Pacific Highway Upgrade Nambucca Heads to Urunga Operational Phase

Threatened Flora Monitoring Annual Report Year 4 – 2020/21

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This report, **Pacific Highway Upgrade Nambucca Heads to Urunga Operational Phase - Threatened Flora Monitoring Annual Report Year 4 2020/21**, was prepared for Transport for NSW in accordance with the NSW *Environmental Planning and Assessment Act* 1979, the NSW *Biodiversity Conservation Act* 2016 and the Commonwealth *Environmental Protection and Biodiversity Conservation Act* 1999.

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Any opinion expressed in this report is the professional, objective opinion of the author.

9th February 2021

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GLOSSARY

TERM	MEANING
ANPC	Australian Network for Plant Conservation
BC Act	NSW *Biodiversity Conservation Act* 2016
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999
EP&A Act	NSW *Environmental Planning and Assessment Act* 1979
In situ	Latin term meaning 'in the original place'. In this report, refers to threatened plants that are being protected where they were found
LGA	Local Government Area
MCoA	Ministers Conditions of Approval
NH2U	Nambucca Heads to Urunga Pacific Highway Upgrade Project
NSW EPA	NSW Environment Protection Authority
NSW OEH	NSW Office of Environment and Heritage
RMS	NSW Roads and Maritime Services (now known as Transport for NSW)
TA	Translocation Area
TFMP	Threatened Flora Management Plan (Ecos Environmental 2013)
TfNSW	Transport for NSW (formerly RMS)
TSC Act	NSW *Threatened Species Conservation Act* 1995

INTRODUCTION

The Nambucca Heads to Urunga Pacific Highway Upgrade Project (NH2U) is a 22-km-long section of the Pacific Highway upgrade on the Mid North Coast of NSW. The NH2U project comprises the northern half of the Warrell Creek to Urunga section of the Pacific Highway upgrade, which is being built in two stages. Mitigation measures employed during the construction of NH2U included *in situ* protection, or translocation, and monitoring, of populations of the following eight threatened or rare plant species:

Spider Orchid *Dendrobium melaleucaphilum* (Endangered, BC Act)

Red Bopple Nut *Hicksbeachia pinnatifolia* (Vulnerable, BC Act & EPBC Act)

Slender Marsdenia *Marsdenia longiloba* (Endangered, BC Act; Vulnerable, EPBC Act)

Rusty Plum *Niemeyera whitei* (Vulnerable, BC Act)

Woolls's Tylophora *Tylophora woollsii* (Endangered, BC Act & EPBC Act).

Koala Bells *Artanema fimbriatum* (unlisted, nationally rare)

Gully Ironbark, Nambucca Ironbark *Eucalyptus ancophila* (unlisted, local endemic species)

Ford's Goodenia *Goodenia fordiana* (unlisted, nationally rare)

In situ flora populations

One component of the mitigation measures employed on the NH2U project involved the protection and monitoring of *in situ* plants of Spider Orchid, Slender Marsdenia and Gully Ironbark that remain within the NH2U road reserve and were not directly impacted by the project. Baseline data collection, and construction phase monitoring, has been undertaken on 76 Spider Orchid plants, five Slender Marsdenia plants and a single Gully Ironbark (Ecos Environmental 2014, 2016, 2017) which are located at various points in the road reserve along the NH2U route (Figure 1).

Translocated Flora Species

Where threatened or rare plants were recorded within the NH2U construction footprint and direct impact was unavoidable, a program was developed to guide the translocation and monitoring of Spider Orchid, Red Bopple Nut, Slender Marsdenia, Rusty Plum, Woolls's Tylophora, Koala Bells and Ford's Goodenia from the construction footprint into one of two recipient sites (Translocation Areas, TA1 and TA2) that adjoin the NH2U footprint and are owned and managed by TfNSW (Figure 1).

The translocations were conducted according to the Warrell Creek to Urunga Threatened Flora Management Plan (TFMP, Ecos Environmental 2013), which was prepared as a condition of approval by the NSW Department of Planning and the Commonwealth Department of Environment.

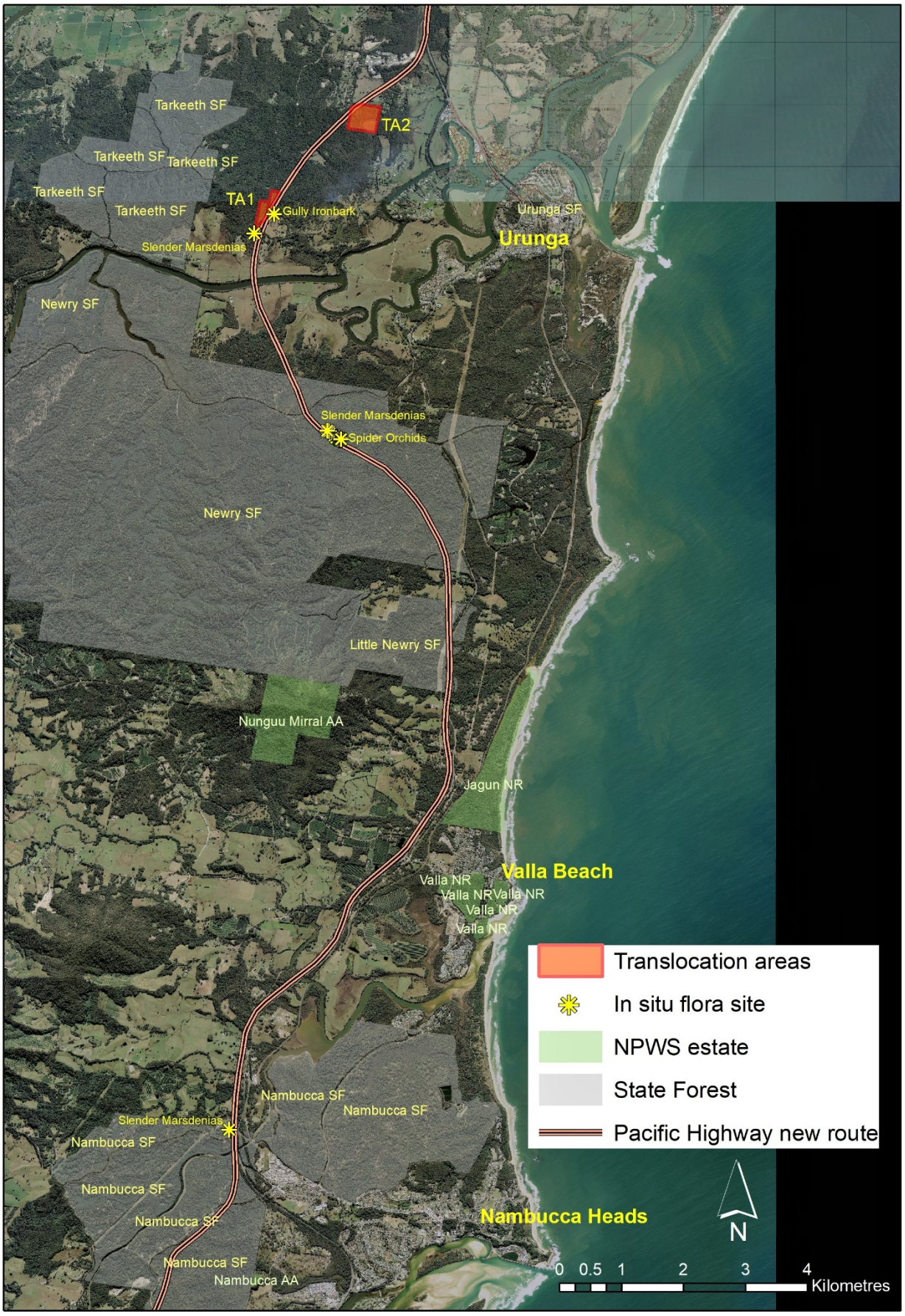

Figure 1: Location of NH2U in situ and translocated threatened or rare flora monitoring sites.

Translocation methods and planting layout

A detailed description of the actual salvage and translocation methodology is provided in Ecos Environmental (2013, 2014a, 2016a, 2016b). The summary provided below is also drawn from these Ecos Environmental reports and explains the source of plant material (transplanted from construction footprint or propagated off-site), whether a slow-release fertiliser was applied, and the location within TA1 or TA2 of the transplants or enhancement plantings.

