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Tylophora linearis Propagation and Translocation Annual Report 2022



Whitehaven Coal

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Glossary and abbreviations

Acronym	Description
BMP	Biodiversity Management Plan
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
BC Act	NSW <i>Biodiversity Conservation Act 2016</i>
MCCM	Maules Creek Coal Mine
TFPP	Threatened Flora Project Plan
WHC	Whitehaven Coal
BOA	Biodiversity Offset Area
OEH	NSW Office of Environment and Heritage



1 Summary

In accordance with Section 4.1.2 and Section 6.14 of the approved Biodiversity Management Plan (BMP) for the Maules Creek Coal Mine (MCCM) described a *Tylophora linearis* Propagation and Translocation Program. This Propagation and Translocation Program formed Appendix C of the MCCM BMP (WHC 2017). The MCCM BMP is supported by the Threatened Flora Project Plan (TFPP) prepared by Ecoplanning (2021). The TFPP outlines how WHC will monitor the threatened flora – including *T. linearis* – which is present on their Biodiversity Offset Areas and adjacent to their mining operations.

Quarterly monitoring in the 2022 period showed that many *T. linearis* individuals continued to persist within WHC BOAs, including the production of new stems and flowers, however, no plants monitored during 2022 were found to have developed seed, including after a cross-pollination trial. This lack of success in the *T. linearis* populations to produce progeny limits WHCs opportunities for future germination and translocation trials.

Following from the observations of the 2021 monitoring period, the stem counts for *T. linearis* sub-populations on WHC BOAs was highly variable. Generally, the 2022 year was wetter than the climatic average, which would suggest that higher than normal stem counts would be observed, however, this was not the case.

For future monitoring, individual *T. linearis* stems from *in situ* populations WHC BOAs have been tagged, to potentially glean individual level data, which may help inform future management of the species on WHC properties.

Within the Wollondilly BOA, the translocation trial in enclosures A through G, there has been some continued success with the trial, with approximately 5 plants being observed during 2022. However, the Topsoil Translocation trial in the Teston South BOA has not produced any *T. linearis* stems to date.

2 Introduction

This annual report has been prepared to collate the results of the management actions and monitoring efforts for *T. linearis* during 2022, and to summarise the quarterly reports prepared by Ecoplanning (2022a, 2022b, 2022c, & 2023).

2.1 Summary of *Tylophora linearis*

Tylophora linearis is a threatened flora species listed as vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act) and endangered under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The species is a twiner or subshrub with cylindrical stems, up to 3 mm diameter, with linear-lanceolate leaves up to 10 cm long and 4 mm wide (PlantNet 2023). The species has been recorded from Armidale to Temora, within dry scrub and open forests in association with *Eucalyptus fibrosa*, *E. sideroxylon*, *E. albens*, *Callitris endlicheri*, *C. glaucophylla* and *Allocasuarina luehmannii* (NSW Department of Planning and Environment [DPE] [OEH] 2022).

2.2 WHC management obligations for *Tylophora linearis*

Tylophora linearis was identified at Maules Creek Coal Mine (MCCM) during pre-clearing surveys in 2014 and 2015. On 14 May 2014, the NSW Department of Planning and Environment requested an addendum to the MCCM BMP to document a propagation and translocation program for *T. linearis*. The propagation and translocation program is made up of the following stages (WHC 2017 – Appendix C):

- Stage 1 – Root Architecture (complete) and Growth Study (ongoing);
- Stage 2 – Seed Production Monitoring (complete);
- Stage 3 – Seed Collection and Storage (complete);
- Stage 4 – Seed Propagation (complete); and
- Stage 5 – Translocation Trials (ongoing).

Stages 2 – 4 of the previous *T. linearis* Propagation and Translocation Program (WHC 2017 – Appendix C) have been completed and documented in previous annual reviews (WHC 2021b, WHC 2020). During 2021, WHC (through its specialist consultants) continued research into Stages 1 and 5 of the translocation program as well as undertaking a trial for Stage 2.

