

## Tasmania and asparagus weeds: hanging in the balance

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### Abstract

With resources stretched to the limit, Tasmania is under threat from both bridal creeper, *Asparagus asparagooides* (L.) Druce, and asparagus fern, *A. scandens* Thunb. An eradication program primarily focused on bridal creeper in the past has had major

successes but needs significant resources to enable eradication timeframes to be maintained.

The bridal creeper program has been predominantly community based, with assistance from a number of individuals from various local and State government

agencies. Flinders Island has the largest number of sites and this challenge is compounded by a low population base. Over a dozen native plant species are expected to be lost if the eradication program is not maintained and increased.

Asparagus fern is increasing greatly in its range on both Flinders Island, King Island and the Tasmanian mainland. It is often found growing at the same sites as bridal creeper. This has been included in the eradication program as it would, over as short term, colonize the areas controlled for bridal creeper and would potentially have a similar impact. Eradication of both species is still feasible in Tasmania and both are identified in the Tasmanian Bridal Creeper Strategy as being eradicable weeds.

## Eradication of invasive alien plants on Lord Howe Island, NSW using three *Asparagus* species (*Asparagus asparagooides* (L.) Druce, *A. plumosus* Baker and *A. aethiopicus* L.) as a case study

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### Summary

Of the approximately 500 recognized alien plants on Lord Howe Island, 17 are declared noxious weeds. Following many years of dedicated but ultimately futile 'control' effort, 15 of these (including three *Asparagus* species) are now targeted for total eradication on all land tenures. The two other listed noxious weeds, *Lilium formosanum* and *Ageratina adenophora* are so widespread and numerous, including in totally inaccessible areas, that eradication is not planned for these species at this stage. The distribution and total population of *A. plumosus* is relatively limited, while *A. aethiopicus* and *A. asparagooides* are more widely distributed and more numerous. In contrast to the mainland situation, the chance of re-infestation of the island following eradication of these species is very low given the distance offshore from mainland Australia (provided effective quarantine is maintained). A close-spaced grid-search and treatment methodology within 6–8 hectare blocks has been adopted for the whole island. Management is based on a model developed by the NZ Department of Conservation for their island weed management programs.

### Introduction

Lord Howe Island (31°31'S, 159°04'E) lies 570 km off the east coast of Australia, 1350 km from New Zealand and 1250 km from New Caledonia. The flora of Lord Howe Island, on basalt derived and calcareous soils, is more closely related to New Zealand and New Caledonia than to Australia (Flora of Australia 1994). Almost half of the island's native flora is endemic (106 species) with five endemic genera.

The island also supports a large endemic fauna, with many species listed as endangered or vulnerable. Due to its outstanding natural phenomena and biodiversity values, the Lord Howe Island Group and surrounding marine areas was declared a World Heritage Area in 1982.

Chief threats to the island's biodiversity reflect the global pattern and consist of invasive alien plant species, feral animals, human disturbance, introduced pathogens such as *Phytophthora cinnamomi* and potential impacts from global warming, particularly with regard to the island's montane habitats. Additionally, there are constant threats of accidental or deliberate introduction of other exotic animals and plants such as the cane toad, crazy

ants and any number of highly invasive garden plants.

Except for rats and mice, all other feral mammals (cats, pigs and goats) have been successfully eradicated from 1980–1990s (though domestic dogs are permitted on the island), and a rat baiting control program has been operating on the island for 15 years. Under a new regional environmental plan for the island, further clearing of native vegetation is virtually prohibited, leaving invasive alien plants as a principal threat to the island's biodiversity.

The local management authority, the Lord Howe Island Board (LHI Board), has conducted weed control programs on an opportunistic basis over the past 10–15 years. In 2002, a Strategic Plan for Weed Management was developed. This represented the first attempt to develop a more time-bound and outcome-oriented approach to weed management on the island.