Translocation Area 1

TA1 was divided into ten sectors (A to J, Figure 2) each receiving one species and different introduction treatments, as described below:

- Transplanted from construction footprint with no addition of fertiliser.
  - Sector A Slender Marsdenia
  - Sector B Woolls's Tylophora
- Transplanted from construction footprint with no fertiliser except initial watering with seaweed solution.
  - Sector C Ford's Goodenia
  - Sector D Koala Bells
  - Sector E Rusty Plum
- Propagated vegetatively and planted in experimental grids with and without addition of slow-release fertiliser.
  - Sector F Slender Marsdenia
  - Sector G Woolls's Tylophora
  - Sector I Woolls's Tylophora
- Propagated from seed and planted in an experimental grid with and without addition of slow-release fertiliser.
  - Sector J Slender Marsdenia
- Transplanted from construction footprint with no fertiliser except initial watering with seaweed solution.
  - Sector H Red Bopple Nut

Translocation Area 2

TA2 consists of two sectors, for the Spider Orchid and Koala Bells (Figure 3).

- Spider Orchid transplanted from construction footprint, no fertiliser addition – Sector A
- Koala Bells population enhancement, no fertiliser addition – Sector B

Individuals were planted at a regular spacing, with rows about 10m apart and individual plants about 5 metres apart along rows. Where a sector was on a hill slope, grid lines were laid out parallel with the slope contour. This facilitated comparison of species performance in relation to slope position.

Monitoring, to date, has been undertaken for a total of 681 translocated plants (Ecos Environmental 2014, 2016, 2016a) as detailed in Table 1 below.

Table 1:Number and location of translocated plants and enhancement plantings at NH2U Translocation Areas.

Translocation Area (TA)	Species	Sector / Method	Number of plants
TA1	Slender Marsdenia	Sector A – transplants	104
		Sector F – population enhancement (veg) & fertilizer experiment	90
		Sector J – population enhancement (seed) & fertilizer experiment	103
	Woolls's Tylophora	Sector B – transplants	42
		Sector G – population enhancement (veg) & fertilizer experiment	87
		Sector I – population enhancement (veg)	51
	Rusty Plum	Sector E – transplants and population enhancement (seed)	3 trees 40 seeds
	Red Bopple Nut	Sector H - transplant	1
	Koala Bells	Sector D - transplants	35
	Ford's Goodenia	Sector C – transplants	5 patches
TA2	Spider Orchid	Sector A - transplants	55
	Koala Bells	Sector B - population enhancement (veg)	69

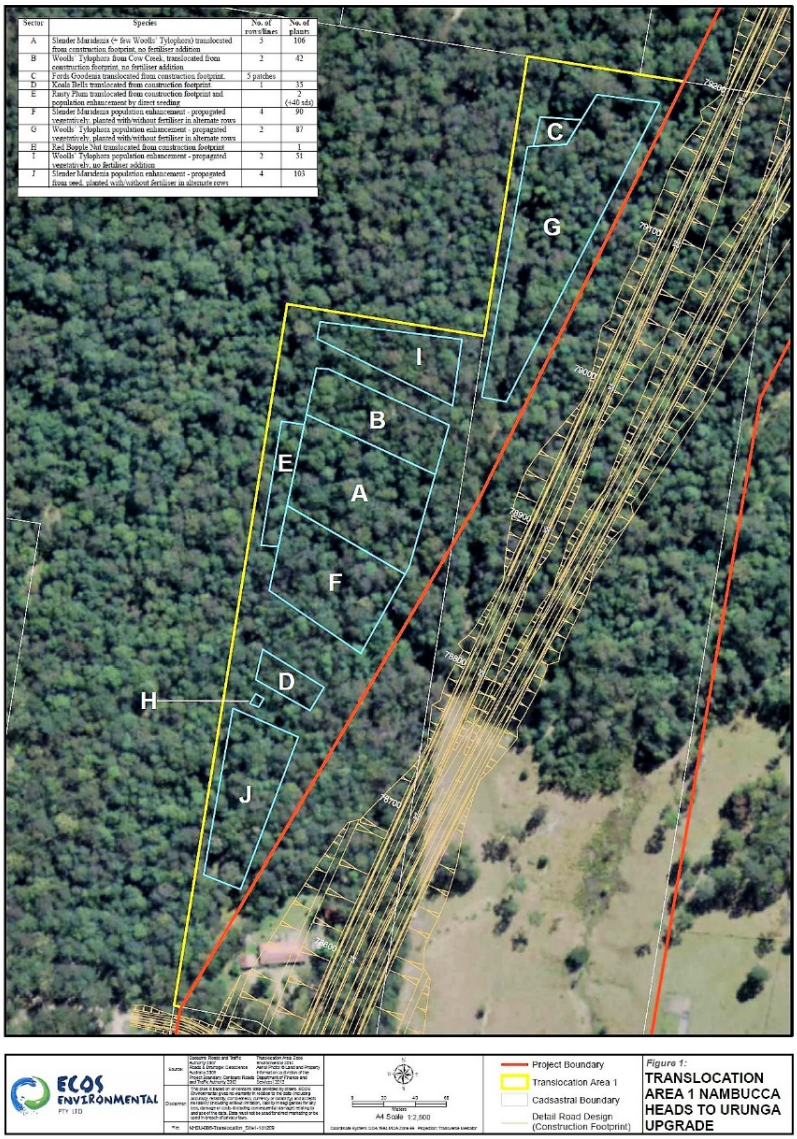

Figure 2: Translocation Area 1 (TA1) showing sectors supporting different species and treatments (from Ecos Environmental 2016a).

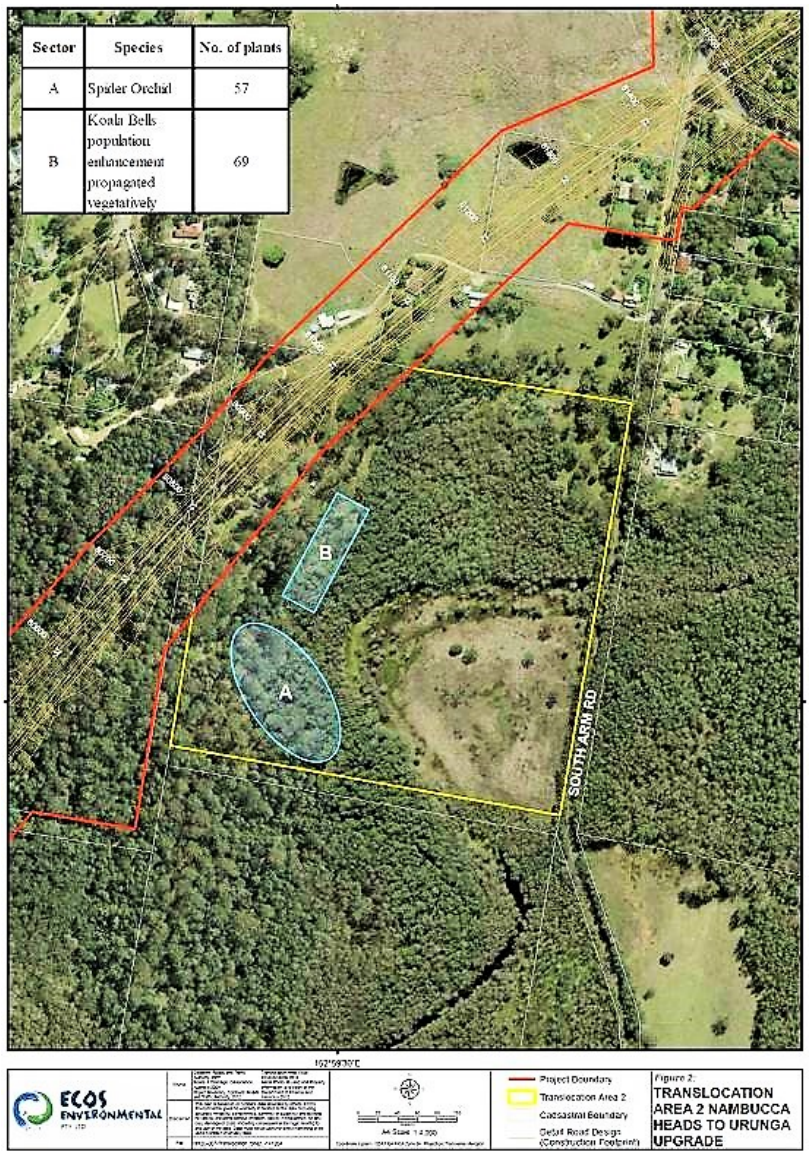

Figure 3: Translocation Area 2 (TA2) showing sectors supporting different species and treatments (from Ecos Environmental 2016a).

Objectives of translocation

The objectives of the translocation project set out in the TFMP are:

- To salvage and re-establish impacted individuals of threatened (TSC/BC/EPBC Act) species.
- To re-establish species at a recipient site near the original site with closely matching habitat and long-term security of tenure.
- To enhance the size and genetic diversity of the translocated population by propagation and introduction of individuals additional to those salvaged from the road footprint.
- To maintain good quality habitat to the relocation site(s).
- To preserve individuals of threatened species *in situ* wherever possible and limit translocation to plants within the highway footprint and construction buffer.