In 2020 and 2021 an updated TFPP (Ecoplanning 2021a) and *T. linearis* Restoration and Translocation Strategy (Ecoplanning 2021c) were prepared to support the previous documents (WHC 2017, WHC 2019), pending the next revision of the BMP. Ongoing monitoring and management actions outlined within the updated TFPP (Ecoplanning 2021a) and Restoration and Translocation Strategy (Ecoplanning 2021c) for *T. linearis* are as follow:

- Ongoing monitoring of the translocated individuals for life cycle/biology analysis.
- Surveillance of natural populations of *T. linearis* to continue to monitor seed production and germination, identify any threats to threatened flora and to increase knowledge of each species' ecology and reproductive habits.
- Further translocations of *T. linearis* via multiple methods including salvage translocations of whole plants and seed collection to enable further germination trials.

3 Methods

3.1 Translocation study

The translocation study included monitoring of *T. linearis* individuals translocated to the Wollandilly BOA in December 2015. Monitoring involved recording remaining stem numbers and stem height of the original 77 plants. Additional information recorded included vegetative condition, flowering, and fruiting phenology.

Approximately 20 cm of topsoil (including shrubs and ground cover), from areas to be cleared for mining and identified during pre-clearance surveys as supporting *T. linearis* was translocated and spread within five enclosures, designated E1 – E5, located within the Teston South MCCM BOA in 2019 (**Figure 3.3.2**). The Teston South BOA was chosen as a recipient site based upon the following:

- having modelled suitable habitat,
- previous *T. linearis* records within the site,
- proximity to the donor sites,
- presence of natural woodland
- proximity to existing tracks for delivery, management, and monitoring access.

Monitoring of the enclosures involved recording the number of *T. linearis* stems present (quarterly inspections with all stems flagged, numbered, their length measured and dated) and weed monitoring.

As a reference to these five translocation areas, the *T. linearis* enclosure Wollandilly H was monitored quarterly.

3.2 Hand-pollination trial

Given that there had been limited success in collecting viable seed from natural flowering and pollination, a cross-pollination trial was undertaken in 2022 as an active pollination initiative for the *T. linearis* populations on WHC BOAs aligned with and an extension of the Seed Production Monitoring (Stage 2, WHC 2017 – Appendix C) and the enhancement of "Use/Collection of Seed" under the Threatened Species Licence C0005930 for planting into WHC offset sites. The hand-pollination trial commenced in the second quarter of 2022 and involved hand transfer of pollinia from one flower on one *T. linearis* stem to one flower on a second stem of *T. linearis*. The two *T. linearis* stems involved in the hand-pollination trial were located within the Wollondilly M enclosure (**Figure 3.3**) and were separated by approximately 50 m to minimise the chance that the stems were part of the same *T. linearis* individual.

3.3 Seed collection

In accordance with the updated TFPP (Ecoplanning 2021a), all offset area populations were inspected during the monitoring period in search of seed for translocation trials. A subset of the known populations was inspected each quarter to detect any flowers or follicles. Where flowering plants were detected more regular inspections were undertaken to identify follicle and seed development.