This paper outlines the current management approach targeting eradication, using three *Asparagus* species as a case study.

### Mapping

From 2002–3, detailed mapping was conducted over much of the island's Permanent Park Preserve to determine the density and distribution of noxious plants within the Preserve. The Preserve occupies 70% of the island and includes the cliff bound, 800 m high Mt. Gower and Mt. Lidgbird. The mapping was conducted using 100 m spaced transects with sample plots every 20 m along transect (Le Cussan 2002a, 2002b, 2003a, 2003b). The results were alarming with both densities and distribution of noxious weeds within the Preserve being far greater than had been expected. The following maps show the

density and distribution of ground asparagus (*Asparagus aethiopicus* L.), climbing asparagus (*Asparagus plumosus* Baker) and bridal creeper (*Asparagus asparagooides* (L.) Druce) on the island (Figures 1–3). Distribution of other noxious weed species such as cherry guava (*Psidium cattleianum* Sabine) and bitou bush (*Chrysanthemoides monilifera* (L.) Andrews ssp. *rotundata* (DC.) Norl.) extend much further into the rugged southern mountains.

The first herbarium records of ground and climbing asparagus on the island date from 1930, with bridal creeper recorded in 1962. As with all of the island's declared noxious plants, all three *Asparagus* species were introduced as garden plants. The principal disperser for all three *Asparagus* species is thought to be the Lord Howe Island silver eye *Zosterops lateralis* subsp. *tephropleura* Gould (Hutton personal communication). From the original plant(s) imported to the settlement area only 75 years ago, ground asparagus is now distributed (in patches) throughout 80% of the island. Climbing asparagus has spread less rapidly, having extended its distribution to the northern half of the island over the same period. Bridal creeper appears to be quite aggressive, having become distributed throughout the northern half of the island in a mere 40 years.

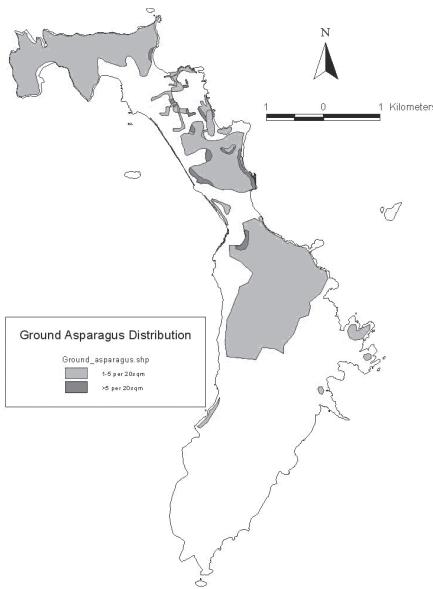
## Management

### Existing noxious weeds

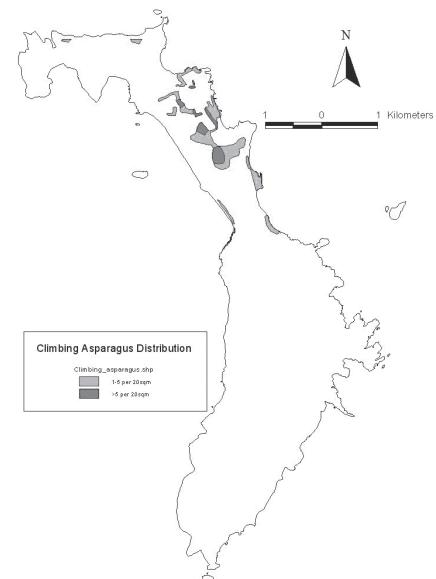
The management regime for noxious weed eradication adopted by the Lord Howe Island Board is adapted from programs developed by the New Zealand Department of Conservation (NZ DoC) for their island ecology management programs (West 1996, Ambrose 2005, Coulston 2002, Wotherspoon and Wotherspoon 2002). However, unlike many of the islands managed by NZ DoC, Lord Howe Island is inhabited, with a resident population of around 350 people. Land tenure consists of crown land designated (largely) as Reserve on the south and north of the island with perpetual lease or special lease making up the majority of the settlement area in the centre of the island.

