

Restoration of native vegetation and re-introduction of *Malva preissiana* on Penguin Island – preliminary findings

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ABSTRACT

Penguin Island's vegetation in southwestern Australia has been degraded by anthropogenic activities and breeding silver gulls (*Chroicocephalus novaehollandiae*). However, native vegetation cover is important for breeding seabirds such as bridled terns (*Onychoprion anaethetus*). This pilot project aimed to restore native vegetation cover around artificial nest tubes for bridled terns using tubestock of berry salt bush (*Rhagodia baccata*) and bower spinach (*Tetragonia implexicoma*), and to re-introduce the Australian hollyhock (*Malva preissiana*), an ornithocoprophilic coastal plant that disappeared from Penguin Island in the 1970s due to competition with introduced *Malva* spp. and other nitrophilous weeds (Rippey *et al.* 2002). A total of 80 *R. baccata* or *T. implexicoma* seedlings and 980 *M. preissiana* seeds were planted, but less than 4% of the tubestock survived and less than 1% of the *M. preissiana* seeds germinated. Disturbance by breeding silver gulls was identified as a major issue, therefore seedling protection from these birds is now being used for ongoing restoration projects.

KEYWORDS: Weed, gulls, Australian hollyhock, seabird, vegetation, coastal, island, colony, Penguin Island, Australia

INTRODUCTION

The vegetation on Penguin Island, a small (12.5 ha) coastal island in Western Australia 40 km south of Perth (32°30'S, 115°69'E), has been shaped by its geology and the predominant climatic conditions in the region. Penguin Island is an A-class reserve located in the Shoalwater Islands Marine Park and lies on the Garden Island ridge which is an aeolian dune of Tamala limestone (Haig, 2002). It has a Mediterranean climate and is subjected to a coastal sea breeze which carries salt spray (DCALM, 1992). Therefore, the native vegetation is adapted to growing in these conditions and displays sclerophyllous and xeromorphic characteristics (DCALM, 1992).

Numerous seabird colonies such as the little penguin (*Eudyptula minor*), Caspian terns (*Hydroprogne caspia*), crested terns (*Thalasseus bergii*) and bridled terns (*Onychoprion anaethetus*) rely on Penguin Island's native vegetation cover to nest (DEC and MPRA, 2007). However, anthropogenic activities have degraded the island's vegetation, especially through the construction of shacks until 1987 when the Department of Parks and Wildlife bought the island's lease and undertook restoration work (Brown *et al.*, 2015a). Furthermore, in the 1960s silver gulls (*Chroicocephalus novaehollandiae*) started breeding on Penguin Island during the winter months and contributed to the degradation of its native vegetation through trampling, picking material for nest-building, dispersing seeds from weeds and depositing significant amounts of guano that alters soil composition

(Hogg & Morton, 1983; Brown *et al.*, 2015a; Otero *et al.*, 2015). Hence, disturbance from human activities and gulls, as well as pelicans and cormorants to some extent, has contributed to the continued degradation of the island's vegetation so that in winter, weeds grow and compete with the native vegetation, and in summer bare soil remains where the weeds grew (Brown *et al.*, 2015a). The overall decline in native vegetation cover has led to the loss of nesting habitats for seabirds. It is probable that these disturbances also contributed to the disappearance of the native Australian hollyhock (*Malva preissiana*) on Penguin Island in the 1970s (Brown *et al.*, 2015b).

The aims of this study were:

- to determine if native vegetation cover could be re-established around bridled tern nesting boxes by planting tubestock of berry salt bush (*Rhagodia baccata*) and bower spinach (*Tetragonia implexicoma*), and
- to determine if the Australian hollyhock could be grown from seeds around bridled tern nesting boxes.

METHODS

STUDY SITE

The study site was located on the north-east end of Penguin Island which has been a known breeding area for bridled terns for the past 60 years (Dunlop & Jenkins, 1994). A large portion of the vegetated area has been lost to weeds, such as weedy annual grasses including *Lolium*

spp., *Bromus* spp. and Brassicaceae (Bettink *et al.*, 2009; Brown *et al.*, 2015a). The area had also previously been flagged as a hotspot for tree mallow (*Malva dendromorpha*) which is a weed of main concern growing on Penguin Island (Bettink *et al.*, 2009). The remaining native bushes include *R. baccata* and *T. implexicoma* and are used by bridled terns for cover for nesting in summer.