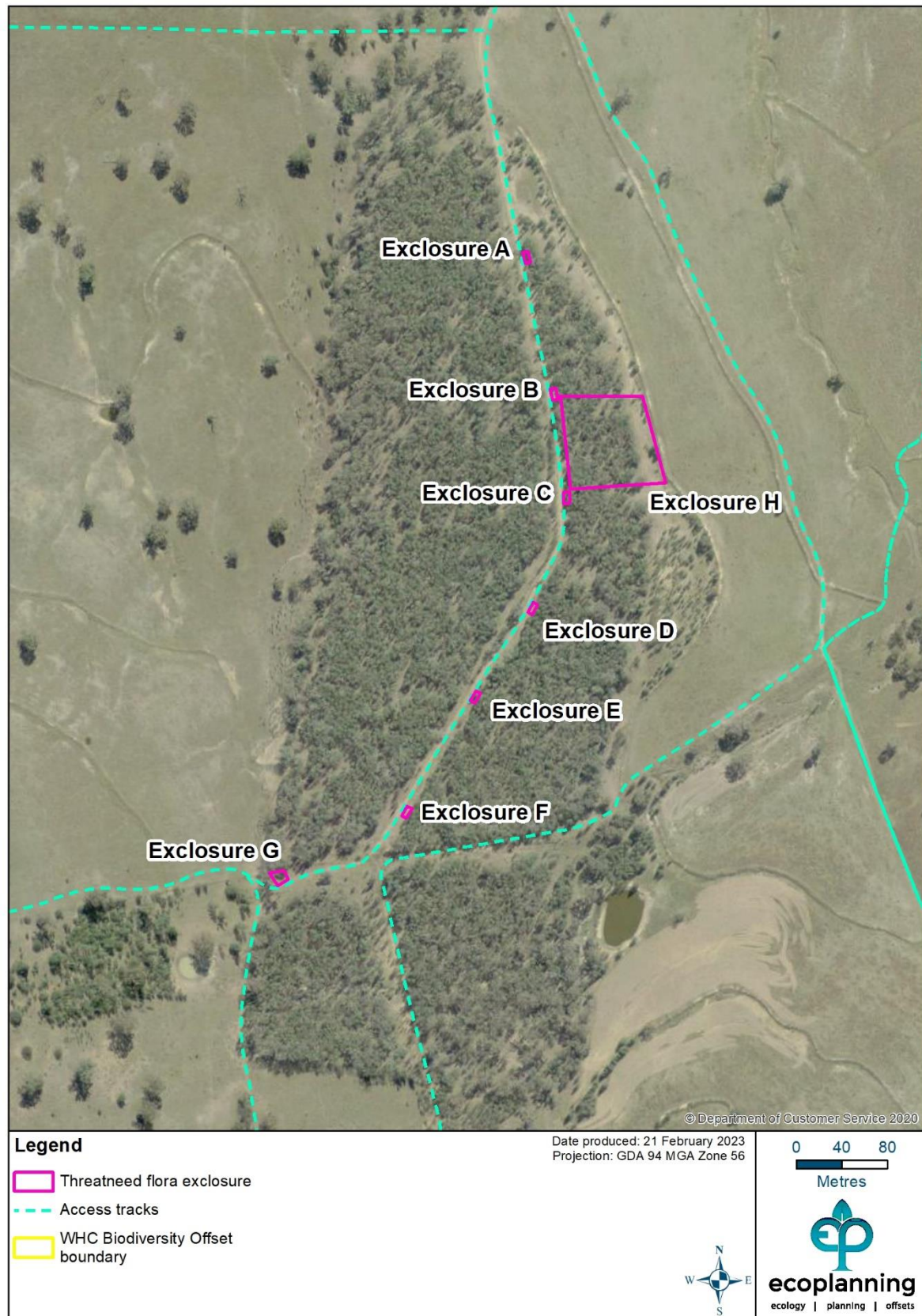


Figure 3.3.1: *Tylophora linearis* monitoring locations within Wollandilly Offset.



Figure 3.3.2: Teston South monitoring locations.