The Lord Howe Island Board has responsibility for the management of all vacant crown land (around 80% of the island). As weeds are 'tenure blind', a management regime has also been developed for special and perpetual leases.

Property Management Plans are being developed for both special and perpetual leases in conjunction with the leaseholders. Special leases are renewed every 10 years, but they now have property management plans attached to the lease providing an opportunity for review of performance against lease conditions including weed management. Control or eradication on perpetual lease is much more dependent on leaseholder goodwill, but it is hoped



**Figure 1. Distribution of ground asparagus on Lord Howe Island.**

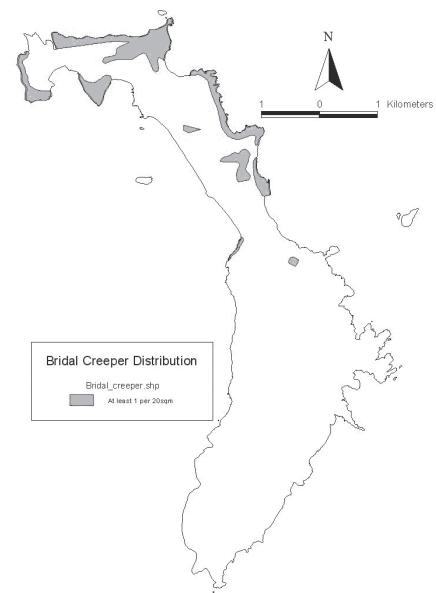


**Figure 2. Distribution of climbing asparagus on Lord Howe Island.**

that through an extensive consultative and cooperative approach, eradication of alien weed species on perpetual leases will also be achieved. Additionally, small landcare units are being created consisting of 4–6 neighbouring leaseholders who will work collectively (with assistance from the LHI Board) to control and eventually eradicate noxious weeds from their perpetual leases.

The survey, treatment and monitoring of weed infestations is managed by subdividing the whole island into small manageable work units or blocks up to eight hectares in area, which are permanently marked. Within the settlement area, tenure boundaries are used so that a block corresponds to a designated portion or lease. Each block is systematically grid searched. Effort and numbers of each size class (seedling, juvenile, mature) of each weed species treated are recorded and databased (in MS Access). Since it is most likely that newly propagated weed species will arise from previously infested areas, known infestations are also permanently marked within each block. These infestations (which may only consist of one mature plant in an otherwise intact area) are numbered, marked with flagging tape and recorded on a database. The progress of that particular infestation is tracked during each subsequent search with those results also databased. For example, an infestation may consist of:

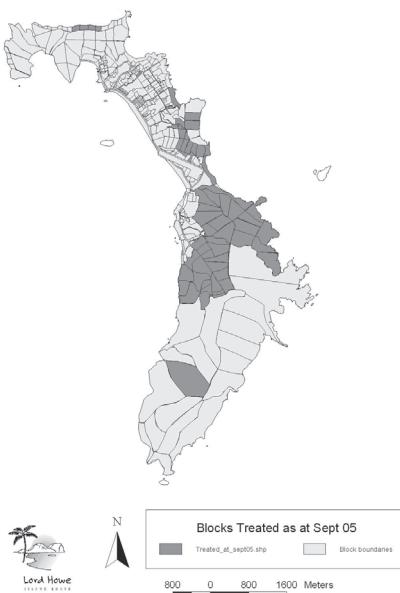
- Year One – three mature ground asparagus plants, five juvenile plants and 10 seedlings. The site is treated, permanently marked, GPS position recorded and numbers of treated plants databased.
- Year Two – three juvenile plants and 10 seedlings, treated.



