

Executive Summary

1.1 Introduction

The Lord Howe Woodhen (*Gallirallus sylvestris* Sclater 1869) is a flightless bird endemic to Lord Howe Island. This species is listed as Endangered under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is protected under the *Lord Howe Island Act 1953*.

1.2 Legislative context

This recovery plan has been prepared in accordance with the provisions of the TSC Act. The TSC Act is the legislative framework in NSW to protect and encourage the recovery of threatened species, populations and communities. Under the TSC Act, the Director-General of National Parks and Wildlife is responsible for the preparation of recovery plans.

The EPBC Act requires the Commonwealth Minister of the Environment to ensure the preparation of a recovery plan for nationally listed species and communities or adopt plans prepared by others including those developed by State agencies. It is the intention of the Director-General of National Parks and Wildlife to forward the final version of this recovery plan to the Commonwealth Minister of the Environment for consideration for adoption, once it has been approved by the NSW Minister for the Environment.

1.3 Preparation of Plan

This recovery plan has been prepared with the assistance of a number of people from the LHIB, National Parks and Wildlife Service and Taronga Park Zoo as well as local residents of Lord Howe Island. The information in this recovery plan was accurate to the best of the NPWS's knowledge on the date that it was approved.

Following adoption of the recovery plan by the Minister copies of all submissions will be available for public inspection.

1.4 Current Species Status

The Lord Howe Woodhen is listed on Schedule 1 (Part 1) of the TSC Act as an Endangered species. It is listed as Vulnerable on Schedule 1 (Part 2) of the EPBC Act. The IUCN – World Conservation Union – has identified the Lord Howe Woodhen as Endangered (Baillie and Groombridge 1996).

Prior to the start of a rehabilitation program in the 1970s, the population was estimated at 30 individuals. As a result of this program, one of the most successful ever implemented for any bird species, the wild population increased between 1980 and 1985 by over 100 to 140 individuals in at least three geographically discrete populations. In the April 2002 monitoring survey, 127 individuals were counted, not including the Little Slope site, which was not surveyed due to weather conditions.

1.5 Recovery Objectives

This recovery plan is framed within the following recovery objectives:

- to maintain and where possible, increase the population of wild Woodhens on Lord Howe Island;
- to establish a Lord Howe Island recovery team to co-ordinate the implementation and ongoing review of the recovery plan;
- to involve the Lord Howe Island community in monitoring, management, habitat rehabilitation and threat abatement;
- develop a plan for establishing and resourcing an on-island captive breeding facility in the event of a substantial reduction in Woodhen numbers; and
- to establish captive populations at sites other than Lord Howe Island as insurance against catastrophe affecting the wild population.

1.6 Recovery Criteria

Achievement of the recovery objectives will be measured against the following recovery criteria:

- regular monitoring shows that numbers of Woodhens are stable or increasing;

- a recovery team is established which ensures the plan is implemented and reviewed;
- the carrying capacity of the Island for Woodhens and the critical number of Woodhens to trigger an on-island captive breeding program will be determined within six months through analysis of habitat availability and monitoring data;
- a contingency plan for on-island captive breeding is developed within eighteen months and implemented in the event of a substantial reduction in Woodhen numbers;
- captive colonies are established elsewhere as insurance against catastrophe (eg. disease, cyclone, predation) on Lord Howe Island; and
- successful establishment of broader community involvement in monitoring and management.

1.7 Recovery Actions

Recovery actions will be directed towards:

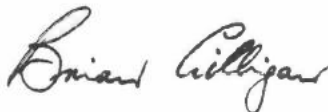
- maintaining and increasing current population levels;
- protecting existing habitats;
- controlling threatening processes;
- monitoring population levels precisely;
- establishing and activating a recovery team;
- establishing captive populations off Lord Howe Island, as insurance against catastrophic decline; and
- developing a plan for establishing an on-island captive breeding facility and implementation of the plan in the event of a substantial reduction in Woodhen numbers.

1.8 Biodiversity Benefits

The effectiveness of management efforts to rehabilitate the Lord Howe Woodhen since the 1970s is an indication of the extent to which some of the more widespread indirect impacts of human settlement on Lord Howe Island have been controlled. In this respect, the Woodhen is an indicator species for the good environmental management of the island's terrestrial ecosystems and an icon for conservation of the island and its wildlife.

The Woodhen is one of a suite of species endemic to the Lord Howe Island Group. The high level of endemism in this island group was one of the principal reasons for its World Heritage listing in 1982. Australia has an international obligation under the World Heritage Convention to protect and conserve the World Heritage values of the Lord Howe Island Group, including the Lord Howe Woodhen.

The implementation of this recovery plan will consolidate and extend these significant biodiversity benefits.



DIRECTOR-GENERAL



MINISTER FOR THE ENVIRONMENT

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- Peter Evans, Acting Manager, Lord Howe Island Board.
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Local residents:

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- Christine Skeggs,
- Des Thompson,
- Rodney Thompson.

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Acronyms Used in this Document

AQUIS	Australian Quarantine and Inspection Service
ARAZPA	Australian Regional Association of Zoological Parks and Aquaria
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESD	Ecologically Sustainable Development
IUCN	International Union for the Conservation of Nature
LEP	Local Environmental Plan
LHIB	Lord Howe Island Board
NPW Act	NSW <i>National Parks and Wildlife Act 1974</i>
NPWS	NSW National Parks and Wildlife Service

1 Current Conservation Status

The Lord Howe Woodhen (*Gallirallus sylvestris*, Sclater 1869) is listed on Schedule 1 (Part 1) of the *Threatened Species Conservation Act 1995* (TSC Act) as an Endangered Species. It is listed as Vulnerable on Schedule 1 (Part 2) of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The species is classified as Endangered by the IUCN (Baillie and Groombridge 1996). The Lord Howe Woodhen is endemic to Lord Howe Island, a part of NSW located about 700 km north-east of Sydney in the south-west Pacific Ocean. Originally described as 'common' in the early 1800s, the number of Woodhen had declined to 37 by the late 1970s, restricted to the high plateau of Mount Gower in the southern mountains of the island (Miller and Kingston 1980). This decline heightened concern for the species' future and prompted the implementation of a rehabilitation program. This program included the elimination of feral Pigs (*Sus scrofa*) from Lord Howe Island and a very productive captive breeding and release program for the Woodhen. As a result of this program, one of the most successful ever implemented for any bird species, the wild population increased between 1980 and 1985 by over 100 to 140 individuals in at least three geographically discrete populations. In April 2002 monitoring survey, 127 individuals were counted, not including the Little Slope site which was not surveyed due to weather conditions (see Section 3.2).

2 Description

The Lord Howe Woodhen was formally described by Sclater as *Ocydromus sylvestris* (*Proc. zool. Soc. Lond.* 1869: 472). It is a medium-sized, flightless rail that inhabits the forest floor on Lord Howe Island. It has a body length of 30 to 40 cm (males 34 to 42 cm; females 32 to 37 cm) (Fullagar 1985). Adults weigh between 450 and 500 grams; males are typically 15% heavier than females and lowland birds 25% heavier than those on Mount Gower (R. Harden, NPWS, pers. comm.). It is generally dull olive brown with paler markings around the face (including grey flecks in birds > 7 yrs old). The primaries and secondaries (flight feathers) are bright chestnut with fine black barring. The Woodhen's pinkish-grey bill is slender, down-curved and slightly shorter or the same length as the head. Its legs are thick, with a pinkish grey-brown tarsus between 40 and 57 mm long (Marchant and Higgins 1993).

3 Distribution and Abundance

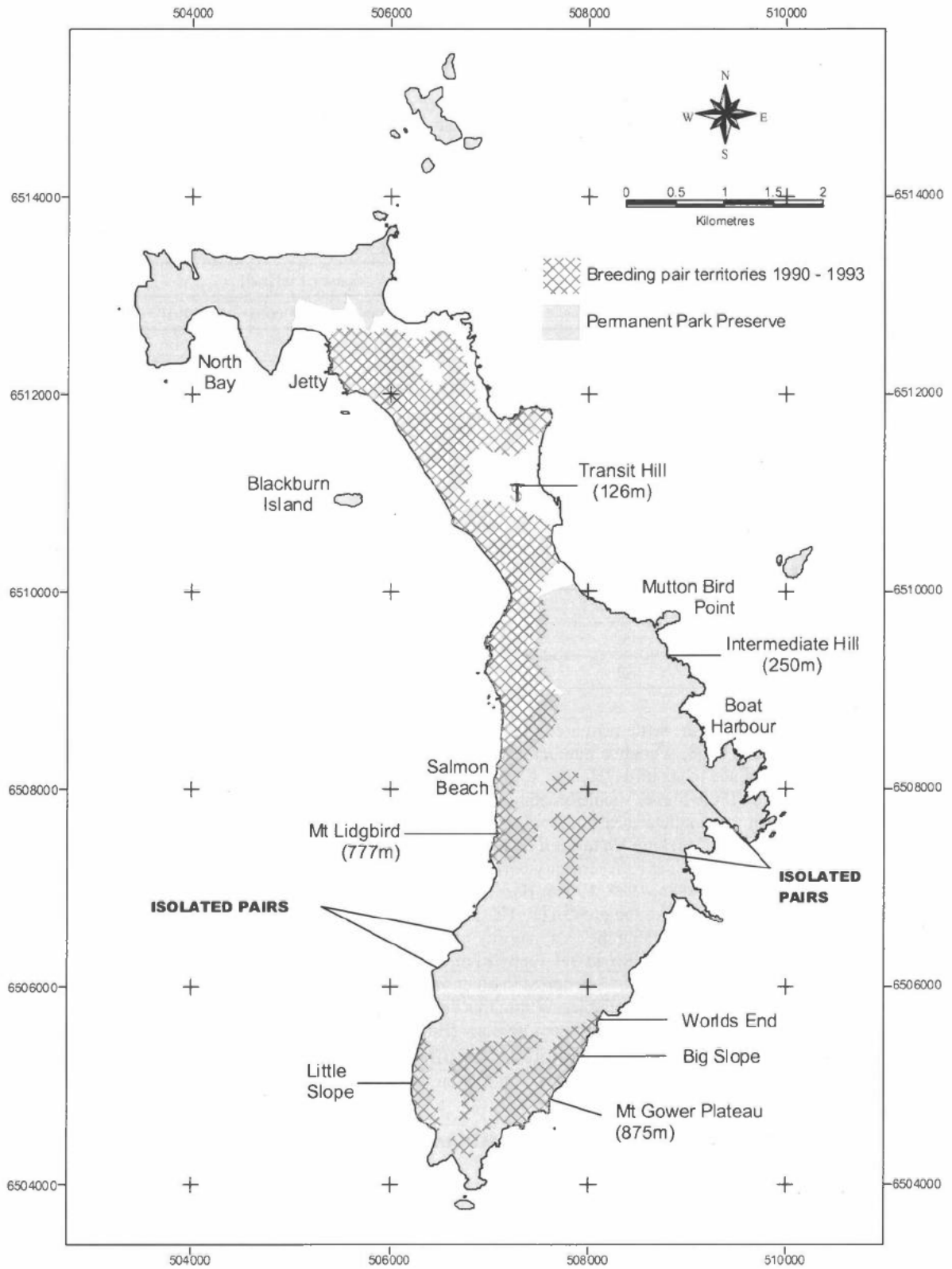
3.1 Historical Distribution and Abundance

The Lord Howe Woodhen occurs only on Lord Howe Island (see Figure 1). It was discovered in 1788 and observed on subsequent visits by mariners who described it as common. It appears always to have been confined to the mainland of the island and there are no records of it on the offshore islands, which lack forest (Fullagar 1985).