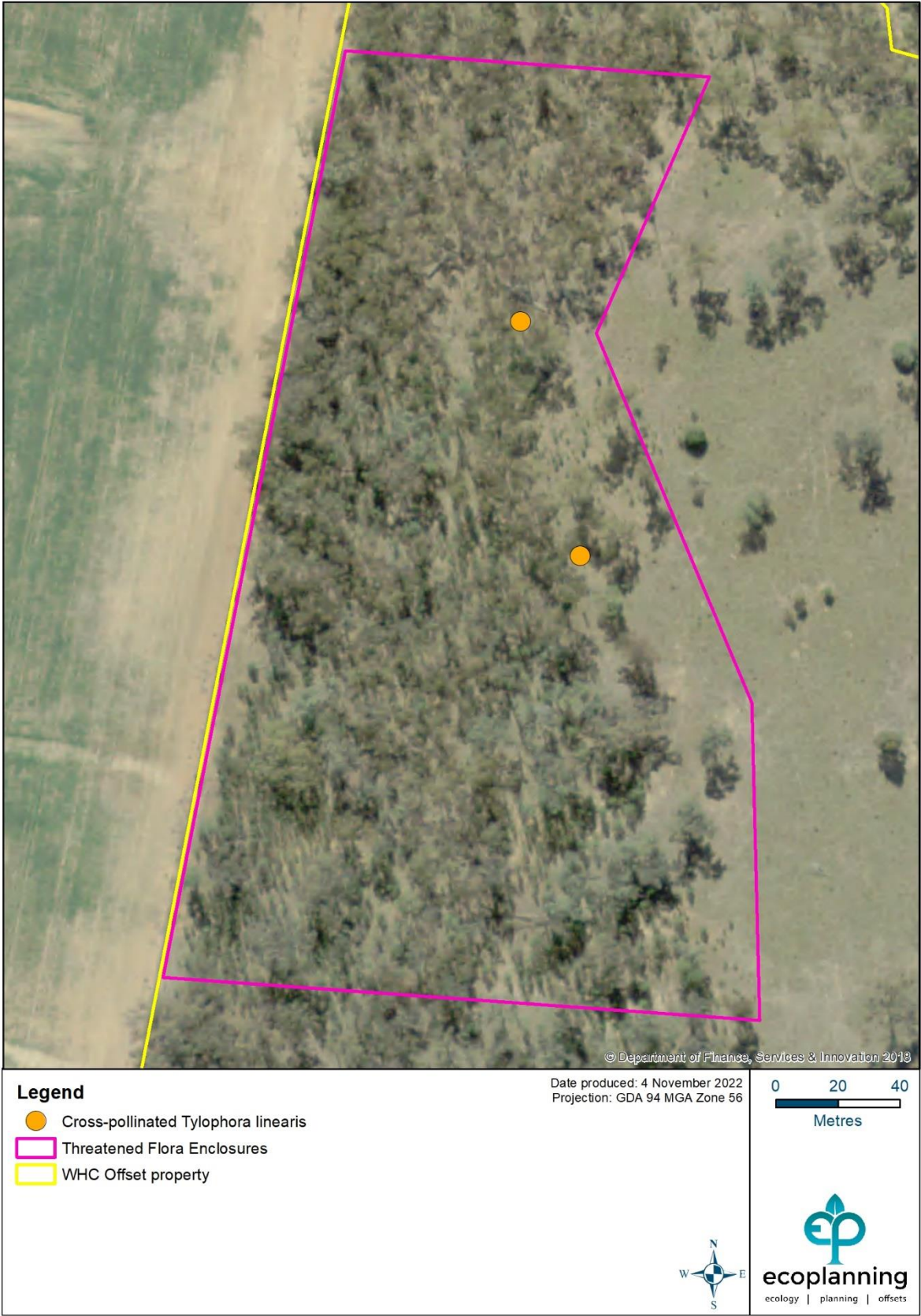


Figure 3.3: Location of the *T. linearis* individuals which were part of the 2022 cross-pollination trial.

3.4 Rainfall

Given that the majority of *T. linearis* sub-populations are located in the proximity of the Wollondilly BOA, the weather station on this property was used to inform the local rainfall and maximum daytime temperatures for 2022 (Advitech 2022). As a reference for the climatic patterns, the weather station at Gunnedah Airport was selected (BOM 2023) (**Figure 3.4**).

It is important to note that climatic conditions, particularly drought, as being a primary influence of monitoring projects in previous seasons. Above average rainfall conditions were recorded at the Wollondilly BOA (854 mm) when compared to the climate average (559 mm; Gunnedah Airport). Above average rainfall events were recorded in the months of February to April and August to November (**Figure 3.4**). These high rainfall conditions follow the trends observed in previous monitoring years (Ecoplanning 2021b).