**Figure 3. Distribution of bridal creeper on Lord Howe Island.**

- Year Three – eight seedlings, treated.
- Year Four – two seedlings, treated.
- Year Five – nothing found.
- Year Six – nothing found.
- Each subsequent search at this particular infestation will then likely reveal 'nothing found' indicating that this particular infestation in this block has been eradicated.

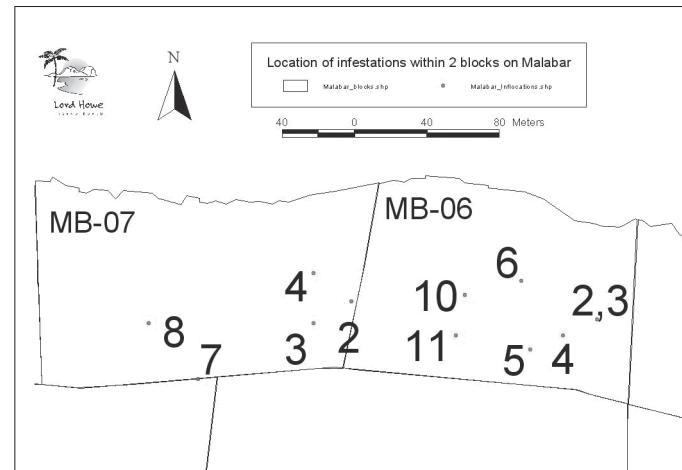
This procedure is repeated for all known infestations of all noxious weed species within each block. Where new searches reveal new infestations, these are marked as they are discovered. Using this system, follow-up searches are intensified in areas of previously known infestations, while at the same time monitoring for any new infestations (see Figures 4 and 5).



**Figure 4. Lord Howe Island divided into permanent blocks for weed searches and treatment. A portion (special lease or perpetual lease) in the settlement area constitutes a block. Dark-shaded blocks are those which have been searched and treated for all targeted noxious weeds (including the three *Asparagus* species) since November 2004. Over 400 000 individual weeds in total have been removed from these blocks.**

In areas where infestations are very dense, such as ground asparagus on the Malabar Range cliff blocks, individual infestations are not recorded at this stage. Once these infestations are reduced to occasional occurrences then they will be allocated a permanent infestation mark.

At this stage, while overall island infestation levels are very high, it is intended to treat every block at least once every two years. In more remote or rugged areas, a helicopter is used to search for and treat targeted noxious weeds (by aerial spraying or winch access). As the overall weed population on the island decreases, the time taken to treat weeds within each block should decrease, and all blocks would then be searched annually. The NZ DoC database records over the past eight years for Raoul Island in the Kermadec Group, reveal dramatic consistent downward trends in populations of all targeted weed species (Ambrose 2005). This can only be achieved through a consistent, long term and committed approach. The aim is to remove all mature fruiting plants first, leaving the remaining population consisting of only non-reproducing juveniles and seedlings and eventually, of only those plants emerging from the soil seed bank.



**Figure 5. Location of infestations within Blocks 6 and 7 on Malabar, mapped using GPS. Infestations include bitou bush, African boxthorn (*Lycium ferocissimum* Miers), lantana (*Lantana camara* L.), and cherry guava.**

During the first sweep of the blocks, all observed mature plants and all sub-mature plants that are likely to reach reproductive maturity within two years are removed. Through continuously searching and treating these blocks, the soil seed bank will eventually be exhausted. This is obviously a long-term program, with commitment required for longer than the generously estimated duration of seed viability, since some mature plants will be missed in the early searches of the blocks. Nonetheless, consistent biennial and then annual effort will eventually lead to eradication. Figure 5 shows the island sub-divided into its smaller manageable block units. Figure 5 details some blocks with their weed infestation locations. Note that infestation locations for the two blocks shown on Malabar in Figure 5 relate to species other than asparagus, as the density and distribution of ground asparagus and bridal creeper in these blocks is too great to allocate individual infestation markers.