In accordance with the Ministers' Conditions of Approval (MCoA) for the TFMP, an annual monitoring report is to be prepared which addresses the monitoring goals, provides an evaluation of the effectiveness of the mitigation measures against performance indicators, documents any corrective actions implemented, and identifies recommendations for any adaptive management.

Upon completion of the construction phase of the NH2U upgrade, responsibility for operational management passed to TfNSW. This report describes the results of Year 4 (operational phase) monitoring of *in situ* and translocated flora for the NH2U upgrade. It should be noted that, upon completion of construction phase monitoring of translocated plants, monitoring of those species not listed as threatened under the TSC (BC) Act or the EPBC Act (Koala Bells and Ford's Goodenia) has been discontinued.

MONITORING METHODS

Monitoring of all *in situ* and translocated plants was undertaken in November 2020 and January 2021.

The following description of the NH2U flora monitoring methodology is adapted from Ecos Environmental (2014 to 2017). During the NH2U construction phase, monitoring of transplants was conducted every 3 months in Year 1, every 6 months in Year 2 and annually in Year 3. Population enhancement individuals were monitored twice in Year 1 thence at the same time as transplanted individuals. Ongoing monitoring during the NH2U operational phase is to be undertaken annually for a minimum five years.

Each transplanted and propagated plant was given a unique identification number which was written on flagging tape and attached to the plant itself, or to its protective wire cage. Transplants were re-located in the field using a hand-held GPS to navigate to a set of coordinates that had been recorded when the plants were introduced to the sites (in some cases coordinates were not available – in such cases a thorough search of the relevant sector was undertaken by the author, and each transplant found had locality coordinates recorded with a GPS unit). Data were recorded as per Section 3.8 of the TFMP and listed in Table 2 below.

Table 2: Monitoring data recorded for each translocated species.

Data Recorded	Slender Marsdenia	Woolls's Tylophora	Rusty Plum	Red Bopple Nut	Spider Orchid
Monitoring Number	y	y	y	y	y
Date	y	y	y	y	y
Line	y	y	-	-	-
Source Label	y	y	y	-	y
Translocation Label	y	y	y	y	y
Species - Current ID	y	y	-	-	-
Condition Class	y	y	y	y	y
No. leaves	y	y	-	-	
Height (cm)	y	y	y	y	
New Shoots – New Active Growth (Y/N)	y	y	y	y	y
Comment	y	y	y	y	y
No. of pseudobulbs with leaves	-	-	-	-	y
Length of the longest pseudobulb	-	-	-	-	y
Waypoint	y	y	y	y	y
Coordinates	y	y	y	y	y

Condition Class Scores

The key attribute for evaluating species survival and performance was Condition Class, which was scored on a scale of 0 to 5. The scores were defined differently according to plant type, as detailed below in Table 3, Table 4 and Table 5.

Table 3: Condition scores applied to Slender Marsdenia and Woolls's Tylophora.

Score	Condition
0	dead
1	stem died back to ground, no leaves or green stem, live stem stub may be present
2	plant < 75 cm tall; stem with leaves, with or without new shoots (active growth), or green leafless stem
3	plant > 75 cm tall, stem with leaves, with or without new shoots (active growth), if green leafless stem <1m or leaves discoloured score as 2
4	plant > 1.5m tall with > 15 leaves, mature or nearing maturity
5	plant flowering or seeding

Table 4: Condition scores applied to Rusty Plum and Red Bopple Nut.

Score	Condition
0	dead
1	leafless and no sign of re-shooting
2	pruned foliage retained, or small amount of re-shooting after defoliating, or foliage sparse/discoloured (<40 cm tall Koala Bells)
3	vigorous re-shooting (>40 cm tall Koala Bells)
4	crown recovering, foliage healthy
5	growing actively, flowering or seeding recorded

Table 5: Condition scores applied to Spider Orchid.

Score	Condition
0	dead
1	pseudobulbs discoloured/grazed/withering, no new growth
2	pseudobulbs healthy in colour, not withering, no new growth
3	plant small, not many healthy pseudobulbs, new growth occurring
4	several healthy pseudobulbs present, new growth occurring
5	several good sized, healthy pseudobulbs, flowering or seeding recorded

Data Analysis

Monitoring data were stored and processed in Excel™ spreadsheets.

Species survival rate was calculated as:

(no. of individuals in condition classes 2+3+4+5/total no. plants) X 100

Species 'thrival' rate (a term used by Ecos Environmental to describe the general trend in vigour of plants in individual sectors or subject to different treatments) was calculated as:

(number of individuals in condition classes 3+4+5/total no. plants) X 100

The thrival rate provides, according to Ecos Environmental (2016a) a better indication of the percentage of plants likely to reach reproductive maturity. Mean species height was calculated for all plants including those with zero height (i.e., plants that had died back to the ground – condition class 1 - not just plants in condition classes 2 to 5).

YEAR 1 MONITORING RESULTS AND RECOMMENDATIONS

The Year 1 NH2U threatened flora monitoring report (Richards 2017) found that whilst the survival of Slender Marsdenia transplants was comparable to that achieved in other translocation projects, many transplants had died back as a result of a very dry winter-spring in 2017. Furthermore, it was discovered that the Woolls's Tylophora plants were in fact the common *Tylophora paniculata*, and that the Rusty Plum enhancement plantings had been almost entirely lost. Therefore, the following recommendations were made:

1. Discontinue monitoring of *Tylophora paniculata* plants in Sectors G and I in TA1.
2. Direct seed an additional 40 Rusty Plum seeds into Sector E in TA1.
3. Install protective cages on all new and surviving Rusty Plum enhancement plantings.

The direct seeding of Rusty Plum seed, and installation of cages, was undertaken in October 2018 and is described in a separate report (Richards 2018). From 2018 on, Sectors G and I in TA1 will no longer be monitored.

YEAR 2 MONITORING RESULTS AND RECOMMENDATIONS

The Year 2 NH2U threatened flora monitoring report (Richards 2018a) found that performance indicators were met for *in situ* plants of Slender Marsdenia and Gully Ironbark, but that Spider Orchid had failed to meet the target for percentage of plants in condition class 3 or better. Results for translocated plants were mixed, with target survival rates after five years not met for Slender Marsdenia, Woolls's Tylophora and Rusty Plum. Recommendations arising from the Year 2 report were:

1. Monitor Rusty Plum enhancement plantings six months after planting (i.e., April 2019) to assess condition of protective cages, incursion of weeds or competing native species, whether any seeds have germinated, and to undertake any necessary maintenance of the enhancement plantings.
2. Engage a qualified bush regenerator to assess the current level of infestation of Broad-leaved Paspalum and Lantana in TA1, and, if necessary, provide an appropriate control program. Observations by the author during monitoring surveys suggests that both weed species have increased in density in parts of TA1, particularly in the vicinity of old vehicular tracks. Early action to control both species would be beneficial.

As of February 2020 (when Year 3 monitoring surveys occurred, see below), the Year 2 recommendations had not been implemented, due to a lapse in communication between different contractors and TfNSW personnel. Recommendations provided in the Year 3 report accounted for this oversight and provided appropriate mitigation measures, as described below.

YEAR 3 MONITORING RESULTS AND RECOMMENDATIONS

Monitoring surveys are usually undertaken during late spring to early summer (October to December). However, the early start to the 2019 bushfire season was accompanied by extended periods of high to extreme fire danger and hazardous levels of bushfire smoke across the NSW mid-north coast from August 2019 to January 2020. This situation compelled the author to postpone field-based surveys until early February 2020. The Year 3 NH2U threatened flora monitoring report (Richards 2020) found that performance indicators were met for *in situ* Slender Marsdenia and Gully Ironbark. Despite *in situ* Spider Orchid meeting only two of three performance indicators, it was considered that this was due to three seasons of drought and recent tree fall in the site making it very difficult to re-locate all tagged plants. Translocated Spider Orchid, Rusty Plum, Red Bopple Nut and Slender Marsdenia had, to date, met performance indicators. Woolls's Tylophora and Rusty Plum enhancement plantings had not met performance indicators. Based upon these results, recommendations arising from the Year 3 report were:

1. Cessation of monitoring of all *in situ* plants. After six years of monitoring, it is considered that all extant *in situ* plants are highly likely to survive into the future.
2. Cease monitoring the translocated Spider Orchids in TA2.
3. Continue monitoring of all currently monitored sectors and plants in TA1.

4. Repeat the Rusty Plum enhancement planting program. Rather than direct-planting of seeds, it is recommended that collected seeds are germinated and grown on in nursery conditions. Planting of seedlings into TA1 would occur only when weather conditions are favourable. The protective tree guards from the previous attempt in 2018 are already in place within TA1 and can be re-used. The planting should be followed up with regular inspections and hand-watering as required..
5. Implement weed control program in TA1 targeting Broad-leaved Paspalum and Lantana in areas identified by bush regenerator as requiring action.