The island was settled in 1833-34, at which time the Woodhen was still reported as quite common (Lourie-Fraser 1985). By 1853, however, the species had become almost restricted to the higher and more isolated southern parts of the island (the southern mountains), with a few persisting in lowland areas until the end of the 1930s (Miller and Kingston 1980, Fullagar 1985, Lourie-Fraser 1985).

A bird collector named R. Bell resided on Lord Howe Island just before World War 1. From his shooting records, it was clear that the Woodhen occurred throughout the southern mountains, both in the lower and upper areas (Miller and Kingston 1980). Bell recorded particularly high densities at Little Slope on the south-western part of the island. At the same time, he described population densities on the small (25 ha) plateau on Mount Gower as comparatively low, suggesting that this area was possibly marginal habitat for the species (Miller and Kingston 1980).

Figure 1. Known distribution of Lord Howe Woodhen.



By 1940, the species was confined to the upper regions of Mounts Lidgbird and Gower and three isolated pockets on the south-eastern flank of Mount Gower. By the 1970s, most individuals occurred on the Mount Gower plateau, above the cliff line. There is a single record of a Woodhen from the Transit Hill area (Miller and Mullette 1985). The reasons for the contraction in range are discussed in Section 8 of this plan.

Since 1940 the distributions of Woodhens and feral Pigs have mostly been mutually exclusive. It is probable that Pig predation on nesting Woodhens, as well as habitat disturbance and modification from Pig feeding activities, contributed significantly to the disappearance of birds from areas inhabited by Pigs (Miller and Mullette 1985) (see Section 8).

Between 1978 and 1983, Pigs were eliminated from the island and a captive breeding program for the Woodhen was producing birds for release into the wild (see Section 9). The release sites of the captive-bred birds are shown in Table 1.

Table 1: Release dates, numbers and areas of captive bred and relocated Lord Howe Woodhens.

DATE	NO. OF BIRDS	RELEASE AREAS
May 1981	4	Little Slope (S.W. coast of island)
Nov 1981	1	Kings (Salmon Beach on W coast of island)*
Dec 1981	3	Little Slope
Feb 1982	7	Little Slope
Jun 1982	8	Little Slope
Jan 1983	17	Erskine Valley (btw Mts Lidgbird and Gower)
Feb 1983	7	Erskine Valley
June 1983	12	Erskine Valley
Nov 1983	7	“Goat House” (E. of Mt Lidgbird)
Nov 1983	3	Boat Harbour (N.E. of Mt Lidgbird)
Dec 1983	8	Boat Harbour
Mar 1984	5	Boat Harbour
TOTAL	82	

(Source: Fullagar 1985)

* only bird released in the settlement area.

Between 1982 and 1988, Woodhen numbers on Little Slope increased to an estimated 28 birds (1986-88), but by 1989 had declined to six birds (Harden 1990a, see Sections 4 and 8). Surveys conducted in 2001 recorded 13 individuals on Little Slope. Viable breeding populations had established themselves patchily through much of the settlement area in the central and northern lowlands of the island (Harden 1986).

Post release surveys of Erskine Valley and on the east side of Mt Lidgbird showed that the captive released populations did not persist at either locality between 1985 and 1989, and only a handful of birds were recorded in those areas (Harden 1986, 1987, 1990b; Harden and Robertshaw 1988, 1989). A small number of isolated pairs persists in these areas to the present (R. Harden, NPWS, pers. comm., D. Hiscox, LHIB, pers. comm.). By 1989, it became apparent that the vast majority of territories of released captive bred birds in the lowlands were located in Megaphyllous Broad Sclerophyll Forest (*sensu* Pickard 1983), particularly the Kentia Palm (*Howea forsteriana*) association. Territories in other settings have been associated with residences where supplementary food has been available. Within this vegetation type, most territories occurred on or immediately downslope of areas of igneous geology (Harden and Robertshaw 1988, 1989). Similar vegetation with calcarenite geology was unoccupied. Despite the high fecundity of the species and its ability to colonise suitable new areas subsequent to rehabilitation, birds have not colonised such vegetation on other geology to the same degree.

3.2 Current Distribution and Abundance

The total number of birds on the island has not increased significantly since the initial captive release program (1981 – 1983) and associated rapid breeding and spread of released birds (1981 – 1985). This suggests that, at least in the lowlands, the population of Woodhen may have reached carrying capacity, as suggested a decade earlier by Harden and Robertshaw (1988).

The total population can be estimated by adding 20-30 birds (10 pairs), to account for areas not surveyed (R. Harden, NPWS, pers. comm.). On this basis, the total population estimate in 1997 was 220-230 individuals and 71-74 breeding pairs. These were distributed approximately as follows:

- c. 70 birds in the settlement area;
- c. 65 birds on Mount Gower summit;
- c. 30 birds on Far Flats;
- c. 15 birds at Grey Face;
- c. 10 birds at Little Slope; and
- c. 20-30 estimated total on the summit and east side of Mount Lidgbird, Thatch Pocket, Little Pocket and Big Pocket on Mount Gower.

The November 1998 survey counted 160 individuals and 44-50 breeding pairs. However, this was considered to be an underestimate as the weather was the most unfavourable of any survey since 1985, and the seas too rough to allow access to Little Slope. Counts recorded for surveys conducted since November 1999 are presented in Table 2. The Lord Howe Island Board (LHIB) staff has conducted the surveys since 1999 (Harden in prep.) and some adjustment in survey results may initially have occurred due to changes in survey personnel.

Table 2: Woodhens counted during surveys 1999-2002

Location	Nov. 1999	April 2000	Nov. 2000	April 2001	Nov. 2001	April 2002
Settlement	64	48	35	32	48	41
Far Flats	28	34	25	19	15	22
Grey Face	27	15	14	12	22	15
Boat Harbour	0	0	0	3	2	2
Little Slope	6	no survey	9	13	13	no survey
Erskine Valley	3	2	2	4	3	2
Mt. Gower	47	47	51	34*	46	45
Total	175	146	136	117	149	127

*Survey undertaken after Providence Petrels (*Pterodroma solandri*) had arrived making it difficult to hear and locate Woodhens.

#Add 20-30 to total for population estimate as per 1997 estimate.

There has been concern over the apparent lower numbers counted in the April 2001 survey. The drop in numbers appeared to be located primarily in the settlement, Far Flats and Mt Gower. Supplementary feeding of Woodhens at some locations within the settlement has ceased and this may have contributed to the lower numbers of birds in the settlement and Far Flats. In addition, the Providence Petrels had arrived on the top of Mt Gower prior to the survey and the noise generated by the birds impacted on the survey teams ability to locate and record Woodhens. The November 2002 and April 2002 surveys indicate that the numbers on Mt Gower appear relatively stable. Similarly numbers within the settlement have increased since April 2001. Of particular interest is the reappearance of Woodhens at Boat Harbour in April 2001. A database for managing the Woodhen survey data has been developed and will be managed by the LHIB. The database will assist in analysing trends in the survey data and assessing the status of the Woodhen population.

4 Ecology

4.1 Feeding Ecology

The Lord Howe Woodhen forages from the ground during the day and occasionally at night (Marchant and Higgins 1993). It moves slowly across the forest floor, using its bill to sift among fallen leaves and rotting timber for arthropods and for digging in the underlying soil for earthworms (Marchant and Higgins 1993). It has not been recorded using its feet to scratch (Miller and Mullette 1985).

Miller and Mullette (1985) investigated the foraging behaviour and diet of the Woodhen. Some 52.2% of foraging actions involved digging with the bill in the soil, which usually resulted in the capture of earthworms from depths as great as 10 cm. When feeding like this, individual Woodhens often worked a small area (0.5 sq. m) for up to 30 minutes. Some 30.7% of foraging actions involved sweeping the half open bill through the leaf litter and catching arthropods. When feeding, the Woodhen regularly moved quite large objects (eg. palm fronds) to expose earth or litter for foraging.

The vast majority of the Woodhen's diet (>80% by both frequency and weight) comprised earthworms (Miller and Mullette 1985). The same study found that white grubs (coleopteran and hemipteran larvae) were the second most consumed diet item. Informal observations have also been recorded of Woodhens taking flying cicadas, the blossoms of the green plum (*Randia stipulosa*), and occasionally lichen and fungi (Miller and Mullette 1985), as well as molluscs, spiders, millipedes, amphipods and isopods (Fullagar 1985, Marchant and Higgins 1993).

Woodhens readily scavenge food from walkers and residents (eg. butter, porridge, stew, biscuits, meat, chocolate and bread, Marchant and Higgins 1993). Their scavenging behaviour has included eating the flesh and insect larvae in dead Providence Petrels. Bester *et al.* (in prep) found that the greatest cause of Providence Petrel mortality was attributed to Woodhen predation. The Woodhen predation rate on Providence Petrels during 2000 was 14.7% (ie. 46 losses / 312 burrows with eggs). Woodhens took substantial numbers of petrel chicks, not only entering burrows to take them, but also by excavating small holes in the roof of the nest chamber through which to extract the chick below. However, the predation rate on eggs was much lower as the Woodhens would refrain from entering the burrows whilst the adult was in attendance. Woodhens took mostly those eggs that were abandoned and later pushed out of the burrow by rising floodwaters or by prospecting non-breeding birds.

It is likely that the Lord Howe Island Woodhen is not posing a threat to the long-term survival of this species at this stage, and that the Woodhen may depend upon Providence Petrel chicks when other food sources are in short supply.

Additionally the Woodhen has been observed to kill and eat introduced Rats and Mice (R. Harden, NPWS, pers. comm.).

In the settlement area, Woodhens often eat food provided for domestic poultry and are regularly observed breaking and eating chicken eggs. The Woodhen drinks fresh water from streams, pools and droplets on moss. It is significant that earthworms, the predominant item in the Woodhen's diet, were also found to be a major item in the diet of feral Pigs located on the island. Other potential food competitors in Woodhen habitat include the Buff-banded Rail (*Gallirallus philippensis*) and Purple Swamphen (*Porphyrio porphyrio*), numbers of which appear to have increased in the settlement area in the last five years (D. Hiscox, LHIB, pers. comm.). The self-introduced Blackbird (*Turdus merula*) and Song Thrush (*T. philomelos*) forage in similar habitat and in the same way as Woodhens and may compete with them in the settlement area, the only part of the island where these species co-occur regularly.

Studies were undertaken before the release to the wild of captive bred Woodhens to locate sites supporting good populations of soil invertebrates. The studies showed that densities of soil invertebrates were significantly higher in lowland forest than in the Woodhen's habitat on Mount Gower (Miller and Kingston 1980). Work by Miller and Mullette (1985) showed that lower altitude Woodhen territories (established after the rehabilitation of the species) showed a higher proportion of successfully breeding pairs and higher numbers of chicks fledged per pair. This may relate to the greater food resources available in lowland territories but also to the unoccupied space available for population expansion at that early stage in the species' rehabilitation.