In an effort to recover nesting grounds for bridled terns, 50 artificial nest tubes were installed in spring 2015 on weeded patches in the study area. The nest tubes were built out of a storm drain PVC pipe (diameter 30 cm) that was cut length-wise to obtain two dome-shaped half pipes and sectioned in 50 cm long pieces. They were then painted with limestone-coloured paint to give them a more natural appearance. The nest tubes were laid about 4 m apart on bare ground as bridled terns usually nest 1–5 m apart from each other (del Hoyo *et al.*, 1996).

Restoration techniques

Seeds from *R. baccata* growing on Penguin Island and cuttings from *T. implexicoma* were collected and grown in pots offsite. The resulting tubestock of *R. baccata* and *T. implexicoma* were planted around 40 artificial nest tubes in June 2014. Before planting, weeds that were growing within a 1.5 m radius of the nest tubes were removed. Two seedlings of either *R. baccata* or *T. implexicoma* were planted on either side of the nest tube.

Additionally, *M. preissiana* fruits were collected early in 2014 from plants cultivated in Perth that had been grown from seeds that originated from Shag Rock in the Shoalwater Islands Marine Park (650 m North of Penguin Island). The seeds were isolated using sieves and filtered through Selecta aspirator/gravity separator zig-zag ZZ1 – Machinefabriek B.V. The fruit cases were removed to separate the seeds and for half of the seeds, a small portion of the upper seed coat was removed (“nicked”

seeds) to determine if this would enhance germination. The germination rate for both the “nicked” and “not nicked” seeds was determined to be 100% using standard testing procedures on agar plates (Carlson *et al.*, 1982).

The seeds were sown around ten bridled terns’ artificial nest tubes in June 2014. The areas around the nest boxes were weeded before using a seeding board to plant the seeds. The boards were placed on both sides of the nest tubes (0.5 m in length) to plant an equal number of “nicked” and “not nicked” seeds (Figure 1). The seeds were sown at a depth of about 2 mm.

The germination and survival of *M. preissiana* seedlings was determined by visiting the sites every four weeks and the plots were also weeded during those visits.

RESULTS

A total of 80 *R. baccata* or *T. implexicoma* seedlings were planted around the bridled tern nest tubes. All except for three plants were removed by breeding silver gulls within a day. The remaining three plants (all *R. baccata*) were still growing in June 2016, two years after planting. Therefore, less than 4% of the planted tubestock survived.

A total of 980 *M. preissiana* seeds were planted around ten artificial nest tubes. Germination was recorded in July 2014 (one month after planting) and a total of eight plants grew around seven of the nest boxes. Therefore, less than 1% of the seeds that were sown had developed by the time of the visit. Seven of the seeds that grew were “not nicked”. By November 2014, one of the *M. preissiana* plants was flowering. A year after planting, only five plants survived and in July 2015 those five plants were flowering and producing fruits. In particular, one plant reached 1.5 m in height and nearly 2 m in diameter. All plants died in summer 2015/2016.