While all the above recommendations were accepted by TfNSW, endorsed by NSW EPA, and approved by DPIE, the monitoring of *in situ* Slender Marsdenia was continued in the current survey. This is because Slender Marsdenia is also listed as threatened under the EPBC Act, and Commonwealth approval of the Year 3 recommendations had not been received at the time of Year 4 surveys and preparation of this report.

RESULTS – IMPLEMENTATION OF YEAR 3 RECOMMENDATIONS

Rusty Plum Enhancement Planting

Mature Rusty Plum fruits were collected during late spring 2020. Less than 10% of discernible fruits were gathered from individual sites. Seeds were prepared in accordance with known techniques (e.g., Dunphy *et al*. 2020) by soaking overnight to remove insect larvae, then removing the outer coat by hand before potting into individual pots and maintaining in a shadehouse. As of early February 2021, 10 of 40 seeds had germinated (B. Hely, New Earth Bush Regeneration, pers. comm. 9th Feb 2021). It is envisaged that, if all seedlings have grown sufficiently (> 30cm tall) and weather conditions are suitable, planting out may be possible as early as spring 2021, otherwise when appropriate up to February-March 2022.

Weed Control Program – Initial Treatment

The first weed treatment at TA1 was performed on 25th November 2020 by New Earth Regeneration (three personnel). Treatment involved hand removal and cut and paint of Lantana plants (Figure 4) and targeted spot-spraying of Broad-leaved Paspalum (Figure 5) in the vicinity of the Rusty Plum translocations and enhancement plantings.

Figure 4: Bush regeneration team cutting and painting Lantana. Large translocated Rusty Plum in background.

Figure 5: Spot-spraying of Broad-leaved Paspalum in TA1.

An inspection of the treatment area on 3rd January 2021 revealed significant reduction in weed cover and minimal impact upon native recruitment into the site (Figure 6).

Figure 6: Post-treatment image taken 3rd Jan 2021 of area treated for Broad-leaved Paspalum 25th Nov 2020.

Weed Control Program – Follow-up Treatment

The follow-up weed treatment was undertaken at the site on 22nd January 2021, after being delayed by wet weather. Inspection of treated areas at the time of follow-up show complete removal of Lantana from treated areas and almost complete removal of adult and seedling Broad-leaved Paspalum (Figure 7; Figure 8).

Figure 7: Follow-up treatment of seedling Broad-leaved Paspalum 22nd Jan 2021

Figure 8: Follow-up weed treatment, TA1, 22nd Jan 2021

RESULTS – *IN SITU* FLORA MONITORING

Slender Marsdenia

Appendix 1 provides full details of the results of the NH2U Year 4 monitoring of *in situ* Slender Marsdenia. Of the five *in situ* Slender Marsdenia plants being monitored, one (ML119) has now been recorded as died back for four consecutive years. Of the remaining sites, the plants near Martells Road (2010-1 and 2010-3) supported healthy plants, with a condition class of 3. Plants at site UTW3 remained in only fair condition, whilst plants at site UTW4 (Figure 9), had declined in condition.

Figure 9: In situ Slender Marsdenia UTW4 in Jan 2021.

RESULTS - TRANSLOCATED FLORA MONITORING

Appendix 2 provides full details of the results of the NH2U Year 4 monitoring of translocated flora within TA1. Monitoring of translocated Spider Orchid plants in TA2 has now ceased. A summary of Year 4 results is provided below.

Slender Marsdenia

Slender Marsdenia was planted in three sectors in TA1:

- Sector A - Directly transplanted from construction footprint with no fertiliser.
- Sector F - Propagated vegetatively and introduced with and without fertiliser.
- Sector J - Propagated from seed and introduced with and without fertiliser.

Sector A

Survival rate for all 106 plants in Sector A was 40.6%, a small increase on the previous year (39.6%). Mean plant height increased from 40.4cm to 46.6cm. 23 of these plants were a metre or more in height. The percentage of plants with active shoot growth was 42%. 62 plants had died back, and two plants that could not be found last year were re-located and were resprouting under tree-fall debris.

Survival and mean height results recorded during all Sector A surveys are summarised in Table 6 below.

After six years the 'thrival rate' of Slender Marsdenia in Sector A was 28.3% (30 plants out of 106 with a Condition Class score of 3, 4 or 5), an increase from the previous survey rate of 25.5%. No plants were in flower or fruit at the time of survey.

Table 6: Slender Marsdenia in TA1 Sector A - mean height in centimetres and percent survival of transplants – all surveys.

All plants n = 106	Mar 2014	Dec 2014	Jan 2016	Nov 2016	Oct 2017	Nov 2018	Feb 2020	Jan 2021
Survival %	90.5	87.6	71.2	67.9	40	36.8	39.6	40.6
Mean height (cm)	36.25	36.25	42.38	39.97	36.3	40.7	40.4	46.6

Sector F

The survival rate of all 90 plants in Sector F was 58.9%, a significant improvement on the previous survey. Mean plant height was 56.6cm, also a significant increase on the previous survey. Survival and mean height results recorded during all Sector F surveys are summarised below in Table 7.

The thrival rate after six years was 37.8%, an improvement on the previous survey rate of 36.7%. 25 plants with a condition class score of 3 or more were more than one metre in height. No plants were in bud, or flowering, at the time of the current survey.

Table 7: Slender Marsdenia in TA1 Sector F - mean height in centimetres and percent survival of transplants.

All plants n = 90	Jul 2014	Jan 2016	Nov 2016	Oct 2017	Nov 2018	Feb 2020	Jan 2021
Survival %	83.63	77.1	66.75	61.1	42.2	51.1	58.9
Mean height (cm)	21.04	68.50	55.89	52.44	30.7	46.1	56.6

Sector J

103 propagated Slender Marsdenia seedlings were planted in Sector J in August 2014. Results from the current survey reveal an increase in survival rate to 58.3% and mean plant height to 41.98 cm since the last monitoring survey (Table 8).

The current thrival rate of Slender Marsdenia in Sector J is 30.1%, which is slightly lower than the previous year, but not significantly so. 17 plants were one metre or more in height. No plants were in flower or fruit.

Table 8: Slender Marsdenia in TA1 Sector J - mean height in centimetres and percent survival of transplants.

All plants n = 103	Dec 2014	Jan 2016	Nov 2016	Oct 2017	Nov 2018	Feb 2020	Jan 2021
Survival %	92.2	86.4	82.5	54.39	43.7	48.5	58.3
Mean height (cm)	46.75	69.15	64.19	54.61	32.3	37.2	41.98

Woolls's Tylophora

Woolls's Tylophora *Tylophora woollsii* was translocated to TA1 into Sector B as direct transplants from the construction footprint with no fertiliser.

Sector B

Mean survival rate for all plants in Sector B for the current survey was 9.52% (4 plants of 42), a slight decrease from the previous year. Mean plant height increased to 5.81cm (Table 9).

The strongest indicator of the poor state of plants in this sector is the thrival rate of just 2.38% (i.e., only one plant was assessed as being in condition class 3 or better). As suggested previously by the author and Ecos Environmental (2016a), the recipient site represents sub-optimal habitat for Woolls's Tylophora.

Table 9: Woolls's Tylophora in TA1 Sector B - mean height in centimetres and percent survival of transplants.

All plants n = 42	Mar 2014	Dec 2014	Jan 2016	Nov 2016	Oct 2017	Nov 2018	Feb 2020	Jan 2021
Survival %	90.5	80	73.8	31	14.29	9.5	11.9	9.52
Mean height (cm)	76.31	38.84	34.07	11.73	4.88	2.07	1.6	5.81

Identity of Tylophora Plants in Sector B

In the first NH2U Operational Phase threatened flora monitoring report, Richards (2017) noted that *Tylophora* plants in Sectors G and I were actually the common species *T. paniculata* (based upon flowering specimens observed by A. Benwell of Ecos Environmental). It was recommended that monitoring in those sectors be discontinued, leaving only Sector B containing putative *T. woollsii* transplants. Richards had also noted on monitoring proformas, and in monitoring reports, that a number of plants (vegetative material only) in Sector B looked very much like *T. paniculata* (*T. woollsii* and *T. paniculata* are difficult to separate vegetatively, even by experienced botanists). In attempting to determine the origin of the Sector B material, the original Threatened Flora Management Plan (Ecos Environmental 2013) and the Year 1 Construction Phase Threatened Flora Monitoring Report (Ecos Environmental 2014a) were re-visited. These documents confirm that the translocated plants in Sectors B, G and I originated from the same source (Cow Creek, within the highway construction footprint). Thus, the plants in Sector B are actually *T. paniculata* and not *T. woollsii*.