4.2 Social Organisation

The Woodhen has been reported to be monogamous, usually pairing for life (Miller and Kingston 1980, Lourie-Fraser 1985). Observations of Woodhen pairs by Island residents indicate that birds will change partners (D. Hiscox, pers comm). If pairs split then one of them moves to fill a vacancy in an adjacent territory; seldom do they move any further (Miller and Mullette 1985). On Mount Gower in the late 1970s the population reached its lowest level of only three to four breeding pairs (Miller and Mullette 1985). Harden and Robertshaw (1988, 1989) analysed post rehabilitation banding records and found pairs were more stable in the southern mountain area of the island than in the settlement area. For example, between 1986 and 1988, in the former area, four of an original eight known pairs were still together, while in the latter area, only three of an original 16 pairs were still together. The reasons for pairs splitting are unknown.

Pairs defend an exclusive territory in which they forage and breed and, once established, rarely move further than 500 m (Harden 1986). Between 1978 and 1980, territories on Mount Gower averaged 2 to 3 ha (Lourie-Fraser 1985). Since rehabilitation, lowland territories are of the order of 1 to 4 ha (R. Harden, NPWS, pers. comm.).

Most commonly, Woodhens reproduce from August to January and continue raising young until April.

However, the start and finish dates of breeding can vary between years and there are breeding records for much of the year (Miller and Mullette 1985).

Woodhens construct a nest in a shallow depression on the ground, lined with dry grass and leaves, between 10 and 25 cm across and about 2.5 cm deep. It is located on the ground under dense ferny vegetation, or in the unused burrow of a Providence Petrel (Miller and Kingston 1980). One to four eggs are laid 24 to 36 hours apart and incubated by both parents for 20 – 23 days. The young are precocial and move from the nest within 2 days of hatching. Within the territory, the pair builds 3 or 4 nursery nests in which to brood young chicks at night. Both parents brood and feed the chicks, helped by young of the previous brood. Chicks fledge at 28

days of age and are approaching adult size after about 80 days. However, they are not fully grown until about 12 months old, after which time they can be sexed based on measurements.

The adults expel juvenile Woodhens from the parental territory in the winter months (Lourie-Fraser 1985) and at about four months of age (Marchant and Higgins 1993). The juveniles then move about until they either find a mate in an existing territory or establish a new territory with a mate (Harden and Robertshaw 1988).

They can breed at nine months of age (Marchant and Higgins 1993). Juveniles that do not establish in a territory by the next breeding season generally do not survive (Harden and Robertshaw 1988, 1989). Earlier hatched juveniles have a higher survival rate than later hatched birds and it has been postulated that the former may have a time and size advantage in establishing a territory (Harden and Robertshaw 1989).

Breeding success is greater in the lowlands than on Mount Gower and greater in the settlement area than in the southern mountains (Marchant and Higgins 1993, Harden and Robertshaw 1988, 1989). For example, between 1986 and 1990, lowland pairs produced between 2.9 and 3.6 young per year, while over the same period in the southern mountains (both lowland and mountain sites), pairs produced between 1.2 and 1.7 young per year. Conversely, between 1986 and 1995 the mean juvenile mortality in the first year was much lower on Mount Gower (41%) than southern mountains lowland sites (54%) and the settlement area (71%) (R. Harden, NPWS, pers. comm.). The reasons for these differences are not known. This relatively high avian rate of reproduction more than compensates for adult mortality but leads to a proportionally high rate of juvenile mortality in the first year (c. 60%) (Harden and Robertshaw, 1989). The high juvenile mortality rate is likely to be a consequence of their social organisation and possibly limited high quality habitat.

Some settlement residents regularly feed some Woodhen pairs residing in the vicinity of their houses.

Anecdotal evidence (D. Hiscox, LHIB, pers. comm.) suggests that it is these pairs that produce the most young in the Settlement area, even when they live in apparently sub-optimal habitat (e.g. garden vegetation on calcarenite). Feed provided for domestic poultry may also be an important source of food for the Woodhen within the Settlement area.

An unusual example of social organisation arose in 1981 – 82 as a result of a captive released female pairing with a wild male at the King's house near Salmon Beach (Miller and Mullette 1985). With supplementary feeding by the King's, the pair produced 16 chicks in 18 months and, within four years, had produced 36 chicks. Young from one brood assisted in the defence and feeding of chicks from subsequent broods and in the defence of the territory. This behaviour was never observed in the remnant population on Mount Gower where all available territories were occupied. The young from this exceptional pair almost certainly occupied the Far Flats and the settlement area. However, the original breeding pair died in 1995, which may have contributed to fewer Woodhens being recorded in the settlement.

5 Disturbance

The Lord Howe Woodhen is tolerant of a range of human activities and a significant proportion of the population (c. 40%) lives in the settlement area on the island. The Woodhen, like many island animals, is tame and, at times, inquisitive. This made it vulnerable in the early days to predation by humans and introduced predators such as Cats (Fullagar 1985) and Masked Owls.

Dogs are well managed on the island and incidents of Dogs taking Woodhens are rare. Feral Cats no longer exist and there is one domestic Cat remaining on the island, which is desexed. Importation of Cats to the island is prohibited.

A full account of the factors leading to the decline of the Woodhen is provided in Section 8.

6 Habitat

The Lord Howe Woodhen occurs predominantly in three vegetation types (*sensu* Pickard 1983):

- Gnarled Mossy-Forest;
- Megaphyllous Broad Sclerophyll Forest, particularly the *Kentia Palm* (*Howea forsteriana*) association, where it is growing on soils derived from igneous geology; and
- gardens around houses.

The first occurs on the summit plateau of Mount Gower and the summit ridge of Mount Lidgbird. The second occurs patchily through the settlement area, mid-slope on the northern face of Mount Lidgbird ('Grey Face'), and low on the eastern slopes of Mount Gower and the western flanks of both mountains. The third occurs in the settlement area (Harden and Robertshaw 1988, 1989).

The Woodhen is rarely found in the rainforest sub-formation of Closed Forest, the most widespread forest type on the island (Marchant and Higgins 1993).

In addition to these broad habitat types, the Woodhen has also been seen in areas of:

- forest bordering pasture and gardens (Marchant and Higgins 1993);

- pasture and reedy swamp (Fullagar 1985); and
- rubbish dump where they obtained supplementary food (Fullagar 1985) prior to upgrading of the disposal facility.

Only 10% of the island has been cleared and a further 10% disturbed by human activities. This leaves 80% of the indigenous vegetation on the island comparatively intact although subject to weed invasion, particularly at its margins (see Section 9). It is of interest that a disproportionate amount of the favoured lowland habitat occurs as remnants within the settlement area on the island. This has implications for management discussed in Sections 10 to 12.

7 Relevant Legislation

7.1 State, Commonwealth and International Listing

The Lord Howe Woodhen is listed as Endangered under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is protected under the *Lord Howe Island Act 1953*.

The TSC Act is the legislative framework in NSW to protect and encourage the recovery of threatened species, populations and communities. One of the consequences of listing as a threatened species on the TSC Act is that consideration must be given to the species in assessing the impacts of developments and activities with the aim of minimising adverse impacts. A licence under the TSC Act may be required if actions are likely to result in the harming of the species or damage to its habitat.

Animal Ethics approval and licences must also be obtained under the *National Parks and Wildlife Act 1974* to take, handle or keep the Lord Howe Woodhen for scientific purposes, for the welfare of the animal or if there is threat to life and property. Research on any flora and fauna on the island requires a permit under this act, Animal Ethics approval and the *Lord Howe Island Act 1953* (NSW) (LHI Act).

The LHI Act established the LHIB, which is charged with the care, control and management of the affairs and trade of the Island. The Permanent Park Preserve is established under s.19A of the LHI Act and is managed in accordance with a Plan of Management.

Additionally the Lord Howe Island Group is listed as a World Heritage site and therefore must be managed in accordance with the provisions of the EPBC Act.

7.2 Recovery Plan Preparation and Implementation

Recovery plan preparation

The TSC Act provides a legislative framework to protect and encourage the recovery of Endangered and Vulnerable species, Endangered Populations and Endangered Ecological Communities in NSW. Under this legislation the Director-General of National Parks and Wildlife has a responsibility to prepare recovery plans for all Endangered and Vulnerable species, Endangered Populations and Endangered Ecological Communities listed on the TSC Act schedules. Similarly, the EPBC Act requires the Commonwealth Minister for the Environment to ensure the preparation of a recovery plan for nationally listed species and communities or adopt plans prepared by others, including those developed by State agencies. Both Acts include specific requirements for the matters to be addressed by recovery plans and the administrative process for preparing recovery plans.

This recovery plan has been prepared to satisfy both the requirements of the TSC Act and the EPBC Act and therefore will be the only recovery plan for the species. It is the intention of the Director-General to forward this recovery plan to the Commonwealth Minister of the Environment for adoption, once it has been approved by the NSW Minister for the Environment.

Recovery plan implementation

The TSC Act requires that a public authority must take any appropriate measures available to implement actions included in a recovery plan for which they have agreed to be responsible. Public authorities and councils identified as responsible for the implementation of recovery plan actions are required by the TSC Act to report on measures taken to implement those actions.

In addition, the Act specifies that public authorities must not make decisions that are inconsistent with the provisions of the plan. The government agencies responsible for implementing this plan are the NSW National Parks and Wildlife Service (NPWS) and the LHIB.

The EPBC Act states that the Commonwealth must implement a recovery plan on those areas that apply to Commonwealth lands. There are no Commonwealth owned lands on Lord Howe Island.

The EPBC Act additionally specifies that a Commonwealth agency must not take any action that contravenes a recovery plan.

Many Woodhens occur on private leases in the settlement area of the island (there is no freehold title land on the island). Therefore, the implementation of this plan will depend significantly on a co-operative approach involving local leaseholders.

The attainment of the recovery plan objectives will be subject to available funding.

7.3 Critical Habitat

The TSC Act makes provision for the identification and declaration of Critical Habitat for species, populations and communities listed as Endangered. Once Critical Habitat is declared, it becomes an offence to damage Critical Habitat (unless the action is specifically exempted by the TSC Act). A Species Impact Statement (SIS) is mandatory for all developments and activities proposed within Critical Habitat, with the nature and extent of the SIS determined by the Director-General of National Parks and Wildlife. The declaration of Critical Habitat is not considered to be a priority for this species, as other mechanisms provide for its protection.

Under the EPBC Act, Critical Habitat may be registered for any nationally listed threatened species or ecological community. When adopting a recovery plan the Federal Minister for the Environment must consider whether to list habitat identified in the recovery plan as being critical to the survival of the species or ecological community. It is an offence under the EPBC Act for a person to knowingly take an action on a Commonwealth area that will significantly damage Critical Habitat (unless the EPBC Act specifically exempts the action). Although this offence only applies to a Commonwealth area, any action that is likely to have a significant impact on a listed species occurring within registered Critical Habitat on other areas is still subject to referral and approval under the EPBC Act. Proposed actions within registered Critical Habitat on non-Commonwealth areas are likely to receive additional scrutiny by the Commonwealth Minister.