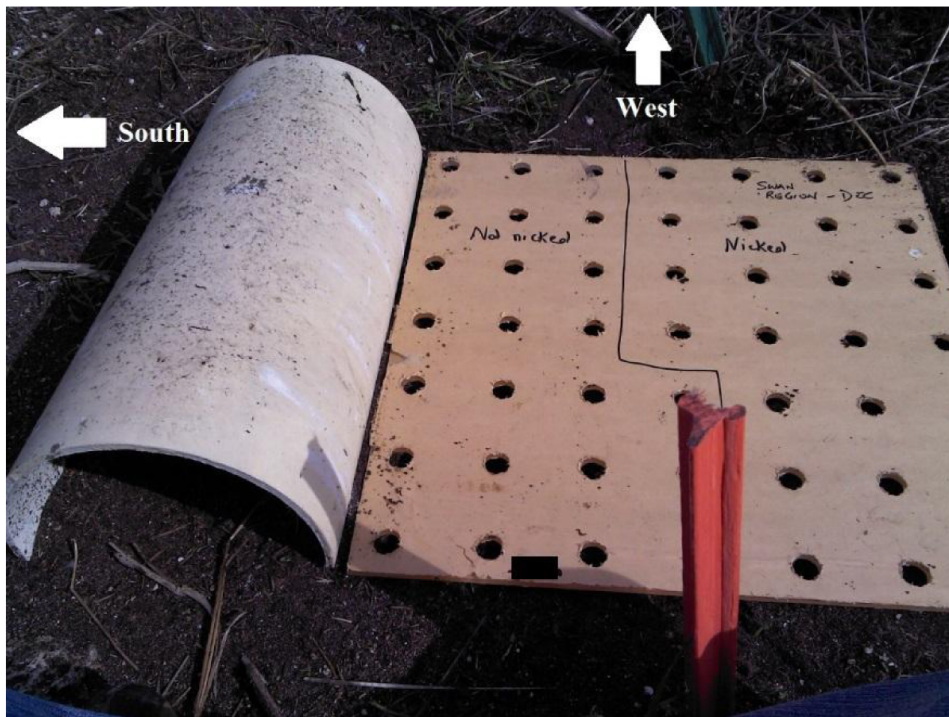


Figure 1. Planting board (0.5 x 0.5 m) for *Malva preissiana* seeds for germination around bridled tern artificial nest tubes on Penguin Island in June 2014. The “nicked” slots were for seeds with a small part of the seed coat removed.

DISCUSSION

Breeding gulls (Laridae) are known to be major disturbances to the vegetation where they nest (Hogg & Morton, 1983; Otero *et al.*, 2015). While our trial showed that planted tubestock was removed by breeding gulls, it also showed that *M. preissiana* grown from seeds were not affected. Therefore, it is important to protect planted tubestock, and ongoing revegetation trials on Penguin Island are showing successful growth of seedlings when protected with cages (see Brown *et al.*, 2015a).

While the field germination rate of *M. preissiana* seeds was very low (less than 1% compared with 100% germination rate in the laboratory test), the plants that grew and survived for nearly two years produced abundant fruits. Furthermore, nicking of the seeds was unnecessary for enhancing germination rate. The sites where those plants grew are being monitored to detect any sign of germination from the dropped fruits. However, in spring 2015 many of the flowers and fruits were eaten by insects, so it is unknown whether the seeds from the plants that dropped on the soil were viable or not.

It is interesting to note that the nest tubes around which the *R. baccata* plants grew, and four of the nest tubes around which *M. preissiana* grew, were taken up by bridled terns during their breeding season in summer (out of the ten artificial nest tubes that were occupied during the summer). Therefore, a total of 70% if the shaded nest tubes were taken up by bridled terns compared with 7.5% of the unshaded nest tubes. The natural shade cover provided by the growing plant was a likely factor in drawing the breeding pairs to the restoration site. It is believed that the guano that falls on either side of the nest tube when bridled terns roost on top of them will help *M. preissiana* plants grow. Indeed, bridled terns are true seabirds and feed almost exclusively on fish, squid and crustacea during their breeding season (Dunlop & Jenkins, 1994). Therefore, since *M. preissiana* has a life cycle that is reliant on guano deposit (Ripsey *et al.*, 2002), it is believed that the birds' droppings are beneficial to the plants.

Overall, while native vegetation can be re-established around bridled tern nest tubes on Penguin Island, it is necessary to protect young plants. Therefore, the restoration of native vegetation on coastal islands in Western Australia would be possible provided that weeds are removed and tubestock of native plants are protected from breeding silver gulls.

ACKNOWLEDGEMENT

The authors thank all the volunteers who assisted with the fieldwork, and particularly Brown K. and Paczkowska G. for their guidance in drafting and implementing this project, and Elizabeth Ripsey for reviewing and

providing feedback on the earlier version of this paper. AMT Labbé was the recipient of the Robert Hammond Research Grant at Murdoch University. This research was conducted under a number of licences: Department of Parks and Wildlife Regulation 4: CE005025, CE004529, CE004213, and Regulation 17: SF009937, SF009561, SF010526.

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