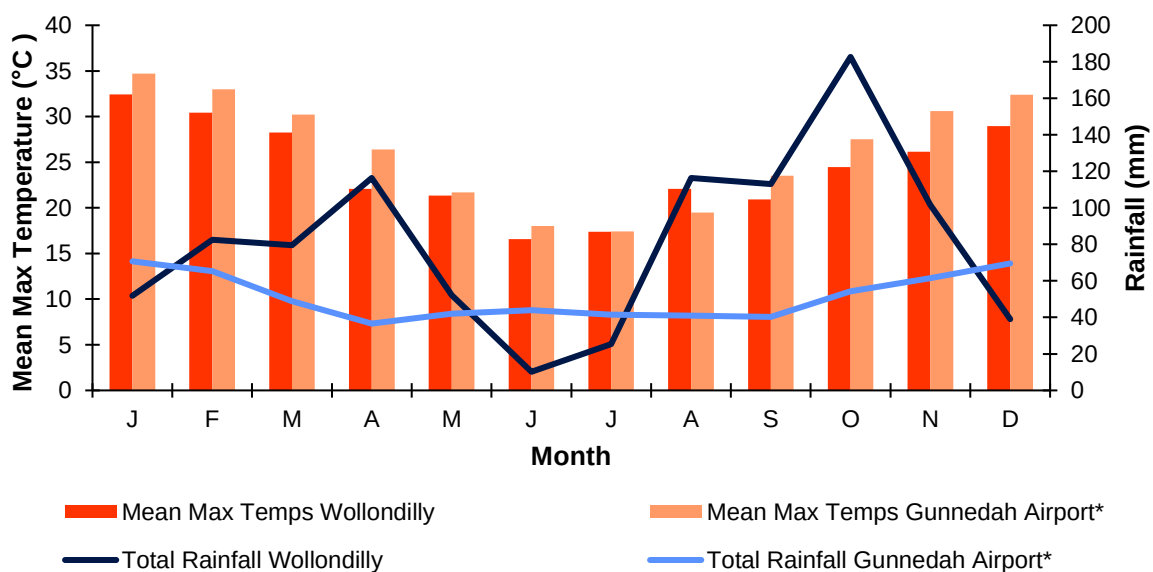


Figure 3.4: Month rainfall totals and mean daily maximum temperatures from the Wollondilly BOA weather station and climatic patterns from Gunnedah Airport (*data collected by BOM [2023]).

4 Results and discussion

The results of the ongoing translocation trials – representing Stage 5 of the *T. linearis* Propagation and Translocation Program (WHC 2017), are presented in **Table 4.1**. Results of each trial, as of 2022 and ongoing work conducted across the reporting period, are detailed in the following sections.

Table 4.1: Summary of *T. linearis* translocation to December 2022

Source (provenance)	Date	Plants/seeds translocated	Translocation method	Surviving translocations	Cumulative count of surviving translocated individuals
MCCM Project boundary	03/12/2015	77	Seed collection & propagation	3/77 (Q1) 3/77 (Q2) 1/77 (Q3) 5/77 (Q4)	5*
	27/02/2019	Unknown	Topsoil transfer	0	5*

* Based on number of plants as at December 2022 with above ground growth. However, this study has found plants can go up to 3 years without above ground growth so maximum number of plants with above ground growth in last 3 year has been 10.

4.1 Growth study

4.1.1 Wollandilly BOA

The abundance of *T. linearis* stems observed during surveys within Wollandilly Enclosure H is shown on **Figure 4.1**. The decline in number of observed *T. linearis* stems (identified in the 2021 *T. linearis* annual review [Ecoplanning 2021b]) did continue into 2022. The highest number of *T. linearis* stems observed in Q2 and Q3 within Enclosure H was 3, with a minimum of 1 stem observed from surveys in Q1 and Q4 2022.

As noted in previous Ecoplanning reports, there is the potential for *T. linearis* stem counts to correlate with annual rainfall. **Figure 4.2** compares these trends between the first quarter of 2018 and the final quarter of 2022. The relationship between number of *T. linearis* stems in the Wollandilly H enclosure and the quarterly rainfall appears to be a strong negative correlation. Continued comparison between these two variables should continue to determine the significance of this relationship.