This recovery plan identifies those habitat features and the location (sections 3.2 and 6) currently known to be critical to the survival of the Lord Howe Woodhen, as required by the EPBC Act.

7.4 Environmental Assessment

The TSC Act amendments to the environmental assessment provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act) require that consent and determining authorities in NSW consider threatened species and their habitats when exercising a decision-making function under Parts 4 & 5 of the EP&A Act. When considering any activity that may affect the Lord Howe Woodhen, these authorities should consider the conservation strategy outlined in this plan.

Where an activity or development that may impact upon Lord Howe Woodhen or its habitat is not subject to approval under the EP&A Act, an approval may nevertheless be required under the *Native Vegetation Conservation Act 1997* or the TSC Act. These approvals must also take the strategy in this plan into consideration.

Exceptions are where the proposed activity or development is classed as exempt or is undertaken in accordance with previously approved Regional Vegetation Management Plans or Property Management Plans.

The NSW NPWS is represented on the Regional Vegetation Management Committees that are responsible for the preparation of these plans and will seek appropriate identification and protection of relevant Lord Howe Woodhen habitat under them.

Development applications on Lord Howe Island are considered in accordance with the provisions of the EP&A Act and the Lord Howe Island Regional Environmental Plan 1986 (REP). The consent authority for the Island is the LHIB. Planning NSW is currently undertaking a review of the REP.

The following public authorities currently have a decision making function in relation to the Lord Howe Woodhen:

- The LHIB;
- Planning NSW;
- the NPWS; and
- the Commonwealth through its responsibilities to manage World Heritage properties and nationally listed threatened species and ecological communities under the EPBC Act.

Any other activity not requiring development consent under the EP&A Act, which is likely to harm the Lord Howe Woodhen or damage its habitat, requires a Section 91 licence from the NPWS under the provisions of the TSC Act. If the impact is likely to be significant, a Species Impact Statement is required.

The EPBC Act regulates actions that may result in a significant impact on nationally listed threatened species and ecological communities. It is an offence to undertake any such actions in areas under State or Territory jurisdiction, as well as on Commonwealth-owned areas, without obtaining prior approval from the Commonwealth Environment Minister. As the Lord Howe Woodhen is listed nationally under the EPBC Act, any person proposing to undertake actions likely to have a significant impact on this species should refer the action to the Commonwealth Minister for the Environment for consideration. The Minister will then decide whether the action requires EPBC Act approval.

Administrative guidelines are available from Environment Australia to assist proponents in determining whether their action is likely to have a significant impact. In cases where the action does not require EPBC Act approval, but will result in the death or injury of a Lord Howe Woodhen and the bird is in, or on, a Commonwealth area, a permit issued by the Commonwealth Minister under the EPBC Act, will be required. The Environment Minister can also delegate the role of assessment and approval to other Commonwealth Ministers under a Ministerial Declaration and to the States and Territories under bilateral agreements. The development of a bilateral agreement between NSW and the Commonwealth is not yet complete, but when in place will avoid the need for duplication of environmental assessment.

8 Management Issues

8.1 Threats and Reasons for Decline

The decline of the Lord Howe Woodhen started with the discovery of the island in 1788. Mariners visiting the island described the species as abundant and a good source of food (Miller and Kingston 1980, Miller and Mullette 1985, Fullagar 1985).

Observations reported in Miller and Kingston (1980) indicate that the Woodhen underwent its most dramatic decline between 1833 and 1853. The Australian Museum expedition in 1887 as reported the Woodhen as "soon to become extinct" (in Miller and Kingston 1980).

It is clear that by the end of the 19th century they were restricted to the area now known as Little Slope, the higher slopes of Mounts Lidgbird and Gower, and the Erskine Valley (Figure 1). The decline continued until about 1940, by which time the species was restricted to small populations on the tops of Mounts Lidgbird and Gower, and on the south-eastern flank of Mount Gower.

The introduction of exotic fauna is considered to be the principal reason for the decline of the Woodhen. Permanent settlement of the island in 1833-34 resulted in the release of Cats and Dogs. The reasons for the dramatic decline in Woodhens between settlement and 1853 were thought at the time to be the "ravages" of Cats and hunting by people for food (Miller and Kingston 1980). Table 3 summarises the history, status and impacts of key exotic species.

Table 3: Status of selected exotic fauna on Lord Howe Island and their impacts on the Lord Howe Woodhen. (Sources are provided in brackets).

EARLIEST DATE	STATUS	IMPACTS ON WOODHEN
PIGS		
1800 (Miller and Mullette 1985) before 1839 (Fullagar 1985)	Spread through all but the inaccessible areas of the island isolated by the sea and cliffs (eg. Mount Gower Plateau, Little Slope). Almost eradicated from 1979 - 85 (200 killed in this period). By 1985, one boar thought to remain on Mt Lidgbird. Pigs now considered to have been eradicated from the island.	<ul style="list-style-type: none"> • Eat Woodhens and their nest contents. • Eat earthworms so possible food competitor with Woodhen. • Disturb soil invertebrate communities. • Thin dense vegetation and arrest regeneration. • Cause erosion and downslope sedimentation and stream turbidity. • Probably responsible for the decline

		of the Woodhen in the southern part of the island.
GOATS		
before 1851 (Miller and Mullette 1985; Fullagar 1985)	Spread through all accessible parts of the island. Introduced to Big Slope around 1900 and to Little Slope in 1920s. Eradicated from Little Slope (300 animals) in 1955. In 1998, 150 – 200 were thought to occur in the southern mountains. In 1999, a goat control program was undertaken which reduced the known population to three. Follow up programs are required to achieve eradication.	<ul style="list-style-type: none"> • Thin dense vegetation and arrest regeneration. • Cause erosion and downslope sedimentation and stream turbidity. • Contribute to habitat modification by weeds through soil disturbance and dispersal of propagules.
CATS		
before 1845 (Miller and Mullette 1985; Fullagar 1985) c. 1837 (Miller and Kingston 1980)	Spread through much of island by 1850s. Probably not in high numbers in the wetter, southern and mountainous parts of the island. Cats probably not present at Little Slope after 1950. Cats are now banned from importation and one old, desexed domestic cat now remains. Feral Cats have been eradicated.	<ul style="list-style-type: none"> • Eat Woodhens. • Cat predation probably partly responsible for the initial disappearance of the Woodhen from the northern and central parts of the island in the early years of settlement. • Probably not responsible for the decline in the southern part of the island.
RATS		
1918 (Fullagar 1985)	<p>Came off shipwreck in 1918 and increased dramatically, spreading throughout island. In 1927, in response to a bounty, 13,771 rat tails were handed in. Numbers kept low through poisoning in settlement area and kentia palm seeding areas (eg. Little Slope). Numbers at higher densities on Mount Gower. Ongoing rat control programs (poisoning with warfarin) are in place.</p> <p>Predation by the Ship Rat (<i>Rattus rattus</i>) on Lord Howe Island was listed as a Key Threatening Process under the TSC Act in 2000.</p> <p>LHIB is considering a rodent eradication proposal.</p>	<ul style="list-style-type: none"> • Probably have had a limited effect on Woodhen. • Woodhen can kill Rats and defend themselves from attack. • Co-existed with Woodhens for many years on Mount Gower. • May predate eggs and small chicks. • Woodhens consuming rat bait may be poisoned. • A Threat Abatement Plan must be prepared for Ship Rats on Lord Howe Island. • The LHIB rodent eradication proposal would likely require Woodhens to be removed and held in captivity during the baiting program.

MASKED OWLS		
<p>1920-1930 (Fullagar and Disney 1975)</p>	<p>Masked Owls and Barn Owls introduced to control Rats, without success. Barn Owls thought to be extinct. Masked Owl persists today in most parts of the island but more commonly in the southern mountains (D. Hiscox, LHIB, pers. comm.).</p>	<ul style="list-style-type: none"> • Initially not thought to have caused decline. • Woodhens have been killed by owls and a captive bird was taken once from its enclosure. • Possibly implicated in the decline of the Woodhens on Little Slope. • Potentially a significant factor limiting population growth in some parts of the island. (D.Hiscox, LHIB, pers. comm.). • If Rats are eradicated, the potential threat to Woodhens is likely to increase.
HUMANS		
<p>first visited 1788 then settled permanently 1833-34 (Miller and Mullette 1985; Fullagar 1985)</p>	<p>Small community established in northern and central part of island. Current population 320 plus a maximum permissible 400 tourists at a time.</p>	<ul style="list-style-type: none"> • Human predation probably largely responsible for the initial disappearance of the Woodhen from the northern and central parts of the island in the early years of settlement. • Clearance of 10% and disturbance of further 10% of island's forests, some of which was Woodhen habitat. • Woodhens are occasionally run over by vehicles. • Woodhens consume rat bait (some types of which are lethal) in the settlement area. • Some members of the community protect Woodhens in their gardens and provide supplementary food to increase survival and breeding output.

The current and potential threats to the Woodhen population are discussed below.

- The species occurs only at Lord Howe Island and, as such, is vulnerable to disease or natural disaster.
- Introduced Masked Owls may be impacting on juvenile Woodhen survival rates (D. Hiscox, LHIB, pers. comm.).
- Increased rat control is likely to cause an increase in predation of Woodhens by Masked Owls (B. Harden, BRMD, pers comm.).
- A proposal is being considered by the LHIB to eradicate rodents from the island using aerial baiting and bait stations. A Risk Assessment Report is currently being prepared for the LHIB which will consider the potential impacts of the program on the Woodhens and other species and the mitigation measures required. The Woodhens are likely to be significantly at risk from the baits.

- In the settlement area, introduced Blackbirds and Song Thrushes, together with apparently increasing numbers of Buff-banded Rails and Purple Swamphens, may be competing with the Woodhen for food (D. Hiscox, LHIB, pers. comm.).
- The introduction to the island of additional exotic species (animal or plant) could threaten the species or the integrity of its habitat.
- Existing weed species may encroach into areas of key habitat and could threaten habitat integrity.
- Quarantine controls on the island are not well developed. There is a risk that a soil, plant or animal pathogen could reach the island and significantly affect the habitat, food or health of Woodhens.
- Loss of preferred habitat through clearing for agriculture or development.
- Consumption of rat bait by Woodhens.
- Impacts of domestic Dogs.
- Reduction in amount of supplementary feeding may affect populations numbers in the settlement.

The bulk of the population is descended from a very small number of captive-released birds derived from three pairs taken from the wild at Mount Gower. Inbreeding and a lack of genetic diversity may theoretically cause future inbreeding depression and associated problems (eg. decreased reproduction success or decreased resistance to disease). However, this is not considered a priority issue at this stage.

A population viability analysis (PVA) of the species using the VORTEX program by Brook *et al.* (1996) revealed that, in the absence of further changes or catastrophes, there was a 2% chance of the species going extinct in the coming 100 years. When the time frame was increased to 1,000 years, the probability of extinction rose significantly to 21%.

