the TSC Act.

13.2 Recovery performance criteria

The recovery criteria are that:

- all potential habitat areas are surveyed and threatening processes identified within two years of commencement of the Recovery Plan;
- the understanding of the ecology and biology of the species is sufficient to enable management for long term survival of the species in NSW;
- adequate management regimes are in place to protect all known populations from human-induced disturbance;
- all known populations are protected; and
- all known reproductive population sites are assessed for Critical Habitat within the meaning of the TSC Act.

14 Recovery Actions

The NPWS will coordinate the implementation of all recovery actions. Recovery actions will be directed towards:

- implementing management programs which promote the protection and survival of known wild populations;
- undertaking surveys of potential habitat for previously undetected occurrences of the species; and
- research on population ecology, genetics and impact of fungal pathogens and health of the species.

In the absence of full scientific information, the following actions are considered necessary for adequate management of *E.* sp. Rocky Creek.

14.1 Action 1

Precautionary measures

The NPWS recommends that visits to the *E.* sp. Rocky Creek Site 1 within Whian Whian State Forest be kept to a minimum. Where possible, visits to other *E.* sp. Rocky Creek sites following a visit to Site 1 should be avoided. All footwear and other materials in contact with the plants or soil at Site 1 should be sterilised. This is a precautionary measure against the spread of potential fungal pathogens to other populations. Draft hygiene protocols are provided in Appendix 1.

14.2 Action 2

Survey

Systematic surveys of potential *E.* sp. Rocky Creek habitat will be carried out and documented. The site specific threatening processes and their severity will be identified and documented. The locations recommended by McKinley *et al.* (1998) will be included in surveys.

A number of these recommended sites have recently been surveyed (Kooyman pers. comm.). Where new sites are located, liaison with the relevant landholder regarding management and protection of the site will occur.

14.3 Action 3

Research

Increased understanding of the ecology and population dynamics of *E.* sp. Rocky Creek and its habitat will be achieved by:

1. Establishing a working group to investigate the cause/s of the tree deaths, particularly the potential role of fungal pathogens, at Site 1 in Whian Whian State Forest.
2. Undertaking a demographic study of the population affected by tree mortality in Site 1. The study will include several other populations e.g. Mt Jerusalem National Park and other sites in Whian Whian State Forest where tree deaths are not currently occurring.
3. Carrying out research on recruitment that will investigate the lack of reproductive success of some populations.
4. Assessing options for an *ex situ* cultivation and population enhancement program.

14.4 Action 4

Monitoring

The monitoring program will be informed by the outcomes from Action 3. Information generated from the monitoring program will provide the basis for ongoing management.

1. The population structure at the seven sites will be monitored on a regular basis to detect any variations in population dynamics and the species' response to a range of disturbance regimes.
2. Tree health will be monitored on a regular basis.
3. The potential success of translocation programs will be assessed through monitoring the existing cuttings, particularly those planted in Mt Jerusalem National Park.
4. The effects of the vine removal from *E.* sp. Rocky Creek trees will be monitored in Mt Jerusalem National Park and Snows Gully Nature Reserve. Recommendations will be made regarding the need for any further control.

14.5 Action 5

Determine the extent and severity of threatening processes, and eliminate or minimise impacts as necessary.

1. Ensure that all known *E.* sp. Rocky Creek locations are protected through conservation measures including secure tenure, forestry prescriptions, environmental protection zone or voluntary land management agreements. Assess the sites supporting reproductive populations for nominations for Critical Habitat. Consultation will occur with SFNSW and Rous County Council.
2. Management should aim to exclude fire from *E.* sp. Rocky Creek sites and habitat. A fire-free buffer of 250 m should be maintained around all sites.
3. The NPWS will undertake audits to ensure that forestry operations are undertaken in accordance with the Upper North-East IFOA with respect to *E.* sp. Rocky Creek.
4. The NPWS will recommend that no new roads or infrastructure are constructed within known *E.* sp. Rocky Creek habitat and within potential habitat unless surveys identify the absence of the species from proposed sites.
5. Implement any protective measures as identified in Action 3.1.
6. Vines will be removed from trees at Snows Gully Nature Reserve and Mt Jerusalem National Park.
7. Assess each population for the need, options and feasibility of translocation actions.
8. Propagate plants for translocation and/or research use if required.

14.6 Action 6

Education

Increase staff and consultant's awareness of risks posed by potential pathogens to *E.* sp. Rocky Creek and the recommended hygiene protocol.

The recommended hygiene protocols will be produced for staff and consultants that may be required to visit the sites to educate them about potential threats to the species posed by pathogens.

14.7 Action 7

Recovery Plan coordination

The NPWS will be responsible for the coordination and implementation of the Recovery Plan.