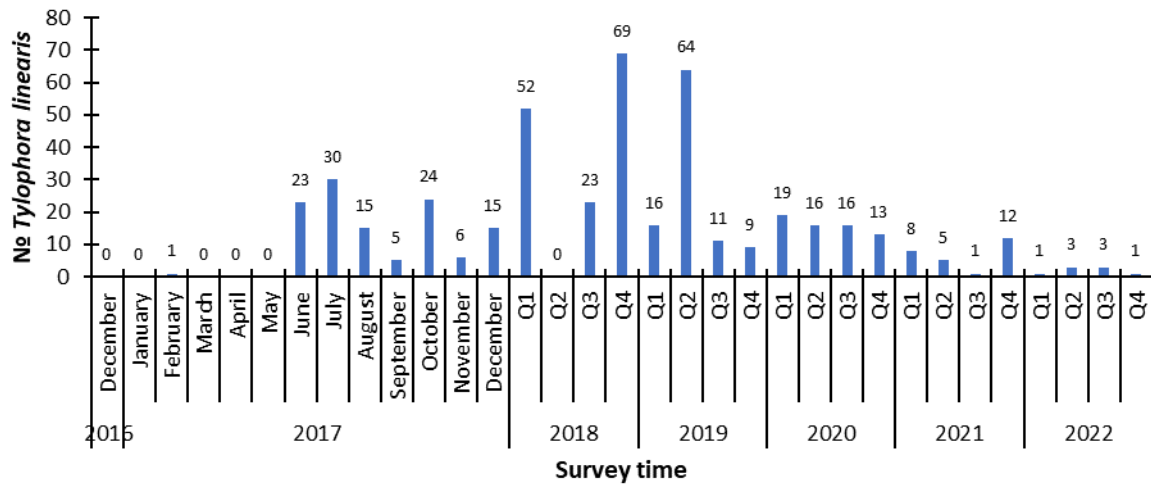


Figure 4.1: Number of *Tylophora linearis* observed in Wollandilly H enclosure since targeted surveys began.

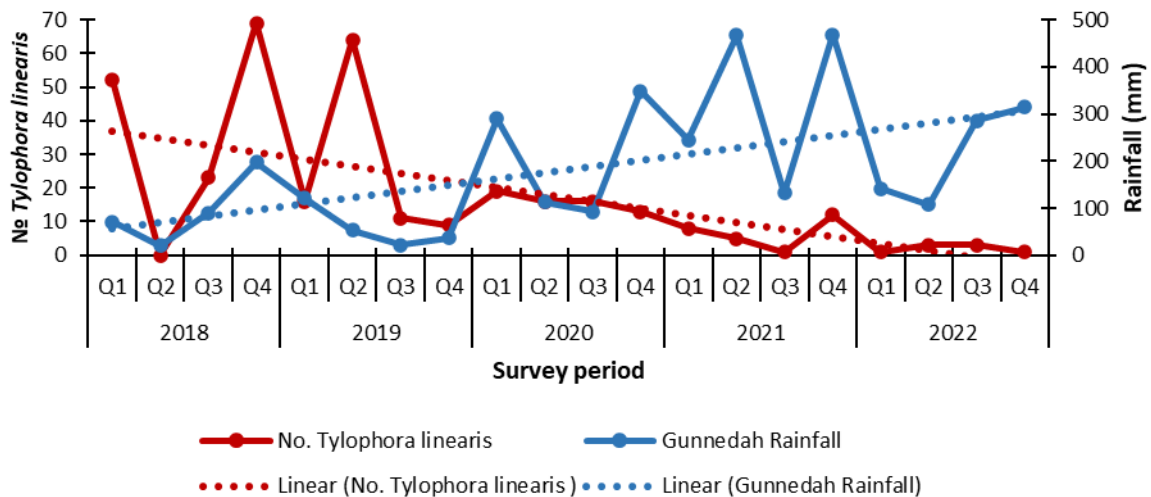


Figure 4.2: Comparison of the number of rainfall and number of observed *T. linearis* stems within the Wollandilly H enclosure across the quarterly monitoring period (from Q1 2018 to present).

4.1.2 Teston South BOA

No *T. linearis* was observed at any of the 5 enclosures during 2022.