Rusty Plum

Translocated Rusty Plums

Two small Rusty Plum trees (4-8m high) were transplanted into Sector E in TA1. One tree had split and was separated into two pieces (plants 1 and 2) before planting. The other tree (plant 3) was pruned back to remove most of the branch system before being transplanted. Plant 2 died in 2017. The current survey revealed no losses since the previous survey, with a survival rate of 67%. Plant 1 bore a healthy, basal stem shoot which had almost doubled in height since the previous survey (Figure 10). Plant 3 was in excellent health, with flowering observed on this plant for the first time since translocation.

Figure 10: Rusty Plum transplanted tree No. 1 in excellent health with new growth.

Rusty Plum enhancement plantings

The original 40 Rusty Plum enhancement plantings (Ecos Environmental 2016a) had decreased to one surviving seedling in 2020, a survival rate of 2.5%. As described in the introductory section of this report, the direct seeding of Rusty Plum seed was repeated, including the installation of tree guards, in October 2018 (Richards 2018), but they all succumbed to severe drought conditions. As noted above, Rusty Plum fruits were collected in spring 2020 for a future attempt at enhancement planting.

Red Bopple Nut

A single Red Bopple Nut tree was transplanted to Sector H in TA1. The tree was recorded in excellent condition during the current survey. Flowering had occurred, with several developing fruits observed (Figure 11).

Figure 11: One of several immature fruits observed on Red Bopple Nut transplant in TA1 Nov 2021

DISCUSSION

In accordance with the MCoA of the NH2U TFMP (Ecos Environmental 2013), each annual monitoring report must include an assessment of the success or failure of protective measures for *in situ* threatened flora, and an assessment of the success or failure of the threatened flora translocation program (salvage translocation and population enhancement measures). These assessments are provided below. Note that only *in situ* Slender Marsdenia is assessed here, and *in situ* and translocated Spider Orchid plants are no longer evaluated. This is in accordance with recommendations in the previous monitoring report. The MCoA also requires a recommended work plan for the next 12 months. This too is provided below.

Evaluation of *in situ* Flora Management

The following performance indicators are used to evaluate the success of protective measures for *in situ* threatened flora:

a) The survival rate of *in situ* threatened flora at the finish of clearing is 100%. No accidental damage occurs during clearing.
b) The survival rate of *in situ* threatened flora at the end of years 1-3 of the monitoring program is at least 80% and at least 70% at the end of years 4-8.
c) Of plants surviving at the end of each year, at least 75% are in good condition – i.e., they have healthy foliage, no sign of die-back or disease and exhibit new shoot growth (Condition Class 3 or better).

Table 10 below summarises how the above performance indicators have been met to date.

Table 10: Evaluation of performance indicators for in situ Slender Marsdenia.

Species	100% survival rate at the finish of clearing.	80% survival rate at the end of years 1-3	At least 75% of surviving plants are	Performance indicators met?

	No accidental damage during clearing	and at least 70% at the end of years 4-8	in good condition at each year end (Condition Class 3 or higher)	
Slender Marsdenia	Y	Y	N (40%)	2 of 3

Slender Marsdenia

Slender Marsdenia currently meets 2 of 3 performance indicators for *in situ* flora. There was a decline in condition of some plants resulting in a median condition class of 2. This is probably a result of the past three seasons of hot dry weather having a significant impact, in particular, on the plants UTW3 and UTW4, which occur on a much drier site than is typical for Slender Marsdenia.

Evaluation of Flora Translocation Program

The following performance indicators are used to evaluate the success of the threatened species translocations (salvage translocation and population enhancement):

a) All directly impacted individuals of threatened species were salvaged and relocated to the receival sites.
b) At least 60% of transplant and enhancement individuals are surviving after the first year, 50% after five years and 40% after eight years.
c) At the end of the monitoring program (8 years), at least 50% of surviving individuals have a Condition Class of 3 or higher.

Table 11 below summarises how the above performance indicators have been met to date.

Table 11: Evaluation of performance indicators for translocated flora.

Species	All directly impacted individuals of threatened species were salvaged and relocated to the receival site(s).	At least 60% of transplant and enhancement individuals are surviving after the first year, 50% after five years and 40% after eight years	At the end of the monitoring program (8 years), at least 50% of surviving individuals have a Condition Class of 3 or higher.	Performance indicators met?
Slender Marsdenia	Y	Y, Y, n/a	n/a	2 of 3 to date
Woolls's Tylophora*	Y	Y, N, n/a	n/a	1 of 3 to date
Rusty Plum transplants	Y	Y, Y, n/a	n/a	2 of 3 to date
Rusty Plum enhancement plantings	n/a	N, N, N	N	0 of 3 to date
Red Bopple Nut	Y	Y, Y, n/a	n/a	2 of 3 to date

***Note** – refer to comments regarding identity of *Tylophora* plants on p.20, and recommendation regarding ongoing monitoring of *T. woollsii* below.

It is clear from Table 11 above that the performance indicators are designed to provide an assessment of translocation success mainly for the latter half of the program (years 5 to 8). Because of this, little can be gleaned from this current assessment, apart from some specific comments below.

Slender Marsdenia

The current mean survival rate of all Slender Marsdenia plants stands at 52.6%, an increase over the previous year's rate of 46.4%. As noted in the previous report (Richards 2020), **this should be considered a very good result for this species, and it is highly likely that a proportion of those Slender Marsdenia plants recorded as having died back are still alive and may resprout in future years**. However, successful achievement of the performance indicators for this species is as dependent on climatic factors as much as anything else. With wetter, milder 'La Niña' weather conditions arriving in early December 2020, it would be expected that significantly more plants will produce aerial shoots and be in better overall condition should this weather pattern persist.

Woolls's Tylophora

The current mean survival rate of Woolls's Tylophora (plants only within Sector B) has decreased to 9.52%, with a correspondingly low median condition class score of 1. If this low survival and condition persists, then the translocation of this species will have failed all survival and condition class performance indicators. Note, however, as discussed on p.20 above, it has been discovered that these plants are actually *Tylophora paniculata*. See recommendation regarding this species below.

Rusty Plum transplants

Because all Rusty Plum transplants and half the Rusty Plum enhancement plantings survived through Year 1, at present Rusty Plum meets relevant performance criteria. Current Rusty Plum transplant survival is 67%, which, if maintained, will meet ongoing performance criteria.

Rusty Plum enhancement plantings

The Rusty Plum enhancement planting survival rate is 2.5%, with all seeds direct-planted in October 2018 failing to survive the winter-spring drought of 2019. It is apparent that these enhancement plantings require ongoing maintenance to assist in their survival in such adverse weather conditions. The current proposal to germinate Rusty Plum seed and only plant seedlings out into TA1 when prevailing weather conditions would assist in their survival aims to redress these failed attempts.

Red Bopple Nut transplant

The single translocated Red Bopple Nut tree is in excellent condition, flowering and sparse fruiting occurring in spring 2020. It is expected that this specimen will meet ongoing performance criteria.

RECOMMENDED 12 MONTH WORK PLAN

The following actions are recommended here with the aim of achieving the principle objectives and performance indicators of the TFMP for *in situ* and translocated flora.

1. Discontinue monitoring of *Tylophora paniculata* plants in Sector B in TA1;
2. Continue monitoring of all other translocated flora in TA1;
3. Assess success of weed control program during Spring 2021 monitoring and advise on whether further weed control is required.

REFERENCES

Dunphy, M., McAlpin, S., Nelson, P., Chapman, M. & Nicholson, H. 2020. Australian Rainforest Seeds. A Guide to Collecting, Processing and Propagation. CSIRO Publishing, Clayton South, Victoria.

ECOS Environmental. 2013. Warrell Creek to Urunga Upgrade Threatened Flora Management Plan. Report prepared for NSW Roads and Maritime Services, Grafton.

ECOS Environmental. 2014. Nambucca Heads to Urunga Pacific Highway Upgrade - Monitoring of In situ Roadside Threatened Plants - Summary for Year 1 (December 2013 to December 2014). Report prepared for Lend Lease Infrastructure.

ECOS Environmental Pty Ltd. 2014a. Nambucca Heads to Urunga Upgrade of the Pacific Highway Threatened Flora Translocation Project - Annual Monitoring Report Year 1 December 2014. Report prepared for Lend Lease Infrastructure.

ECOS Environmental Pty Ltd. 2016. Nambucca Heads to Urunga Upgrade of the Pacific Highway Monitoring of i*n situ* Roadside Threatened Plants - Summary for Year 2 (December 2014 to February 2016). Report prepared for Lend Lease Infrastructure.

ECOS Environmental Pty Ltd. 2016a. Nambucca Heads to Urunga Upgrade of the Pacific Highway Threatened Flora Translocation Project - Annual Monitoring Report (Year 2) February 2016. Report prepared for Lend Lease Infrastructure.

ECOS Environmental Pty Ltd. 2016b. Nambucca Heads to Urunga Upgrade of the Pacific Highway Threatened Flora Translocation Project - Annual Monitoring Report (Year 3) December 2016. Report prepared for Lend Lease Infrastructure.