The impacts of a range of factors on the Woodhen's future survival were assessed using the model developed for the PVA. A 10% increase in mortality resulted in the Woodhen's demise within 100 years. Juvenile mortality was more important than adult mortality in raising extinction probability. Doubling the variance in fecundity (eg. due to climatic change) resulted in a lower population size but did not significantly increase the probability of extinction. Halving of carrying capacity quickly reduced population size, did not significantly affect the probability of extinction within 100 years but increased the probability of extinction within 1,000 years.

Harden and Robertshaw (1988) suggest that habitat availability may be limiting the expansion of the species on the lowlands. There is some evidence to support this proposal in that the Woodhens habitat preferences appear to be very narrow and most of the available habitat has existing territories within it. There has been little increase in numbers or range extension beyond these areas since their initial re-occupation after captive-release. If the preferred habitat on the island is fully occupied, this has implications for management (see Sections 10 – 12).

8.2 Social and Economic Consequences

The total cost of implementing the recovery actions will be \$476500 over the five year period covered by this plan. Responsibility for implementing the plan lies with the LHIB and the NSW National Parks and Wildlife Service. Some funds will be provided from existing resources within the NPWS and LHIB. The balance of the costs identified in Table 3 (\$452000) are unsecured. External funding options including State and Commonwealth Government funding will be investigated.

The Plan will be forwarded to the Commonwealth Minister for consideration for adoption, once it has been approved by the NSW Minister for the Environment.

Social Benefits

The Woodhen has been a focus for educating local, mainland and international communities about the unique and vulnerable environmental values of Lord Howe Island and about the conservation of Endangered Species. The local community has been very involved in Woodhen conservation. It participated in the captive breeding program and many residents have contributed to the successful re-establishment of birds in the settlement through supplementary feeding and protection of the birds on their properties.

Commercial Value

Ecotourism is a growing business activity in Australia. Lord Howe Island has particular values as an ecotourism destination. The Lord Howe Woodhen is one of a number of bird species for which the island is

famous among tourists with an interest in natural history. The Woodhen thus contributes to the image of the island as a high value ecotourism destination.

9 Scientific and Taxonomic Value

The genus *Gallirallus* has been the subject of much taxonomic review and currently contains sixteen extant and recently extinct species (Taylor, 1996). Various species are found between India, through Indonesia and New Guinea to the islands east of New Zealand. Many species have become flightless, particularly on Pacific Islands, and this has led to many suffering population declines after European settlement. The Lord Howe Woodhen has been in the past placed in the separate genus *Tricholimnas* with the Critically Endangered New Caledonian Rail (*G. lafresnayanus*) and the Gilbert Rail (*G. conditicius*). The latter is known from one specimen from Kiribati and has been considered by some as a juvenile specimen of *G. sylvestris* that has been mislabeled. The three volant species (Buff-banded *G. philippensis*, Barred *G. torquatus* and Slaty-breasted Rails *G. striatus*) are all widespread and common. However, many of the flightless species are of restricted range and are under threat. These include the Endangered Okinawa (*G. okinawae*), Near Threatened Roviana (*G. roviaanae*) and the poorly known New Britain (*G. insignis*) Rails from southern Japan, Solomon Islands and Papua New Guinea respectively. The Guam Rail (*G. owstoni*) is already extinct in the wild but a captive population remains. Many other island species have not been so lucky with the list of extinct rails including Hawaii's Wake Island (*G. wakensis*), Dieffenbach's (*G. dieffenbachii*) and Chatham Islands (*G. modestus*), both from the islands to the east of New Zealand and Tahiti (*G. pacificus*) (Fuller, 2002). Sharpe's Rail (*G. sharpei*) is another species represented by one specimen from an unknown location that is probably extinct. The last remaining species in the genus, the flightless, polytypic Weka (*G. australis*) is widespread in New Zealand and nearby islands.

The Lord Howe Woodhen is one of the last remaining monotypic, insular species in the genus that has been reasonably well studied. This makes it of significant scientific and taxonomic interest.

9.1 Biodiversity Benefits

The impacts of human activities (including the introduction of exotic species) on the natural terrestrial ecosystems of Lord Howe Island have been significant, notwithstanding the comparatively small area of the island settled by humans (c. 20%). For example, the introduction of Pigs and Goats not only contributed to reducing the Woodhen's range and numbers but also had similar impacts on the Providence Petrel, and possibly other ground-breeding seabirds (eg. Fleishy-footed Shearwaters *Puffinis carneipes*).

The rehabilitation of the Lord Howe Woodhen is an indication of the extent to which some of the more widespread indirect impacts of human settlement on the island have been controlled. In this respect, the Woodhen is an indicator species for the successful environmental management of the island's terrestrial ecosystems and is an icon for conservation of the island and its wildlife.

The Woodhen is one of a suite of species endemic to Lord Howe Island. One of the principal reasons for the island's listing on the World Heritage Convention is its high species numbers and high level of endemism. For the reasons outlined above, protection of the Woodhen has resulted in the removal of a range of significant threats to this biodiversity.

10 Previous Actions Undertaken

Conservation measures that have been undertaken to protect the Woodhen and its habitat are described in this section.

10.1 Status of Woodhen Habitat

The Lord Howe Island Group, including Lord Howe Island, Ball's Pyramid, the Admiralty Islands and the contiguous seas, was inscribed on the World Heritage List in 1982.

The LHIB is responsible for the care, control and management of the island in accordance with the LHI Act. Approximately 75% of the land in the Island Group is included in the Lord Howe Island Permanent Park Preserve (PPP). The PPP has similar status to a national park but is managed by the Board. The remaining land area is Crown land, much of which is subject to various leases administered by the Board. A Regional Environmental Plan (REP) (1986) zones land on the island with identified permissible land uses. The REP is currently under review.

In the southern mountains, Woodhen habitat falls within the PPP. Under the REP development within the Preserve may only occur in accordance with the plan of management for the area. The plan of management restricts development to park infrastructure and no residential or commercial development is permitted. Many local residents with Woodhens on their leases take an interest in the birds and in the outcome of breeding attempts and the fate of chicks. Many residents provide supplementary food to the Woodhens in their area. This interest has contributed to the species' rehabilitation.

10.2 Previous Studies

In 1970, an environmental survey of the island was initiated to determine its natural values and management needs (Recher and Clark 1974). In 1972, a management plan for the island was prepared (Recher 1972). The 1970 survey led to an intensive study of the Lord Howe Woodhen on Mount Gower by the Australian Museum starting in February 1971 (Fullagar 1985). Most Woodhens were individually colour-banded and aspects of their social organisation, reproduction and feeding were documented for the first time.

In 1978, a full time study began by the LHIB and the NPWS, supported by the National Parks and Wildlife Association of NSW. The study included the evaluation of captive breeding and release site options. This study confirmed the significant role of Pigs in limiting the return of the Woodhen to the lowlands (Miller and Mullette 1985).

From 1986 to 1997, twice-yearly monitoring was undertaken by the NPWS Biodiversity Research and Management Division (NPWS BRMD). The methods and results of this program were documented in annual reports until 1998 (Harden 1986, 1987, 1990, Harden and Robertshaw 1988, 1998), and involved both census methods and maintaining a high percentage of the population individually colour-banded. A report describing the methodology and summarising results to 1997 has been produced (Harden 1998). In 1998 and 1999, annual monitoring was undertaken.

Responsibility for the surveys was transferred to the LHIB in 1999. During the 1999 November survey, Justin Billing (NPWS BRMD) trained Board staff in the survey methodology. In 2000 and 2001 the twice yearly monitoring program was reinstated. A report detailing the results from these surveys is currently in preparation (Harden in prep). An Access database has been developed for managing the monitoring data collected. The database needs to be updated to improve accuracy of data entry, reporting and to include all existing data.

In 1987, a study was undertaken to determine the occurrence of disease in the Woodhen population (see appendix to Harden and Robertshaw 1988). None was found in the birds sampled.

10.3 Control of Exotic Species

Like many islands in the Pacific, Lord Howe Island had a range of mammals introduced that affected the status and distribution of indigenous fauna. Table 3 summarises current knowledge of the date of introduction of exotic species and evidence for their spread on the island, as well as summarising the range of effects on the Woodhen. Information is also provided on current status and control measures.

A significant component of the Woodhen rehabilitation program and one with significant ancillary biodiversity benefits was the control of Goats and Pigs. Predation by the Ship Rat on Lord Howe Island was listed as a Key Threatening Process under the TSC Act in May 2000. A proposal to eradicate rodents from the island is being considered by the LHIB. It is likely that Woodhens would be vulnerable to the baits being laid as part of this program and birds would probably need to be removed from the wild and kept captive until the program was complete. A Risk Assessment Report is currently being prepared.

The LHIB has a 'Noxious Weed Control Procedure' under the LHI Act and the *Noxious Weeds Act 1993*. This procedure is being reviewed to incorporate the impact of many existing and potential environmental weed species on the island, which are not declared noxious. The new document will provide strategic direction for LHIB weed control programs.

Additionally LHIB staff carries out noxious weed inspections on all leases. These inspections allow for the identification of weed infestations and, in conjunction with the leaseholder, the development of control strategies for individual infestations.

Noxious weed species of highest priority with potential to significantly alter Woodhen habitat are:

- Bitou Bush (*Chrysanthemoides monilifera* subsp. *rotundata*)
- Ground Asparagus (*Protoasparagus aethiopicus*)
- Climbing Asparagus (*P. plumosus*)
- Bridal Veil (*Myrsiphyllum asparagoides*)
- Sweet Pittosporum (*Pittosporum undulatum*)
- Cherry Guava (*Psidium catteianum* var. *catteianum*)
- Ochna (*Ochna serrulata*)
- Castor Oil Plant (*Ricinus communis*)

10.4 Current Management Practices

Southern Mountains

In the southern mountains, Woodhen habitats fall within the Permanent Park Preserve (PPP). The Woodhens in this area are protected from the effects of developments that might occur on the island. A permit system currently operating for the track to Mount Gower requires all visitors to the Mountain to be accompanied by a guide. This enables the monitoring and control of visitor activities. The current bed limit on the island makes significant growth in visitation unlikely.

However, two indirect impacts may occur if there were increased tourism and associated development on Lord Howe Island:

- increased human visitation to key habitat areas, causing increased disturbance and possible interference with the Woodhen's usual behaviour. (Miller and Mullette (1985) warn that examination of Woodhen nests resulted in the parents destroying the eggs and the nest); and
- the requirement for the installation of additional visitor infrastructure in or near the Woodhen's key habitats.

Any proposed increase in visitor access or infrastructure would be subject to environmental impact assessment and the protection of Woodhen habitat and populations would remain a priority.

Vegetation Management

- The LHIB is funding the development of a strategic plan for the management of vegetation on the island. The Plan will provide for a weed management strategy and a re-vegetation strategy.

10.5 Captive Breeding

One of the most successful activities to promote the rehabilitation of the Lord Howe Woodhen was the captive breeding and release program between 1981 and 1983. Miller and Mullette (1985) and Lourie-Fraser (1985) provide detailed accounts of this program. The following summary is based on these accounts.