The exotic vegetation cover within topsoil translocation sites, as identified in previous annual reports (Ecoplanning 2020, 2021b) was no longer present, and the ground cover was dominated by a high cover of native vegetation. The high cover of native ground cover species may be having a detrimental effect on the growth of the translocated *T. linearis*. However, given that no *T. linearis* have been observed in any of the five Teston South enclosures since the establishment of the *T. linearis* topsoil trial (a period of four years), management of these native species is not recommended.

4.2 Seed collection

Searches for any reproductive material formed part of the monitoring of *in situ* *T. linearis* populations on WHC BOAs. Although many plants were observed to be flowering during 2022, no plants were found to have produced any follicles. As a reference, *in situ* populations of *T. linearis* in the Pilliga East State Conservation Area had formed follicles (pers. obs.).

4.2.1 Hand-pollination trial

During inspections in the third and fourth quarter of 2022, no follicle or seed development was observed on either of the two plants which formed part of the hand-pollination trial that commenced in the second quarter of 2022.

5 Conclusion and recommendations

The overall aim of the *T. linearis* Restoration and Translocation Strategy (Ecoplanning 2021a) is to directly support the conservation of *T. linearis*, and to maintain a self-sustaining, genetically diverse population of the species within the WHC BOAs, which is capable of surviving in the long term. The continued occurrence of *T. linearis* within multiple enclosures across WHC BOAs, as detected during quarterly searches for reproductive material, indicates that the populations of *T. linearis* on WHC BOAs remains healthy, given the high number of stems observed. However, the reproductive health of the population remains unclear. Given that there is a dearth of knowledge on the reproductive ecology of *T. linearis* in the published literature, it is unknown whether the observed rarity of follicles/seed is typical of the species and part of its natural life-cycle. Planned ecological burns required as part management of WHC BOAs may provide opportunities to determine if resumption of natural disturbance plays a role in the life-cycle of the species.

To support the overall aim of the strategy, one of the objectives of the strategy is to guide the successful translocation of *T. linearis* individuals grown from seed, stem cuttings, or soil seedbank transfer, to suitable habitat within the protected areas that form part of the WHC BOAs. The source of regenerative material for the *T. linearis* within the strategy is to include material collected from natural populations across WHC BOAs, State Forest and populations identified within approved mine disturbance footprints ('salvage'). In 2022, no salvage opportunities were available to be exploited. Additionally, no seed development was detected within WHC BOAs in 2022 which also limited opportunities for further germination trials and translocations. Pre-clearance inspections of the MCCM in 2023 may present salvage opportunities for WHC Biodiversity, with either follicles which may be harvested or whole plants which can be transferred to enclosures within identified target locations in WHC BOAs.

The following recommendations are made to continue to achieve the aim of the strategy and the objective to undertake further translocations:

- As per the TFPP (Ecoplanning 2021a), continued quarterly surveillance of naturally occurring populations should occur to observe patterns of these populations and to identify opportunities for seed collection and propagation. Despite there being no seed produced in 2022, the collection and propagation of seed from naturally occurring populations of *T. linearis* is still considered the least invasive way to support *T. linearis* conservation without impacting naturally occurring populations.
- As per the *T. linearis* Restoration and Translocation Strategy (Ecoplanning 2020), where inspections of naturally occurring populations in 2022 continue to detect limited or no seed production, propagation via stem cuttings should be trialled from healthy and robust individuals of the species. Cuttings should either be taken by qualified horticulturalists, or under their direction, ensuring that resources and materials are ready and available to receive the cuttings.
- As per the *T. linearis* Restoration and Translocation Strategy (Ecoplanning 2020), identification of *T. linearis* should be undertaken as part of pre-clearance surveys. Any *T. linearis* within approved MCCM disturbance footprints should be translocated via a combination of seed collection (where seeds are present), stem cuttings and whole plant translocations.

- As per the TFPP (Ecoplanning 2021a), there is the opportunity to take advantage of the ecological burns required as management of WHC BOAs, to understand how fire interacts with the life-cycle to *T. linearis*. This should be exploited in 2023, with the results informing future management practices of the species.



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