ECOS Environmental Pty Ltd. 2017. Nambucca Heads to Urunga Pacific Highway Upgrade - Monitoring of *in situ* Roadside Threatened Plants - Year 3 (December 2014 to February 2017) Results

Richards, P. 2016. Pacific Highway Sapphire to Woolgoolga Upgrade Threatened Flora Monitoring Annual Report 5. Final report prepared for NSW Roads and Maritime Services.

Richards, P. 2017. Pacific Highway Nambucca Heads to Urunga Upgrade Operational Phase Threatened Flora Monitoring Year 1 Annual Report. Final report prepared for NSW Roads and Maritime Services.

Richards, P. 2018. Pacific Highway Nambucca Heads to Urunga Upgrade Operational Phase Threatened Flora Monitoring Year 1 Recommendation - Rusty Plum enhancement plantings. Report prepared for NSW Roads and Maritime Services.

Richards, P. 2018a. Pacific Highway Nambucca Heads to Urunga Upgrade Operational Phase Threatened Flora Monitoring Year 2 Annual Report. Final report prepared for NSW Roads and Maritime Services.

Richards, P. 2020. Pacific Highway Nambucca Heads to Urunga Upgrade Operational Phase Threatened Flora Monitoring Year 3 Annual Report. Final report prepared for Transport for NSW.

APPENDIX 1:

Monitoring Results – *in situ* Slender Marsdenia January 2021

Site No	Species	Chainage	Date	Condition 2021	Ht (m)	No. lvs	New shoots	Comment 2021
ML 119	Marsdenia longiloba	62100	25-Nov-20	1				Died back. Two other healthy plants 30m upstream
ML 2010-1	Marsdenia longiloba	75000	3-Jan-21	3	1.2	13	y	On Notelaea longifolia
ML 2010-3	Marsdenia longiloba	75000	3-Jan-21	3	0.9	10	y	At base of Forest Oak. Another healthy plant near survey pegs
UTW3	Marsdenia longiloba	78450	25-Nov-20	2	0.2	6	y	Recent re-shoot of last season 'seedling'
UTW3	Marsdenia longiloba	78450	25-Nov-20	2	0.6	11	y	Uphill plant sprawling over litter
UTW4	Marsdenia longiloba	78450	25-Nov-20	2	0.5	10	y	c. 1.5m from bloodwood sapling on Lomandra and leaf litter
UTW4	Marsdenia longiloba	78450	25-Nov-20	1				Died back. New seedling near Turpentine sapling as well

APPENDIX 2:

Monitoring Results –Translocated Flora in TA1 January 2021

Slender Marsdenia - Sector A transplants

No	Date	Species	Line	Source Label	Cond	No. lvs	Height (cm)	New Shoots (Y/N)	Comment
1	Jan-21	Marslong	L7 east	ML14	1		0		db. Parsdorr on cage
2		Marslong	L7	ML2010-2	1		0		db
3		Marslong	L7	MLN-5	1		0		db
4		Marslong	L7	ML14A	1		0		db
5		Marslong	L7	ML14A	1		0		db. P. dorrigoensis in cage
6		Marslong	L7	ML14A	2	8	20	y	Probably Tylophora paniculata
7		Marslong	L7	ML13	1		0		db
8		Marslong	L7	ML14A	1		0		db
9		Marslong	L7	ML11	1		0		db
10		Marslong	L7	UTW-2	1		0		db - tree fall debris
11		Marslong	L7	UTW-2	4	40	170	y	Large, healthy resprout
12		Marslong	L7	TWN-1	1		0		db
13		Marslong	L7	UTW-2	4	15	90	y	resprout recent shoot
14		Marslong	L7	ML20	4	20	140	y	resprout
15		Marslong	L7	ML21	2	5	20	y	resprout
16		Marslong	L7	TWN-1	0		0		gone
17		Marslong	L7	UTW-2	1		0		db
18		Marslong	L7	UTW-2	4	20	120	y	
19		Marslong	L7	UTW-1	3	11	80	y	
20		Marslong	L7 west	UTW-4	1		0		db
21		Marslong	L6 west	TWN-1	3	4	100	y	
22		Marslong	L6	TWN-1	2	5	30	y	
23		Marslong	L6	TWN-1	1		0		db
24		Marslong	L6	TWN-1	1		0		db
25		Marslong	L6	UML-6	3	6	120	y	
26		Marslong	L6	UML-6	2	7	60	y	
27		Marslong	L6	MLN-6	2	8	70	y	
28		Marslong	L6	UML-5	1		0		db

No	Date	Species	Line	Source Label	Cond	No. lvs	Height (cm)	New Shoots (Y/N)	Comment
28b/41		Marslong	L6	UML-5	1		0		db
29		Marslong	L6	ML17	1		0		db
30		Marslong	L6	new near ML18	4	28	200	y	on Cryptocarya rigida
30b/42		Marslong	L6	UML-5	2	0	40	n	db - green stems remain
31		Marslong	L6	new near ML18	1		0		db
32		Marslong	L6	MLN-6	4	38	240	y	on Cryptocarya rigida
33		Marslong	L6	ML18	1		0		db
33b/40		Marslong	L6	ML21	1		0		db
34		Marslong	L6	ML18	1		0		db
35		Marslong	L6	MLN6	3	10	240	y	Climbing Cryptocarya rigida
36		Marslong	L6	ML19	4	40	200	y	Climbing Cryptocarya rigida
37		Marslong	L6	ML19	4	100	200	y	Climbing dead sapling
38		Marslong	L6	ML20	1		0		db
39		Marslong	L6 east	ML21	1		0		db
43		Marslong	L5	ML18	2	5	50	y	resprout
44		Marslong	L5	ML30	2	4	60	y	resprout
45		Marslong	L5	TW29	3	10	90	y	
46		Marslong	L5	ML32	1		0		db
47		Marslong	L5	new adj. ML33	1		0		db
48		Marslong	L5	new adj. ML33	2	6	10	y	resprout
49		Marslong	L5	new adj. ML33	1		0		db
50		Marslong	L5	MLN-2	4	30	400	y	On Cryptocarya rigida
51		Marslong	L5	ML15	1		0		db
52		Marslong	L5	ML15	1		0		db
53		Marslong	L5	new adj. ML33	1		0		db
54		Marslong	L5	new adj. ML33	4	23	160	y	
55		Marslong	L5	new adj. ML33	2	3	15	y	resprout
56		Marslong	L5	new adj. ML33	4	20	150	y	
57		Marslong	L5	new adj. ML33	1		0		db
58		Marslong	L5	ML45-	1		0		db
59		Marslong	L5	ML45-11	3	6	90	y	T. paniculata - recent resprout
60		Marslong	L5	ML47-1	1		0		db
61		Marslong	L5	ML47-2	1		0		db
62		Marslong	L5	ML45-4	1		0		db
63		Marslong	L5 west	ML45-	1		0		db

No	Date	Species	Line	Source Label	Cond	No. lvs	Height (cm)	New Shoots (Y/N)	Comment
106		Marslong	L4	ML2010-3	1		0		db
107		Marslong	L4	ML2010-3	1		0		db
108		Marslong	L4	ML2010-3	1		0		db
109		Marslong	L4	MLN-4	1		0		db
110		Marslong	L4	ML126	4	28	180	y	
111		Marslong	L4	ML126	1		0		db
112		Marslong	L4	ML127	1		0		db
113		Marslong	L4	ML2010-3	1		0		db
114		Marslong	L4	ML2010-3	4	25	190	y	
115		Marslong	L4	ML2010-3	1		0		db
116		Marslong	L4	ML127	1		0		db
117		Marslong	L4	MLN-3	2	5	70	y	
118		Marslong	L4	MLN-3	3	6	90	y	
119		Marslong	L4	MLN-3	2	4	20	y	resprout
120		Marslong	L4	MLN-3	3	9	90	y	
121		Marslong	L4	ML2010-4	4	15	120	y	
122		Marslong	L4	ML2010-4	1		0		db
123		Marslong	L4	MLN-4	3	12	90	y	
124		Marslong	L4	MLN-4	3	5	100	y	
125		Marslong	L4	TWN-2	1		0		db
126		Marslong	L4	TWN-2	1		0		db
127		Marslong	L4	TWN-2	1		0		db
128		Marslong	L3	MLN-4	3	6	100	y	
129		Marslong	L3	MLN-4	1		0		db
130		Marslong	L3	MLN-4	4	16	240	y	on Cryptocarya rigida
131		Marslong	L3	MLN-4	1		0		db
132		Marslong	L3	MLN-3	3	10	100	y	
133		Marslong	L3	MLN-3	1		0		db
134		Marslong	L3	MLN-3	1		0		db
135		Marslong	L3	ML3	1		0		db
136		Marslong	L3	ML3	3	6	130	y	resprout amongst Gynocthodes
137		Marslong	L3	ML3	3	6	120	y	good condition
138		Marslong	L3	ML3	1		0		db
139		Marslong	L3	ML3	1		0		db recent tree fall
140		Marslong	L3	ML2	4	15	120	y	under tree fall