#### Quarantine

In general, there is little awareness of the importance of quarantine measures for the island, particularly with regard to plant importation. Until very recently, hundreds of plant species were imported without consideration of their weed potential, despite a long-standing provision in the *Lord Howe Island Act, 1953* stating that 'A person must not, except in accordance with the approval of the Board, bring onto the Island any... seed or plant or any part of any ... seed or plant'. This situation has now been addressed under a new Plant Importation Policy, where all proposed plant imports must undergo a weed risk assessment, the same as that currently used by the Australian Quarantine and Inspection Service. This does represent a major cultural shift from previous practices, and it will take time to achieve a high level of compliance, but it is significant progress. Considerable

effort is now being undertaken by the LHI Board and the Marine Parks Authority, to ensure adequate bio-security for the island and its surrounding marine environment.

#### Early detection

A large number of alien species were introduced with settlement soon after the 1830s. Alien plant introductions since that time have accelerated dramatically (Pickard 1984, Hutton and Le Cussan 2001). The approximately 500 alien plant species on the island now far outnumber native species, with over 250 species now naturalized. An inventory of garden plants has commenced on all leasehold property on the island to determine the exact flora on the island at the present time. All records are specimen-backed and held with the Queensland Herbarium and the Lord Howe Island Regional Herbarium. Already the inventory is revealing the presence of many species that are on the list of Australia's worst invasive or potentially invasive garden plants (Groves *et al.* 2005). The systematic search program developed across the island allows for consistent treatment of noxious weeds already present, but also allows for early detection of new invaders when they 'jump the garden fence'. Meanwhile new quarantine measures should prevent the import of further invasive alien plants, and the garden inventory will facilitate targeted monitoring of latent invaders.

#### Community awareness

It will be difficult to achieve eradication of noxious weed species on the island without community support. This support depends on a wide understanding of the potential impact of weeds. Presently, few among the Lord Howe Island community fully comprehend the seriousness of the problem, with many prepared to forfeit natural assemblages for 'colour' in the garden.

Invasive alien plants have the potential to cause species extinction (Loope 2004, Loope *et al.* 2004, Smith 1985). Additionally, they can have severe impact on the local island economy. Currently the island attracts 13 000 visitors annually, who provide the main source of revenue for local residents. Visitors are attracted by the island's World Heritage status, however, if the natural values of the island are significantly degraded by invasive alien species visitors may choose other 'higher quality' destinations.

Alien plant invasions generally follow a pattern of initial latency followed by explosive expansion as pollination and dispersal passes a critical threshold (Hobbs and Humphries 1994). This may explain why few of the high-risk weeds currently in gardens cause concern among residents.

It is important to ensure that the community has a higher awareness of these issues, as biodiversity loss directly affects livelihoods, and has a major impact on their future generations. Only when appropriately informed can the community choose its course, fully aware of the consequences.

Several programs are now in place to raise community awareness. These include:

- quarantine workshops and training for key personnel;
- development of property management plans and small landcare units;
- school programs developed by the Co-operative Research Centre for Weed Management;
- School activities such as 'Weedbuster Week';
- provision of a broader range of native plants for home gardens;
- provision of a range of published materials, herbicides and advice on noxious weed management; and
- development of a botanic garden (showcasing the island's flora) and a weed garden (showcasing all the island's noxious and major environmental weeds and describing their impacts).

It is hoped that these and other measures will eventually engender sufficient awareness to encourage the community to accept responsibility for quarantine matters generally and weed management specifically.