- In 1978-80, the NPWS and the Australian Museum studied the soil fauna of the island to determine possible sites for release of captive-bred birds.
- In 1980, a captive breeding facility was established at Steven's Reserve in the Settlement area and a cat-proof fence built around it.
- In June 1980, three wild, territory holding pairs were caught and transported to the facility.
- In the first season (1980-81), 13 chicks were reared. In the second season 19 chicks were reared and the breeding stock was raised to five pairs. In the third season 34 chicks were reared. In the fourth season (1983-84) 14 chicks were reared.
- Including the original wild caught birds, 82 Woodhens were released between May 1981 and March 1984 (see Table 1).
- The captive breeding and release program ceased in 1984.
- Two Woodhens were taken from the island to an enclosure at Taronga Park Zoo in 1989, however they died in 1990 without breeding. These birds were not part of a designed captive breeding proposal.

10.6 Community Activities

The Lord Howe Island community has taken an active interest in the protection and rehabilitation of the Woodhen since the first studies in the 1970s. This interest has included active involvement in conservation activities, including:

- participation in research and monitoring activities;

- monitoring and reporting Woodhen activities to the LHIB;
- maintaining suitable habitat for Woodhens on leases; and
- feeding Woodhens to assist their survival.

These efforts have contributed significantly to the re-establishment and survival of Woodhens in the settlement area and to rehabilitation of the species as a whole.

11 The Species' Ability to Recover

The Lord Howe Woodhen has proved to have a strong ability to recover, helped by the comparatively intact nature of the island's terrestrial ecosystems and a very effective, well funded and co-ordinated rehabilitation effort. The ability of the species to respond to effective management intervention is illustrated by the results of the rehabilitation program. Efforts to maintain the wild population has a high probability of success compared with many other threatened species; provided that limiting factors are identified and effectively managed.

12 Recovery Objectives and Performance Criteria

12.1 Objectives of the Recovery Plan

This recovery plan is designed to achieve five outcomes:

- to maintain and, where possible, increase the population level of wild Woodhens on Lord Howe Island;
- to establish a Lord Howe Island recovery team to co-ordinate the implementation and ongoing review of the recovery plan;
- to involve the Lord Howe Island community in monitoring, management, habitat rehabilitation and threat abatement;
- develop a plan for establishing and resourcing an on-island captive breeding facility in the event of a substantial reduction in Woodhen numbers; and
- to establish captive populations at a sites other than Lord Howe Island as insurance against a catastrophe affecting the wild population.

12.2 Risk Management Framework

This recovery plan has been formulated within a framework of spreading the risk of extinction among a number of "sub-populations". The distinction between sub-populations is made for management purposes, notwithstanding likely movements of individuals between them. These are described below.

The southern mountains (PPP) sub-populations represents the Lord Howe Woodhen in its "pristine" state, with population processes taking their natural course, within a context of reducing island-wide threats (e.g. control of feral pests, Masked Owls, weeds).

The settlement area sub-population is more intensively managed through the involvement of the local community, as insurance against serious, natural decline in the southern mountain population.

If total numbers of the Lord Howe Woodhen on Lord Howe Island drop substantially then a captive breeding facility will be established on Lord Howe Island to enable captive-bred releases to supplement the wild population. The population level which will trigger this process will be determined as part of the recovery actions.

An appropriately designed program to establish off-island captive populations at a suitable institution(s) will be implemented as insurance against catastrophe on Lord Howe Island.

12.3 Recovery Performance Criteria

Recovery performance criteria are that:

- regular monitoring shows that numbers of Woodhens are stable or increasing;
- a recovery team is established which co-ordinates the implementation and review of the recovery plan;

- The carrying capacity of the Island for Woodhens and the critical number of Woodhens to trigger an on-island captive breeding program will be determined through analysis of habitat availability and monitoring data within six months;
- a contingency plan for on-island captive breeding is developed within eighteen months and implemented in the event of a substantial reduction in Woodhen numbers;
- captive colonies established elsewhere as insurance against catastrophe (eg. disease, cyclone, predation) on Lord Howe Island; and
- successful establishment of broader community involvement in monitoring and management of threatening processes.

13 Recovery Actions

13.1 Maintaining and Increasing Current Population Levels

Protecting existing habitats from developments

Existing habitats occur in two distinct management areas: the Permanent Park Preserve and the settlement area.

The Permanent Park Preserve

The Woodhen habitats within the Permanent Park Preserve (PPP) zone specified in the Regional Environmental Plan are protected from the effects of developments that might occur on the island. However, two indirect impacts may come from if there was an increase in tourism and associated development on Lord Howe Island. Specifically, these would be increased human visitation to key habitat areas, causing increased disturbance and possible interference with the Woodhen's usual behaviour; and the requirement for the installation of additional visitor infrastructure in or near the Woodhen's key habitats. Access to Mt Gower is currently strictly limited to tours with small numbers guided by a local expert.

The installation of new paths, board-walks, lookouts and other visitor infrastructure has the potential to affect the habitat of the Woodhen. Conversely, such infrastructure, appropriately placed, also has the potential to protect areas of significant habitat. In this respect, it is essential that any such developments be appropriately assessed for their impact on the Woodhen and on the habitat factors that sustain it.

Action 1: Continue to implement strict procedures for managing the Permanent Park Preserve (PPP) and for minimising the impacts of infrastructure and tourism in the PPP on the Lord Howe Woodhen. Ensure that a full assessment of proposals is undertaken as required by the EP&A Act.

Settlement Area

In the settlement area, Woodhens are found on public land, as well as on perpetual and special leases. In such areas, Woodhen habitat protection derives from the development controls set out in the Lord Howe Island REP and the procedures under the EP&A Act and the TSC Act (see section 9.1).

Action 2: Ensure that the revised REP considers protection of the Woodhen and continue to implement planning controls in the settlement area to ensure protection of habitat for the Lord Howe Woodhen.

Controlling threatening processes

In the settlement area, Woodhens are subject to a range of threats related to human activities.

Predation by domestic Dogs

The *Companion Animals Act 1998* applies to Lord Howe Island and the LHIB controls the importation of Dogs to the Island under section 36 of the *Lord Howe Island (General) Regulation 1994*. Additionally the LHIB has adopted a Dog Control Policy.

This policy outlines the owner's requirements for control of their Dog and identifies areas on the Island designated as Dog exercise (off leash) areas and as Dog prohibited areas. Dogs imported to the Island are required to be de-sexed, only certain breeds are permitted (although some of these are hunting breeds) and Dogs must undergo obedience training.

Action 3: Enforce current Dog controls, and if required review current Dog controls, to ensure protection of the Woodhen.

Feral Pests

Feral Pigs and Cats are no longer present on Lord Howe Island. Feral Goats and Ship Rats continue to occur, although the former were subject to a control program in 1999 which reduced the known population to three.

Further programs are required to ensure that Goats are eradicated and that domestic Goats are not re-introduced into the wild.

Rats do not appear to be a serious problem for the Woodhen, although they adversely affect the Kentia Palm industry and a control program is currently underway. However there is potential for indirect impacts upon Woodhen the population via rat and mouse control programs. In July 2001 the LHIB commissioned a feasibility study for the eradication of Rats and Mice from the Lord Howe Island group. A risk assessment report is currently being prepared for the proposal. The potential impacts of any eradication actions upon the Woodhen population should form a key component of any assessment of the proposal.

Action 4: Eradicate feral Goats on Lord Howe Island and manage domestic Goats to prevent re-introduction to the wild.

Action 5: Liaise with Rodent Eradication Taskforce regarding potential impacts and mitigation measures relating to Woodhens.

Masked Owl

There is some evidence that the introduction of Masked Owls from Tasmania may be contributing significantly to Woodhen mortality. In view of this possibility, the eradication of the owl from the island may reduce the risk to the Woodhen and possibly contribute to an increase in the survival of individuals and, therefore, to an increase in the population size.

An assessment is required to determine if the owl's impact on the Woodhen is significant. Should it be determined that the impact is significant, then knowledge of the population level and ecology of the Masked Owl on the island will be required to develop an effective eradication strategy. The level of impact of owls on Woodhens is likely to increase significantly if the rodent eradication program is approved.

Action 6: Assess the impacts of the introduced Masked Owl on Woodhen population levels and develop appropriate management response.

Weeds

A number of weeds have the potential to alter the structural, floristic and ecological characteristics of Woodhen habitat in the southern mountains. These weed species are included in the priorities under the Lord Howe Island Noxious Weed Control Procedure (soon to be replaced by the Strategic Plan for weed control) (see Section 9.3).

Action 7: Ensure that implementation of the Lord Howe Island Weed Control Programs protects Woodhen habitat.

Quarantine

Quarantine procedures are in place on Lord Howe Island to prevent the introduction of fowl diseases. However, procedures for other bird imports are less rigorous (e.g. ducks, cage birds). It is appropriate to apply the same level of quarantine control to all imported birds where a risk of disease introduction is identified. This would reduce the risk of a disease affecting the Woodhen population on the island. A number of other quarantine issues affect the island and a quarantine plan is to be prepared by the LHIB.

Action 8: Ensure that the quarantine plan being prepared for the island addresses issues of avian disease and the introduction of plants or animals that may impact on the Lord Howe Woodhen.

Potential Competitors

The Buff-banded Rail and Purple Swamphen have increased in numbers on Lord Howe Island in the last five years (D. Hiscox, LHIB, pers. comm.). It is not known if this represents a significant risk to the Woodhen by increasing competition for food and space. The similar foraging habits of the Blackbird and Song Thrush to those of the Woodhen may also reduce food and space for the Woodhen. Controlling these species, particularly in the settlement area, may result in an increase in Woodhen numbers.

Action 9: Assess the potential impact on the Lord Howe Woodhen of food competition from Buff-banded Rails, Purple Swamphens, Common Blackbirds and Song Thrushes and, if necessary, formulate and implement a control strategy.

Monitoring

A thorough and consistent monitoring program for the Lord Howe Woodhen was undertaken between 1986 and 1998 (Harden 1986, 1987, 1990b, 1998; Harden and Robertshaw 1988, 1989). This monitoring program involved a count and banding in November, and again in March. The most accurate results come from sighting and counting individual banded birds and most (up to more than 90% in some years) of the population of Woodhens on the island to date have been individually colour-banded. This makes repeatable estimates of the total population feasible, providing the most accurate possible assessment of any changes in numbers and distribution on an annual basis.

Notwithstanding the success of the rehabilitation program the Woodhen remains one of the world's rarest birds. An effective monitoring program that measures population change is an essential foundation upon which to base the recovery plan. It is essential to alert managers to increased risks to the Woodhen's survival and to enable the performance of management to be evaluated accurately.

The LHIB currently undertakes the twice-yearly monitoring program. A computer database has been developed by NPWS to manage the data derived from the monitoring program. The LHIB will ultimately be responsible for the management of the database. The LHIB staff will require training and support in the management of the Lord Howe Woodhen database.

Action 10: Continue the Woodhen monitoring program using the methodology developed in 1999. Ensure that LHIB staff are trained and supported in the management of the Lord Howe Woodhen database.

Action 11: The carrying capacity of the Island for Woodhens and the critical number of Woodhens to trigger an on-island captive breeding program will be determined through analysis of habitat availability and monitoring data within six months of approval of the recovery plan.