No	Date	Species	Line	Source Label	Cond	No. lvs	Height (cm)	New Shoots (Y/N)	Comment
141		Marslong	L3	ML2	1		0		db - cage collapsed
142		Marslong	L3	ML3	1		0		db - Parsonsia dorrigoensis in cage
143		Marslong	L3	ML3	2	6	15	y	resprout
144		Marslong	L3	UTW10	1		0		db
145		Marslong	L3	UTW10	1		0		db
146		Marslong	L3	UML8	1		0		db - under tree fall
147		Marslong	L3	ML3	1		0		db
148		Marslong	L3	ML3	1		0		db - cage crushed tree fall

Slender Marsdenia - Sector F transplants

No	Species	Line	Date	Cond.	No. leaves	Height (cm)	New Shoots (Y/N)	Comment
F1	Marslong	Line 1 fert	Jan-21	1		0		db
F2	Marslong	Line 1 fert		3	12	90	y	
F3	Marslong	Line 1 fert		1		0		db
F4	Marslong	Line 1 fert		1		0		db
F5	Marslong	Line 1 fert		4	23	160	y	
F6	Marslong	Line 1 fert		3	9	90	y	
F7	Marslong	Line 1 fert		2	4	40	n	yellowing
F8	Marslong	Line 1 fert		1		0		db
F9	Marslong	Line 1 fert		3	9	70	y	
F10	Marslong	Line 1 fert		1		0		db
F11	Marslong	Line 1 fert		3	13	120	y	resprout cage crushed by tree fall
F12	Marslong	Line 1 fert		2	2	60	y	under tree fall
F13	Marslong	Line 1 fert		4	30	190	y	on Cordyline stricta
F14	Marslong	Line 1 fert		1		0		db
F15	Marslong	Line 1 fert		2	2	60	y	
F16	Marslong	Line 1 fert		2	7	50	y	resprout
F17	Marslong	Line 1 fert		1		0		db
F18	Marslong	Line 1 fert		1		0		db
F19	Marslong	Line 1 fert		1		0		db - under tree fall debris
F20	Marslong	Line 1 fert		2	8	40	y	
F21	Marslong	Line 1 fert		2	6	60	y	
F22	Marslong	Line 1 fert		3	13	90	y	

No	Species	Line	Date	Cond.	No. leaves	Height (cm)	New Shoots (Y/N)	Comment
NF23	Marslong	Line 2 no fert		3	14	120	y	
NF24	Marslong	Line 2 no fert		2	6	60	n	
NF25	Marslong	Line 2 no fert		1		0		db
NF26	Marslong	Line 2 no fert		1		0		db
NF27	Marslong	Line 2 no fert		1		0		db
NF28	Marslong	Line 2 no fert		4	25	190	y	
NF29	Marslong	Line 2 no fert		1		0		db
NF30	Marslong	Line 2 no fert		3	11	75	y	
NF31	Marslong	Line 2 no fert		2	5	35	n	
NF32	Marslong	Line 2 no fert		1		0		db
NF33	Marslong	Line 2 no fert		1		0		db - under dense Cissus hypoglauca
NF34	Marslong	Line 2 no fert		3	8	110	y	
NF35	Marslong	Line 2 no fert		2	1	50	n	dying off
NF36	Marslong	Line 2 no fert		1		0		db
NF37	Marslong	Line 2 no fert		1		0		db
NF38	Marslong	Line 2 no fert		1		0		db
NF39	Marslong	Line 2 no fert		2	4	80	n	on cage and dead limb
NF40	Marslong	Line 2 no fert		1		0		db - cage knocked over
NF41	Marslong	Line 2 no fert		4	16	120	y	resprout
NF42	Marslong	Line 2 no fert		1		0		db
NF43	Marslong	Line 2 no fert		1		0		db
NF44	Marslong	Line 2 no fert		2	5	10	y	
NF44a	Marslong	Line 2 no fert		2	8	30	y	resprout
NF44b	Marslong	Line 2 no fert		3	8	120	y	
F45	Marslong	Line 3 fert		1		0		db
F46	Marslong	Line 3 fert		1		0		db
F47	Marslong	Line 3 fert		2	7	40	n	
F48	Marslong	Line 3 fert		4	27	140	y	
F49	Marslong	Line 3 fert		2	6	15	n	
F50	Marslong	Line 3 fert		1		0		db
F51	Marslong	Line 3 fert		2	2	35	n	yellowed leaves
F52	Marslong	Line 3 fert		3	12	90	y	
F53	Marslong	Line 3 fert		1		0		db
F54	Marslong	Line 3 fert		3	4	90	y	resprout
F55	Marslong	Line 3 fert		3	9	120	y	on Tabernaemontana. Good condition

No	Species	Line	Date	Cond.	No. leaves	Height (cm)	New Shoots (Y/N)	Comment
F56	Marslong	Line 3 fert		4	16	110	y	resprout
F57	Marslong	Line 3 fert		4	26	180	y	on Cordyline stricta
F58	Marslong	Line 3 fert		3	14	70	y	Under tree fall debris
F59	Marslong	Line 3 fert		3	10	140	y	
F60	Marslong	Line 3 fert		1		0		db
F61	Marslong	Line 3 fert		3	12	110	y	
F62	Marslong	Line 3 fert		1		0		db
F63	Marslong	Line 3 fert		2	10	40	y	resprout
F64	Marslong	Line 3 fert		1		0		db
F65	Marslong	Line 3 fert		1		0		db
F66	Marslong	Line 3 fert		3	10	90	y	
NF67	Marslong	Line 4 no fert		3	6	170	n	Growing up Gynocthodes
NF68	Marslong	Line 4 no fert		4	21	160	y	resprout
NF69	Marslong	Line 4 no fert		4	20	180	y	
NF70	Marslong	Line 4 no fert		4	36	210	y	on small dead shrub and Trochocarpa laurina
NF71	Marslong	Line 4 no fert		3	15	105	y	some leaves yellowing
NF72	Marslong	Line 4 no fert		1		0		db
NF73	Marslong	Line 4 no fert		1		0		db
NF74	Marslong	Line 4 no fert		1		0		db
NF75	Marslong	Line 4 no fert		3	8	120	y	
NF76	Marslong	Line 4 no fert		2	2	70	y	resprout, tiny leaves
NF77	Marslong	Line 4 no fert		1		0		db
NF78	Marslong	Line 4 no fert		4	15	130	y	
NF79	Marslong	Line 4 no fert		3	5	100	y	resprout
NF80	Marslong	Line 4 no fert		3	5	100	y	on Cissus hypoglauca
NF81	Marslong	Line 4 no fert		3	3	100	y	
NF82	Marslong	Line 4 no fert		1		0		db
NF83	Marslong	Line 4 no fert		4	20	130	y	
NF84	Marslong	Line 4 no fert		2	4	70	y	resprout
NF85	Marslong	Line 4 no fert		2	6	60	n	
NF86	Marslong	Line 4 no fert		1		0		db
NF87	Marslong	Line 4 no fert		1		0		db
NF88	Marslong	Line 4 no fert		0		0		gone

Slender Marsdenia - Sector J transplants

Monit. No.	Species	Line	Fertiliser	Date	Cond	No. Lvs	Ht (cm)	New Shoots (Y/N)	Comment
Line 1	Marslong	L1	no fert						
1				Jan-21	3	14	110	y	
2	Marslong	L1	no fert		4	20	120	y	
3	Marslong	L1	no fert		4	16	100	y	
4	Marslong	L1	no fert		4	32	150	y	
5	Marslong	L1	no fert		2	1	50	n	
6	Marslong	L1	no fert		3	14	90	y	
7	Marslong	L1	no fert		3	10	80	y	
8	Marslong	L1	no fert		2	4	20	y	only just shooting, cage fallen over
9	Marslong	L1	no fert		3	12	80	y	on Morinda and Endiandra sieberi
10	Marslong	L1	no fert		1		0		db
11	Marslong	L1	no fert		3	10	110	y	on Hibbertia scandens
12	Marslong	L1	no fert		2	3	45		resprout
13	Marslong	L1	no fert		2	10	50	y	
14	Marslong	L1	no fert		2	5	30	y	resprout
15	Marslong	L1	no fert		1		0		db
16	Marslong	L1	no fert		1		0		db
17	Marslong	L1	no fert		2	8	30	y	resprout
18	Marslong	L1	no fert		1		0		db
19	Marslong	L1	no fert		1		0		db
20	Marslong	L1	no fert		1		0		db
21	Marslong	L1	no fert		1		0		db - under tree fall debris
22	Marslong	L1	no fert		1		0		db
23	Marslong	L1	no fert		1		0		db
24	Marslong	L1	no fert		3	10	70	y	resprouting
25	Marslong	L1	no fert		2	2	5	n	
Line 2	Marslong	L2	fert						
1					3	6	95	y	
2	Marslong	L2	fert		3	14	105	y	
3	Marslong	L2	fert		2	6	50	y	resprout
4	Marslong	L2	fert		1		0		db
5	Marslong	L2	fert		3	6	95	y	
6	Marslong	L2	fert		3	6	80	y	resprout
7	Marslong	L2	fert		2	6	15	y	resprout
8	Marslong	L2	fert		4	25	90	y	
9	Marslong	L2	fert		4	36	120	y	good health despite sapling fallen on cage