### Volunteers

The LHI Board realizes the valuable contribution volunteers can make to the overall weed eradication program. The Board's volunteer program has been greatly expanded since 2004 and extended programs now run for 8–10 week periods with up to five programs offered throughout the year. These programs target younger volunteers. The LHI Board has joined with the Southern Cross University where the island's conservation volunteer programs are offered as part of the university's internship program. Lord Howe Island is an attractive destination, and the volunteer program is heavily subscribed. It is intended that volunteers will provide up to 60% total search hours currently provided by salaried staff (an increase of 6080 hours per year). Additionally, the Friends of Lord Howe Island offer several one-week programs each year, where six groups of up to 20 people per group contribute four hours each morning to weeding activities primarily targeting the three *Asparagus* species on Transit Hill. This program is better suited to older volunteers.

### Management of asparagus weeds

Treatment methods for all asparagus weeds on the island is predominantly by hand digging with removal of the underground rhizomes. Where access is more readily available, foliar spray is used (20 mL L<sup>-1</sup> glyphosate (360 g L<sup>-1</sup>) + 0.1 g L<sup>-1</sup> Brush-Off + 5 mL L<sup>-1</sup> LI700 surfactant). In remote and/or difficult to access areas, a helicopter will be used to either access or treat infestations (by aerial spraying). Dense towers of climbing asparagus are treated by cutting the cane about 15 cm above ground height, scraping the stems and dripping or spraying 100% glyphosate. In addition, the bridal creeper rust fungus (*Puccinia myrsiphylli* (Thuem.) Wint.) was released at three locations in close vicinity on the Malabar Range in winter 2002 and is now spread across the range of bridal creeper distribution.

Severely rust-infected bridal creeper plants are not removed at this stage, while seemingly uninfected plants are removed by hand. Rust infected bridal creeper plants will be targeted once the mature populations of ground and climbing asparagus and uninfected bridal creeper are removed.

Figure 4 shows the blocks that have been treated for *Asparagus* species since

the eradication program began in November 2004. Over this period however, effort has been focused on cherry guava and bitou bush, with the removal of almost 250 000 guava plants alone. The overall time taken for searching and treatment was 9361.5 hours. Effort largely results from salaried staff, however, volunteer effort is also included. Asparagus plants have been treated as they have been encountered, on a secondary basis. The areas of major asparagus infestation include the settlement areas, Transit Hill and the Northern Hills, which have not yet been targeted. Table 1 shows the results of total numbers of plants killed of each *Asparagus* species in each size class and total weight of rhizome removed.

### Discussion

This new eradication program evolved from several simultaneous events. Firstly, in 2004 the NSW Government Environmental Trust Grant injected more than \$1 million over three years dedicated to weed management on the island. This will hopefully spearhead continued funding to secure the eradication program over a longer time frame. Secondly, all special leases on the island expired on 30 December 2004, allowing for renewal conditions to include the provisions for property management plans. Thirdly, quarantine issues reached new levels of awareness on the island as populations of cane toads and crazy ants were detected at the shipping terminal at Yamba, on the NSW coast, in 2004. This terminal loads the 300 tonne ship that services the island fortnightly. Additionally, a feasibility study was conducted to determine the possibility and the implications of eradication of rats and mice from the island (it was found to be feasible). Part of the study identified the need for strict quarantine measures to be in place before embarking on a rat eradication program, hence the development of the Quarantine Strategy. Fourthly, in 2004 the author was awarded a Churchill Fellowship to investigate weed management practices in four other Indo-Pacific islands. The island programs developed by the NZ DoC were clearly the most effective so the new program developed for Lord Howe Island largely reflects that witnessed on Raoul Island in the Kermadecs. In addition, it was very apparent from the other island ecosystems observed, that if immediate dramatic steps were not taken

**Table 1. Results of *Asparagus* weeds treated since November 2004.**

Species	Seedlings/juveniles (no.)	Mature (no.)	Total (no.)	Rhizomes dug (kg FW)
<i>A. aethiopicus</i>	46280	5259	51539	581
<i>A. asparagooides</i>	4887	2009	6896	8
<i>A. plumosus</i>	3334	1562	4896	56.5
All <i>Asparagus</i> species	54501	8830	63331	645.5

on Lord Howe Island, the opportunity for eradication of its noxious weeds may well be totally lost. Lord Howe Island would then be 'condemned' to a losing battle, essentially an on-going costly but futile program of trying to control an ever expanding weed population and declining biodiversity.