Establishing the Recovery Team

To date, implementation of management actions for the Lord Howe Woodhen has been undertaken by the LHIB, with input from the NPWS. The establishment of a recovery team would assist the Board in consolidating recovery actions and resources for a number of Lord Howe Island species. A significant role of the recovery team would be the storage, analysis and reporting of the monitoring results to measure the performance of management actions. The recovery team would also co-ordinate the implementation of contingency plans if required.

The team should review the recovery plan every five years.

Action 12: Establish a recovery team under the auspices of the National Parks and Wildlife Service and the LHIB to co-ordinate the implementation and funding of species recovery plans.

Community Co-operation Program

The Lord Howe Woodhen occurs in significant numbers on leasehold land in the settlement area. A number of leaseholders have been feeding Woodhens, which has contributed to the increase in numbers in the area. Many of the Woodhens that now occur in the settlement area are found away from their preferred habitat and on calcareous geology. Their persistence in such apparently unsuitable habitats is in part, due to the food provided by residents.

A risk management framework for the Lord Howe Woodhen was outlined in Section 11.2. A significant plank of this framework was the more intensive management of the Woodhen population in the settlement area. It is proposed to maintain this through the establishment of a community-based program of monitoring, habitat protection and supplementary feeding. The activities proposed for this program are described below.

Community Based Monitoring

Residents who currently take an interest in their local Woodhens are able to report regular sightings and movements of individuals, as well as the outcome of breeding attempts and the results of supplementary feeding. To facilitate continuation of community input to the management of Woodhens, a community information brochure should be prepared. The brochure should describe how the monitoring surveys are undertaken, the colour banding process for identification of individual birds and summarise the findings of the surveys. The brochure should also cover issues of Woodhen management, habitat enhancement and protection and appropriate supplementary feeding strategies.

Action 13: Prepare a community information brochure on Woodhen management.

Habitat Protection and Supplementary Feeding Program

A significant number of Woodhens live in artificial garden habitats in the settlement area, as well as remnant indigenous habitats on leases. The planning provisions covering leases provide significant mechanisms for protecting Woodhen habitat. However, the positive involvement of the island's leaseholders in habitat protection is the most effective way of assuring the future of such habitat in the settlement area. This component of the community co-operation program is designed to facilitate this involvement.

The successful ingredients of such a program would include but not be limited to:

- a positive relationship between leaseholders with habitat on their leases and the LHIB and Recovery Team;
- willingness of the leaseholder to protect and manage Woodhen habitat on their lease;
- provision of information on how to protect, manage and/or enhance habitat for the Woodhen.

The leaseholder needs a personal contact, most appropriately in the LHIB, with whom to discuss and develop individual approaches, and from whom to seek information.

In addition, such a program could be pro-active in identifying leaseholders whose leases support areas of potential habitat in which Woodhens may survive, given additional protection and/or supplementary feeding. Supplementary feeding by local residents of wild Lord Howe Woodhens has contributed significantly to the rehabilitation of the species. The settlement is likely to be supporting artificially high populations levels through community based supplementary feeding. Caution will be required in interpreting a population decline following any cessation of food provision. Such a decline may meet the criteria for implementing the on-island captive breeding; however, in fact, the wild population may be stable and at carrying capacity.

A survey of the community based supplementary feeding program for Woodhens in the settlement area should be undertaken to establish how many people are feeding Woodhens, how frequently, and what quantities and types of food are being provided. Guidelines should be prepared for the community on the most appropriate feed types for the Woodhen. Any formal supplementary feeding program should be managed by the LHIB and have an annual budgetary allocation.

Action 14: Formulate and implement guidelines for the protection, management and enhancement of Woodhen habitat on leasehold land. Undertake a study to determine the most appropriate supplementary food types and assess the effectiveness of a community based supplementary feeding program for Woodhen on leasehold land.

Establishing a Captive Population

The Woodhen occurs only on Lord Howe Island. Such a small distribution, combined with low numbers, makes it vulnerable to catastrophic extinction. The precise mechanism of catastrophic extinction is difficult to anticipate. Catastrophic extinction could occur due to:

- cyclone;
- extended drought;
- fire;
- introduction of an avian disease;
- introduction of an exotic predator;
- introduction of a particularly invasive weed;
- reduced reproductive ability relating to low genetic diversity of population.

As insurance against these or other eventualities, a captive colony outside Lord Howe Island, for example on mainland Australia, is required.

The Woodhen is listed as a category one species by the Australian Species Management Program (C. Hibbard, Taronga Park Zoo, pers. comm.). This means that participating zoos around Australia and New Zealand have identified it as a priority for captive management. Zoos that participate in the Australian Species Management Program manage captive populations of endangered indigenous fauna. The Australian Regional Association of Zoological Parks and Aquaria (ARAZPA) Taxon Advisory Group Convenor - Australian Non-passerines has provided the following recommended approach for establishing a captive population as insurance against catastrophe (Hibbard pers comm, August 2001). This includes actions such as:

- Appoint a regional captive management coordinator within the Australian Regional Association of Zoological Parks and Aquaria (ARAZPA) to coordinate the captive management of the species.
- Develop a draft Husbandry Manual for the species based on review of all available literature on natural history of the species, previous management and husbandry of the species in captivity and related material for other *Gallirallus* if further information is required.
- Develop a Population Management Plan that outlines the steps needed to meet the objectives of the captive management program.
- Establish a complex of approximately 12 purpose built aviaries at a major zoological institution on the Australian mainland. This would act as the primary breeding institution for the establishment phase of the program.
- Establish a protocol for the recruitment of suitable founders from Lord Howe Island and their establishment in the captive facility. It is proposed that eight to ten birds form the initial base for the establishment of the captive population.

- Following the initial establishment of the mainland Australian population, specimens would be provided to other statutory zoos within Australia for expansion of the captive population. This would be undertaken under advice from the Species Coordinator and in consultation with the Recovery Team.
- Additional specimens may need to be recruited from Lord Howe Island in order to maintain the genetic integrity of the captive population. It is estimated that this would only require a few individuals every five or so years.
- Once fully established the captive population would remain highly managed to ensure its genetic and demographic health, however, the specimens would need to be integrated into the general collection facilities as it would be financially not realistic to hold the birds in dedicated off-exhibit facilities on an indefinite basis.
- At no stage would the birds be considered for trade, sale or export. All major decisions involving the birds would be coordinated through the Recovery Team. The birds would remain the property of the Government, not the zoological park at which they may be residing.
- Initial establishment costs will be high as the project has limited capacity to be phased in over time. As the program expands to include secondary institutions it would be expected that they use existing facilities to house the birds, otherwise the overall cost would become prohibitive.

Cost estimates are:

Development of husbandry protocols and Population Management Plan	\$5000	
Establishment of purpose built facilities at primary institution (12 aviaries @ \$6000ea)		\$72000
Recruitment of founder specimens from LH Island (transport, quarantine etc)	\$5000	
Staffing costs for dedicated staff member to implement program (half staff member for two years)		\$30000
	TOTAL	\$112000

Some expenses relating to the establishment of this project may be supported by the institution initiating this project, however a funding source for a significant proportion of the funds will need to be secured. Individuals from this population should only be re-introduced to Lord Howe Island in the event of extinction in the wild, as the risk of introducing disease is too high.

Action 15: Establish and manage captive populations of the Lord Howe Woodhen in appropriate off-island institutions, consistent with the protocols of the Australian Species Management Program.

The risk management framework described in Section 11.2 identified on-island captive breeding as a contingency in the event that the wild Woodhen population fell substantially. Before such an eventuality, it would be necessary to have already identified and costed options for the establishment and staffing of a facility. This facility may be required if the rodent eradication program proceeds. To this end, the recovery team should ensure that, early in the implementation of the current plan, these options have been identified.

Action 16: Develop a plan within eighteen months for establishing and resourcing an on-island captive breeding facility, for implementation in the event of a substantial reduction in Woodhen numbers below a population size which will be identified as part of Action 11 or if the rodent eradication program is approved.

14 Implementation

The following table allocates responsibility for the implementation of recovery actions specified in this plan to relevant government agencies for the five year period covered by the plan.

Table 4: Estimated costs of implementing the actions identified in the Lord Howe Woodhen recovery plan are provided below.

Action No:	Action Title	Priority	Estimated \$ Cost/yr					Total Cost	Responsible party for actions in the plan	In-Kind	Cash
			Year 1	Year 2	Year 3	Year 4	Year 5				
1*	Permanent Park Preserve managed to protect Woodhen habitat	1							LHIB		
2*	Ensure settlement planning controls protect Woodhen habitat	1							LHIB		
3*	Dog control	2							LHIB		
4	Goat eradication	3			3500			3500	LHIB	3500	
5*	Liaise with Rodent Eradication Taskforce	1							LHIB NPWS		
6	Introduced Masked Owl impact assessment	2	10000	10000				20000	LHIB NPWS		20000
7*	Ensure Noxious Weed Control Procedure protects habitat for Woodhen	3							LHIB		
8	Prepare Quarantine Plan	2				21000		21000	LHIB NPWS	21000	

9	Assess impacts of avian competitors; develop control strategy	2			10000	10000		20000	LHIB NPWS		20000
10	Woodhen population monitoring	1	45000	45000	45000	45000	45000	225000	LHIB NPWS		225000
11	Determine Woodhen carrying capacity and critical number of Woodhens	1	5000					5000	LHIB NPWS		5000
12	Establish the Recovery Team	1	10000	10000	10000	10000	10000	50000	NPWS		50000
13	Prepare Community information brochure	2	5000					5000	LHIB NPWS		5000
14	Supplementary feeding program. Habitat protection and enhancement guidelines for the settlement	2	10000					10000	LHIB NPWS		10000
15	Establish off-island captive breeding population	2	5000	92000	15000			112000	NPWS, LHIB		112000
16	Develop plan for on-island captive breeding facility	1	5000					5000	LHIB, NPWS		5000
Total			95000	157000	83500	86000	55000	476500		24500	452000

Priority ratings are as per Commonwealth recovery plan guidelines: 1- Action critical to prevent extinction, 2-action prevents negative impact short of extinction, 3-other actions.

* These actions are to be funded by ongoing recurrent funding.

15 Preparation details

15.1 Date of last amendment

10 July 2002

15.2 Review date

July 2007.

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ADDENDUM

March 2003

To meet the statutory requirements of the Environment Protection and Biodiversity Conservation Act 1999, the Recovery Plan for the Lord Howe Woodhen (*Gallirallus sylvestris*) is amended to include the following:

Indigenous Consultation

There are no indigenous inhabitants either historically or current for the Lord Howe Island.

Confirmation to place final plan and map on the web

Confirmation is given that the plan and map as per electronic copy does not contain any confidential information and can be placed on the web.