Monit. No.	Species	Line	Fertiliser	Date	Cond	No. Lvs	Ht (cm)	New Shoots (Y/N)	Comment
10	Marslong	L2	fert		1		0		db
11	Marslong	L2	fert		2	6	25	y	resprout
12	Marslong	L2	fert		2	5	70	y	
13	Marslong	L2	fert		2	2	8	n	reshooting at ground level, lvs yellowed
14	Marslong	L2	fert		2	5	20	y	resprout
15	Marslong	L2	fert		3	12	60	y	
16	Marslong	L2	fert		3	10	100	y	
17	Marslong	L2	fert		1		0		db
18	Marslong	L2	fert		1		0		db
19	Marslong	L2	fert		1		0		db - cage crushed
20	Marslong	L2	fert		4	22	110	y	
21	Marslong	L2	fert		3	9	110	y	
22	Marslong	L2	fert		1		0		db - under pile of Cissus and Melodinus
23	Marslong	L2	fert		2	4	90	n	
24	Marslong	L2	fert		1		0		db - cage crushed
25	Marslong	L2	fert		4	38	200	y	on Synoum glandulosum
Line 3 1	Marslong	L3	no fert		1		0		db
2	Marslong	L3	no fert		1		0		db
3	Marslong	L3	no fert		1		0		db
4	Marslong	L3	no fert		3	8	110	y	growing up Cordyline stricta
5	Marslong	L3	no fert		2	3	30	y	
6	Marslong	L3	no fert		4	20	90	y	on Ripogonum fawcettianum
7	Marslong	L3	no fert		4	28	130	y	
8	Marslong	L3	no fert		2	3	70	n	
9	Marslong	L3	no fert		4	16	130	y	wild Marsdenia longiloba also present
10	Marslong	L3	no fert		3	9	75	y	resprout
11	Marslong	L3	no fert		2	7	25	y	
12	Marslong	L3	no fert		1		0		db
13	Marslong	L3	no fert		2	3	15	n	
14	Marslong	L3	no fert		1		0		db
15	Marslong	L3	no fert		2	4	30	y	
16	Marslong	L3	no fert		2	4	5	y	resprout
17	Marslong	L3	no fert		1		0		db
18	Marslong	L3	no fert		2	4	30	n	
19	Marslong	L3	no fert		4	16	100	y	

Monit. No.	Species	Line	Fertiliser	Date	Cond	No. Lvs	Ht (cm)	New Shoots (Y/N)	Comment
20	Marslong	L3	no fert		1		0		db - cage knocked over
21	Marslong	L3	no fert		1		0		db
22	Marslong	L3	no fert		2	8	6	n	resprout in poor condition
23	Marslong	L3	no fert		1		0		db
24	Marslong	L3	no fert		1		0		db
25	Marslong	L3	no fert		1		0		db - cage overgrown
26	Marslong	L3	no fert		1		0		db
27	Marslong	L3	no fert		1		0		db
Line 4 1	Marslong	L4	fert		2	3	30	n	
2	Marslong	L4	fert		1		0		db
3	Marslong	L4	fert		2	4	60	y	
4	Marslong	L4	fert		2	5	20	n	
5	Marslong	L4	fert		4	15	180	y	resprout - east side of creekline
6	Marslong	L4	fert		4	26	190	y	resprout
7	Marslong	L4	fert		2	4	30	n	
8	Marslong	L4	fert		1		0		db
9	Marslong	L4	fert		1		0		db
10	Marslong	L4	fert		1		0		db
11	Marslong	L4	fert		1		0		db
12	Marslong	L4	fert		1		0		db
13	Marslong	L4	fert		2	6	70	y	
14	Marslong	L4	fert		1		0		db
15	Marslong	L4	fert		3	10	80	y	
16	Marslong	L4	fert		1		0		db
17	Marslong	L4	fert		3	11	95	y	
18	Marslong	L4	fert		1		0		db
19	Marslong	L4	fert		1		0		db
20	Marslong	L4	fert		2	3	50	n	
21	Marslong	L4	fert		2	6	10	y	resprout
22	Marslong	L4	fert		1		0		db
23	Marslong	L4	fert		1		0		db
24	Marslong	L4	fert		1		0		db
25	Marslong	L4	fert		1		0		db
26	Marslong	L4	fert		3	8	80		Under fallen Forest Oak but resprouted

Woolls's Tylophora - Sector B transplants

No	Date	Line	Tentative Species ID	Source Label	Cond	No. lvs	Height (cm)	New Shoots (Y/N)	Comment
64	Jan-21	L8 east, gate	Tylophora woollsii	ML46-6	2	6	15		resprout
65		L8	Tylophora woollsii	ML46-	1		0		db
66		L8	Tylophora woollsii	ML48-5	1		0		db
67		L8	Tylophora woollsii	ML46-1	1		0		db. P. dorrigoensis on cage
68		L8	Tylophora woollsii	ML46	1		0		db
69		L8	Tylophora woollsii	ML46-	1		0		db
70		L8	Tylophora woollsii	ML46-3	1		0		db
71		L8	Tylophora woollsii	ML46-2	1		0		db
72		L8	Tylophora woollsii	ML47-3	1		0		db
73		L8	Tylophora woollsii	ML47-10	1		0		db
74		L8	Tylophora woollsii	ML46-6	1		0		db
75		L8	Tylophora woollsii	ML47-4	1		0		db
76		L8	Tylophora woollsii	ML48	1		0		db
77		L8	Tylophora woollsii	ML48-2	1		0		db
78		L8	Tylophora woollsii	ML47-5	1		0		db
79		L8	Tylophora woollsii	ML46-4	1		0		db
80		L8	Tylophora woollsii	ML47-6	1		0		db
81		L8	Tylophora woollsii	new near TA	1		0		db
82		L8	Tylophora woollsii	new near TA	1		0		db
83		L8	Tylophora woollsii	ML45-3	2	4	7	y	T. paniculata? Very narrow leaves
84		L8	Tylophora woollsii	ML45-2	1		0		db
85		L9	Tylophora woollsii	ML45-6	1		0		db
86		L9	Tylophora woollsii	ML45-10	1		0		db
87		L9	Tylophora woollsii	ML45-4	3	12	80	y	
88		L9	Tylophora woollsii	ML48-4	1		0		db
89		L9	Tylophora woollsii	ML47-8	1		0		db
90		L9	Tylophora woollsii	ML46-7	1		0		db
91		L9	Tylophora woollsii	ML47-7	2	4	20	y	
92		L9	Tylophora woollsii	ML48-1	1		0		db
93		L9	Tylophora woollsii	ML48-5	1		0		db
94		L9	Tylophora woollsii	ML48-7	1		0		db
95		L9	Tylophora woollsii	ML48-4	1		0		db
96		L9	Tylophora woollsii	ML	1		0		db
97		L9	Tylophora woollsii	ML47-9	1		0		db

No	Date	Line	Tentative Species ID	Source Label	Cond	No. lvs	Height (cm)	New Shoots (Y/N)	Comment
98		L9	Tylophora woollsii	ML48-7	1		0		db
99		L9	Tylophora woollsii	ML48	1		0		db
100		L9	Tylophora woollsii	ML47-10	1		0		db
101		L9	Tylophora woollsii	ML45-5	1		0		db
102		L9	Tylophora woollsii	ML45-8	1		0		db
103		L9	Tylophora woollsii	ML48-9	1		0		db
104		L9	Tylophora woollsii	ML48-1	1		0		db
105		L9	Tylophora woollsii	ML48-8	1		0		db

Rusty Plum & Red Bopple Nut transplants

Monitoring Number	Condition notes	Condition Score	Height (m)	Comments
Rusty Plum 1	split one from Boggy Creek shooting	4	1.6	In excellent health. One shoot from base of main stem with vigorous new growth Jan 2021
Rusty Plum 2	split one from Boggy Creek shooting	0	0	dead
Rusty Plum 3	Excellent health	5	4.1	In excellent health. Old flowers present Nov 2020
Red Bopple Nut	Excellent health	5	3.3	Flowered spring 2020, with several young developing fruit present Nov 2020