In essence, the program will run for a minimum of 15 years. All latent weeds will be detected and removed in their early phase of invasion. Fifteen of the island's 17 declared noxious weed species are targeted for eradication; Madeira vine (*Anredera cordifolia* (Ten.) Steenis), Simon bamboo (*Arundinaria simonii* (Carrère) Rivière & C.Rivière), Giant reed (*Arundo donax* L.), ground asparagus, climbing asparagus, bridal creeper, bitou bush, glory lily (*Gloriosa superba* L.), lantana, African boxthorn, ochna (*Ochna serrulata* (Hochst.) Walp.), pittosporum (*Pittosporum undulatum* Vent.), cherry guava, castor oil plant (*Ricinus communis* L.), and rhus (*Toxicodendron succedanea* (L.) Kuntze). The two other listed noxious weeds, Taiwan lily (*Lilium formosanum* Wallace) and Crofton weed (*Ageratina adenophora* (Spreng.) R.M.King & H.Rob.) are so widespread and numerous, including in totally inaccessible areas, that eradication is not planned for these species at this stage. The three *Asparagus* species, gloria lily, bitou bush and cherry guava present the biggest challenge to the eradication program, due to a combination of some or all of the following factors: their large numbers and wide distribution, difficulty of access, difficulty to kill and long seed viability. Figure 4 shows the blocks treated over an 11 month period, representing around 25% of the island's total area. Over 400 000 weeds were removed from this area, over 9361.5 hours, at a cost of \$521 149.00. Based on this experience, it is estimated that primary treatment through the remainder of the island will take a further three years at a cost of around \$1.6 million. It is planned that much of this cost will be defrayed with the use of volunteer labour. Treated areas will require follow-up work in the interim, as no treated area can remain untreated for longer than a two year period. It is estimated that time for re-treatment of areas marked in Figure 4 would be reduced by 40% with a concomitant reduction in costs for treatment (\$312 689 for second search). Costs for the program will be around \$500 000 each year for the next three years, but then costs should reduce each subsequent year as the 'heavy' work in removing the bulk of the mature plants will be replaced by simply removing seedlings, juveniles and the few remaining mature plants. The baseline funding to continue searches across the island once the majority of weeds have been removed is estimated to be around \$250 000–300 000 per year.

Successful resolution of the noxious weed problem on Lord Howe Island faces two major challenges. Firstly, the LHI Board will need to continue to raise community awareness of the threats that weeds pose to its cultural and economic future, through implementation of innovative programs. Successful weed eradication will require cooperation from every landowner and an acceptance of the costs by every resident. Through the LHI Board's leadership and provision of robust advice to the community on the realities of the weed threat in an easily understood format, the community can develop an appropriate understanding as the basis for future support. When an informed community supports a progressive policy developed cooperatively by their Board, a long term and funded commitment can be made and sustained. Secondly, the Board also needs to provide leadership in formulation of a practical and defensible approach to weed management with a worthy and achievable endpoint that encourages confidence, by refocussing away from the past practice of endless and diffuse 'control' activities.

The LHI Board has been successful in maintaining a long-term recovery and monitoring program for the endangered woodhen, *Tricholimnas sylvestris*. Similar commitment is required for the noxious weed eradication program. There are several mechanisms under the *Lord Howe Island Act, 1953* and the *Noxious Weeds Act (NSW), 1993* to enforce compliance amongst leaseholders. However, it is hoped that these measures will not be necessary, and that compliance will result through cooperation and understanding.

The program is in its infancy, but all of the major components have been established or will be finalized shortly. If successful, this model could be adapted for use on other settled, small islands and on the mainland – within national parks and/or in discrete catchment areas.

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