15 Implementation

Table 2 outlines the implementation of recovery actions specified in the Recovery Plan for the period of five years from publication.

ble 2. Estimated costs of implementing the actions identified in the *Elaeocarpus* sp. Rocky Creek Recovery Plan.

tion Jo:	Action Title	Priority	Estimated Cost/yr					Total Cost	Responsible party/ funding source	In-Kind	Cash
			Year 1	Year 2	Year 3	Year 4	Year 5				
	Precautionary action against spread of fungal pathogens	1						*costs included in other actions	NPWS		
	Survey	2		$10,000		$10,000	-	$20,000	NPWS		$20,000
	Pathogen working group	1	$5,000	$5,000	$5,000	$5,000	$5,000	$25,000	NPWS	$10,000	$15,000
3.3	Demographic & recruitment research	1	$10,000	$10,000	$10,000	$10,000	$10,000	$50,000	NPWS	$10,000	$40,000
.4	Monitoring	2	$5,000	$5,000	$5,000	$5,000	$5,000	$25,000	NPWS	$5,000	$20,000
	Ensure populations are protected, assess Critical Habitat	2			$5,000			$5,000	NPWS	$5,000	
	Vine removal	3	$1,200	$400				$1,600	NPWS	$1,600	
5.8	Translocation assessment	3				$700		$700	NPWS	$700	
	Education	1	$1,500					$1,500	NPWS	$1,500	
	Recovery Plan Coordination	1	$2,000	$2,000	$2,000	$2,000	$2,000	$10,000	NPWS	$10,000	
l			$24,700	$32,400	$27,000	$32,700	$22,000	**$138,800**		$43,800	$95,000

ity ratings are: 1 - action critical to meeting plan objectives; 2 - action contributing to meeting plan objectives; 3 - desirable but not essential action.
Kind' Funds represent salary component of permanent staff and current resources
n' Funds represent the salary component for temporary staff and other costs such as the purchasing of survey and laboratory equipment

16 Acknowledgments

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Results from research on *E.* sp. Rocky Creek undertaken by Alan Rich in 1995 have also been incorporated into this work.

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17 Review Date

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

18 List of acronyms used in this document

ANZECC	Australian and New Zealand Environment and Conservation Council
EPBC Act	*Environment Protection and Biodiversity Conservation Act* 1999
dbh	Diameter at breast height
EP&A Act	*Environmental Planning and Assessment Act* 1979
FNPE Act	*Forestry and National Park Estate Act* 1998
IFOA	Integrated Forestry Operation Approval
IUCN	International Union for the Conservation of Nature and Natural Resources
NP	National Park
NPWS	NSW National Parks and Wildlife Service
NR	Nature Reserve
NVC Act	*Native Vegetation Conservation Act* 1997
RFA	Regional Forest Agreement
ROTAP	Rare Or Threatened Australian Plants (Briggs & Leigh 1996)
SFNSW	State Forests of New South Wales
SF	State Forest

TSC Act *Threatened Species Conservation Act* 1995
TSL Threatened Species Licence

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Appendix 1 Draft Hygiene Protocol

Background

Three *E.* sp. Rocky Creek trees died in at Site 1 in Whian Whian State Forest in 1999. Pathology samples taken from the three trees found that all were infected with *Ophiostoma* sp. Two carried *Botryosphaeria ribis*, and one carried a *Hymenochaete* species. The role of these pathogens in the death of the trees is unclear (Simpson 2000). Surveys undertaken in 2001, revealed an additional seven dead trees, all in the larger size category (10–40 cm dbh). Surveys of all other populations found no dead trees (Kooyman 1999). Precautionary measures will need to be implemented to ensure that any potential fungal pathogens are not transferred to other sites.

Proposed hygiene procedures at the *E.* sp. Rocky Creek site in Site 1 Whian Whian State Forest[4]

1. Footwear that has been used at the site must be thoroughly cleaned and sterilised before re-use at other *E.* sp. Rocky Creek sites.
2. A shallow tray containing a disinfecting solution should be set up near the vehicle so that footwear can be disinfected and dried prior to leaving the site or entering the vehicle. Footwear should be scraped clean of mud and the soles of the footwear stood in the tray of disinfectant. The remainder of the boot should be rinsed or sprayed with a disinfecting solution. A change of footwear and bagging the affected footwear for disinfecting later is another option.
3. Any equipment used on site should be cleaned with alcohol or disinfectant between use on different trees on the site. The equipment should be cleaned and sterilised prior to leaving the site or should be bagged for disinfecting prior to re-use at another site.
4. Hands should be cleaned between contacts with different trees or clean plastic gloves worn for each tree sampled.
5. In most instances, vehicles are unlikely to be a problem. However if a vehicle is driven off-road in the vicinity of the site then wheels and tyres should be cleaned and sterilised. This should be done on the formed road where the wheels and tyres should be sprayed with hospital grade 'toilet duck'.
6. Disinfecting agents to be used must be effective against bacteria and both the vegetative and spore stages of fungi. Chloramine and Chlorhexidine based products such as *Halamid, Halasept* or *Hexifoam* Hand Wash are effective for both bacteria and fungi. They are also suitable for use on hands, footwear, instruments and equipment. The manufacturer instructions should be followed when making up these solutions.
7. Bleach and alcohol, diluted to appropriate concentrations are also effective on bacteria and fungi, however, they are less practical because of the corrosive and hazardous nature of these substances. It is also possible to use methanol on instruments, either by:

- immersion in 70% methanol for 30 minutes;
- dipping in 100% methanol and then flamed or boiled in water for 10 minutes.
- some equipment not easily disinfected in these ways can be cleaned using medical standard 70% isopropyl alcohol wipes e.g. *Isowipes*.

8. Any sterilising solutions used must be disposed of safely and away from the site.

[4] derived from NPWS Information Circular No.6: Hygiene protocol for Frogs.

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