NSW NPWS



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LORD HOWE ISLAND

BIODIVERSITY MANAGEMENT PLAN



Australian Government



Lord Howe
ISLAND BOARD

Department of Environment & Climate Change NSW



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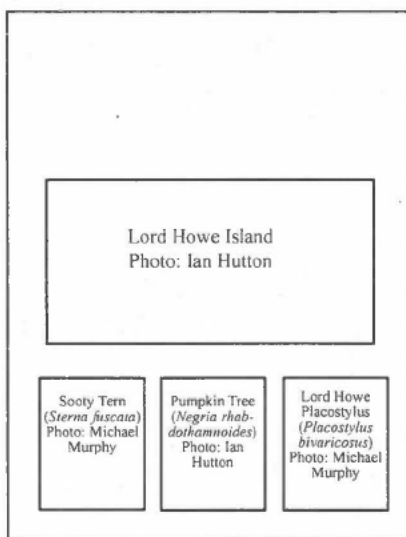
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Executive Summary

The Lord Howe Island Biodiversity Management Plan encompasses threats and management actions relevant to the Island group's overall biodiversity, with a particular focus on rare and significant species and communities of the LHIG. This approach enables holistic and cost-effective management of the Lord Howe Island Group's biodiversity. The Lord Howe Island Biodiversity Management Plan also constitutes the formal National and NSW Recovery Plan for threatened species and communities of the Lord Howe Island Group. As such, it considers the conservation requirements of these species within the Group.

This plan identifies the actions to be taken to ensure the long-term viability of threatened and significant species and communities of the Lord Howe Island Group in nature and the parties who will undertake these actions.

The recovery actions detailed in this plan include: (i) *implementing the Lord Howe Island Board quarantine policy*, (ii) *protecting existing native vegetation*, (iii) *on-ground eradication and control of weeds*, (iv) *revegetation of priority sites*, (v) *control and/or eradication of introduced vertebrate and invertebrate fauna*, (vi) *research and monitoring into species' ecology and management options*, (vii) *monitoring the impacts of climate change*, (viii) *captive breeding and reintroductions*, (ix) *surveys of potential habitat*, (x) *community awareness*.

It is intended that the Biodiversity Management Plan will be implemented over a 10-year period.

The Lord Howe Island Biodiversity Management Plan is presented in two documents. This document consists of the main body of the plan, while the second document contains the appendices that accompany the main plan (appendices document). A list of the appendices contained in the appendices document is provided on the contents page.

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The Plan was prepared and written by Dianne Brown, Lynn Baker, Katrina McKay and Michael Murphy (DECC).

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Appendix 1 List of fauna, flora & communities

Appendix 2 Threatened invertebrates

Appendix 3 Summary of threats to species of the Lord Howe Island Group

Appendix 4 Biodiversity Forecasting Tool

Appendix 5 Species Profiles

1 Introduction

The rich biodiversity of the Lord Howe Island Group (LHIG) supports a high level of endemic and significant species and communities. In addition, due to its isolated geographic location, small size and limited access, there are a number of identifiable and common threats to biodiversity on the LHIG. This combination of unique biota and common threats provides the opportunity to manage species and communities via a multi-species, threat-based biodiversity plan. This holistic approach was chosen in contrast to producing a number of single species recovery plans, which is less efficient in terms of resources for preparation, implementation and prioritisation of management actions.

The LHIG falls under the jurisdiction of the New South Wales (NSW) State government. The Lord Howe Island Board (LHIB) is responsible for the care, control and management of Lord Howe Island, offshore islands and neighbouring coral reefs in accordance with the *Lord Howe Island Act 1953* (LHI Act). All land is vested in the Crown; there is no freehold title.

The Lord Howe Island Biodiversity Management Plan (LHI BMP) has been prepared by the Department of Environment and Climate Change (DECC) in conjunction with the Lord Howe Island Recovery Team and the LHIB. The attainment of the objectives of the LHI BMP are subject to budgetary and other constraints affecting the parties involved.

1.1 Scope of document

The LHI BMP encompasses all islands within the LHIG (Figure 1).

The LHI BMP encompasses threats and management actions relevant to the Island group's overall biodiversity and in particular, rare and significant species and communities of the LHIG.

A number of terrestrial species and ecological communities occurring on the LHIG are listed as Critically Endangered, Endangered or Vulnerable under the *Threatened Species Conservation Act 1995* (TSC Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). To the extent that those species are restricted to the LHIG or

where the LHIG constitutes the major habitat of the species, this LHI BMP constitutes the formal National and NSW Recovery Plan for them.

Flora species addressed by the LHI BMP are those species that are:

- threatened;
- endemic; or
- have a distribution restricted to the LHIG or where the LHIG is the only Australian location.

Fauna species addressed by the LHI BMP are all native terrestrial species including land birds, endemic and threatened invertebrates, endemic reptiles and a native mammal. Sea birds are included where the LHIG constitutes a significant part of their habitat or breeding location. Appendix 1, contained in the appendices document lists all species addressed by the LHI BMP, while Appendix 5 (appendices document) provides profiles of these species.

This plan does not relate directly to the management of the coral reefs and marine environments associated with the LHIG. These areas are managed through zoning and operational plans developed by the NSW Marine Parks Authority, under the *Marine Parks Act 1997*. The LHI BMP is complementary to these zoning and operational plans.

The LHI BMP is intended to provide an holistic approach to future management of the biodiversity of the LHIG, assisting with the prioritisation of actions, and presenting management information in one document.

The plan identifies significant ecological areas, biodiversity 'hot spots', threatened areas and priority management sites for the LHIG. It identifies the actions to be taken to ensure the long-term viability in nature of species covered by the plan, and the parties who will undertake these actions.

1.2 Interaction with other documents

There are two existing recovery plans for LHI species: the Lord Howe Woodhen (*Gallirallus*

sylvestris) and the Lord Howe Island *Placostylus* (*Placostylus bivaricosus*) (a land snail). The LHI BMP does not replace these Recovery Plans, but complements them by including species-specific management actions, as well as incorporating the species covered by individual Plans in holistic management actions. These actions have been prioritised across all relevant species and communities. The individual Plans will be incorporated into this plan when they are due for review.

This plan constitutes only the LHIG component for threatened species where the LHIG is not the only Australian location. This applies to several species of sea bird and a threatened plant.

The LHI BMP provides a wide scope of management actions, the biodiversity benefit of these actions, and priorities for management. Specific management actions may receive different priorities at different times depending on the availability of funding and opportunistic project proposals.

1.3 Description of the Lord Howe Island Group

The LHIG is located 760 kilometres north east of Sydney. This island group, known for its spectacular beauty, supports an extraordinary array of terrestrial and marine ecosystems and landscapes.

The uniqueness and international importance of the LHIG was formally recognised in 1982, when it was inscribed on the World Heritage Register.

The LHIG (Figure 1) consists of a main island (Lord Howe Island) that is surrounded by smaller outlying groups of islands and rocks. The most distant of these is the 551 m high pinnacle of Balls Pyramid, 23 km to the south east of Lord Howe Island.

Lord Howe Island is approximately 11 km long, 2.8 km wide at its widest point and is roughly crescent shaped, enclosing a coral reef lagoon on the south-west side. The total area of the island is 1455 hectares (Hutton 1991).

Lord Howe Island was first sighted in 1788, and European settlement occurred in 1834. There is no archaeological evidence of earlier inhabitants (Pickard 1983). Lord Howe Island is the only island within the LHIG on which settlement has occurred. The settlement area is restricted to the

central lowlands and covers approximately 15% of the island.

Most of the island (87%) has retained its original vegetation (Hunter 2002), with almost 75% of Lord Howe Island and all the other islands within the LHIG protected under the Permanent Park Preserve (PPP). This preserve has a similar status to that of a National Park, the main difference being that the PPP is managed by the LHIB rather than the DECC.

Geology and geomorphology

The LHIG is a relatively young island group. It is part of the largely submerged Lord Howe Island Rise, a volcanic undersea ridge 160 km–300 km wide and rises from ocean depths of over 1.8 km. This rise separates the Tasman and the New Caledonian Basins.

Lord Howe Island is thought to be the remnant of a large shield volcano on the western edge of the Rise. The present land mass is thought to represent two periods of volcanic activity. The northern hills (the Malabar Hill – Mount Eliza chain) and the central Hills (Transit Hill and Intermediate Hill) of Lord Howe Island are remnants of the earlier volcanics (about 6.9 million years ago), and are estimated to be 700 m lower than when they formed (Hutton 1998). The later activity took place about 6.3 million years ago, and produced the basalt flows which constitute the two southern mountains; Mount Gower (875 m) and Mount Lidgbird (777 m) (Green 1994).

The most common volcanic rocks found on the island are basalt and the associated breccia.

Marine erosion has greatly reduced the size of the island to an estimated 2.5% of that which was originally formed (Hunter 2002). A result of this erosion is a spectacular landscape of mountains, cliffs, hills and offshore islands.

Successive ice ages, causing a variation in sea level, led to deposits of wind blown coral and shell debris on the low-lying, flat areas (Pickard 1983). Percolating rainwater cemented these into sedimentary rock known as aeolian calcarenite. The Lord Howe occurrence of aeolian calcarenite is the most significant anywhere on the NSW coast (Smith 2002). Some of the deposits have been dated to over 130,000 years old and contain fossils of bird bones and eggs, land and marine snails, and the now extinct horned turtle *Meiolania platyceps* (Green 1994).

Small swamps are a significant feature of lowland parts of the island and are a result of recent beach deposits which have built up across drainage lines on the island (Smith 2002).

Flora and fauna

The diverse landscape of mountains, valleys, hills, lowlands and seacliffs of the LHIG provide a diverse array of habitat types supporting many distinctive flora and fauna assemblages. Many of the species that occur within the island group are endemic (occur nowhere else in the world).

Many of the flora and fauna species from the LHIG have affinities with species known from the surrounding islands of New Zealand, New Caledonia, Australia and other Pacific Islands (Manidis Roberts 2000; Hunter 2002; Smith 2002).

While many organisms arrived by long distance dispersal by wind and sea to colonise the island group, there is also a strong Gondwanan element in the biota, dating back to the split between Australia and New Zealand. Floristically, the LHIG is closest to Norfolk Island (Hunter 2002), however, both the LHIG and Norfolk Island flora are more closely related to New Zealand and New Caledonia than they are to Australia. The snail fauna shows clear affinities with the Solomon Islands, Fiji, New Caledonia and New Zealand

(Hunter 2002). Section 3 of this plan provides further detail of the flora and fauna of the LHIG.

Climate

The LHIG has a climate that is moderated by oceanic air currents and mild sea temperatures. The LHIG winters are wet and cool, with an average daily maximum of 18°C and average daily minimum of 13°C. The lowest temperature recorded from the settlement area of the island is 6°C, and no frost has ever been recorded (LHIB 2002).

Summers have less rainfall, and are mild or warm, averaging a daily maximum of 25 °C and an average daily minimum of 13 °C. Temperatures on the high plateau of Mount Gower are 6–8 °C cooler than at sea level (LHIB 2002).

The mean annual rainfall of the lowlands is 1650 mm, with a pronounced maximum in mid-winter. The rainfall in the mountainous southern half of the island is considerably higher due to orographic cloud and rainfall influences (LHIB 2002). Humidity on Lord Howe Island is high throughout the year.

The island is generally windy, more so in the afternoons. The salt-laden wind comes predominantly from the south-east and north-east and the mean wind speed is highest in late winter and spring (LHIB 2002).

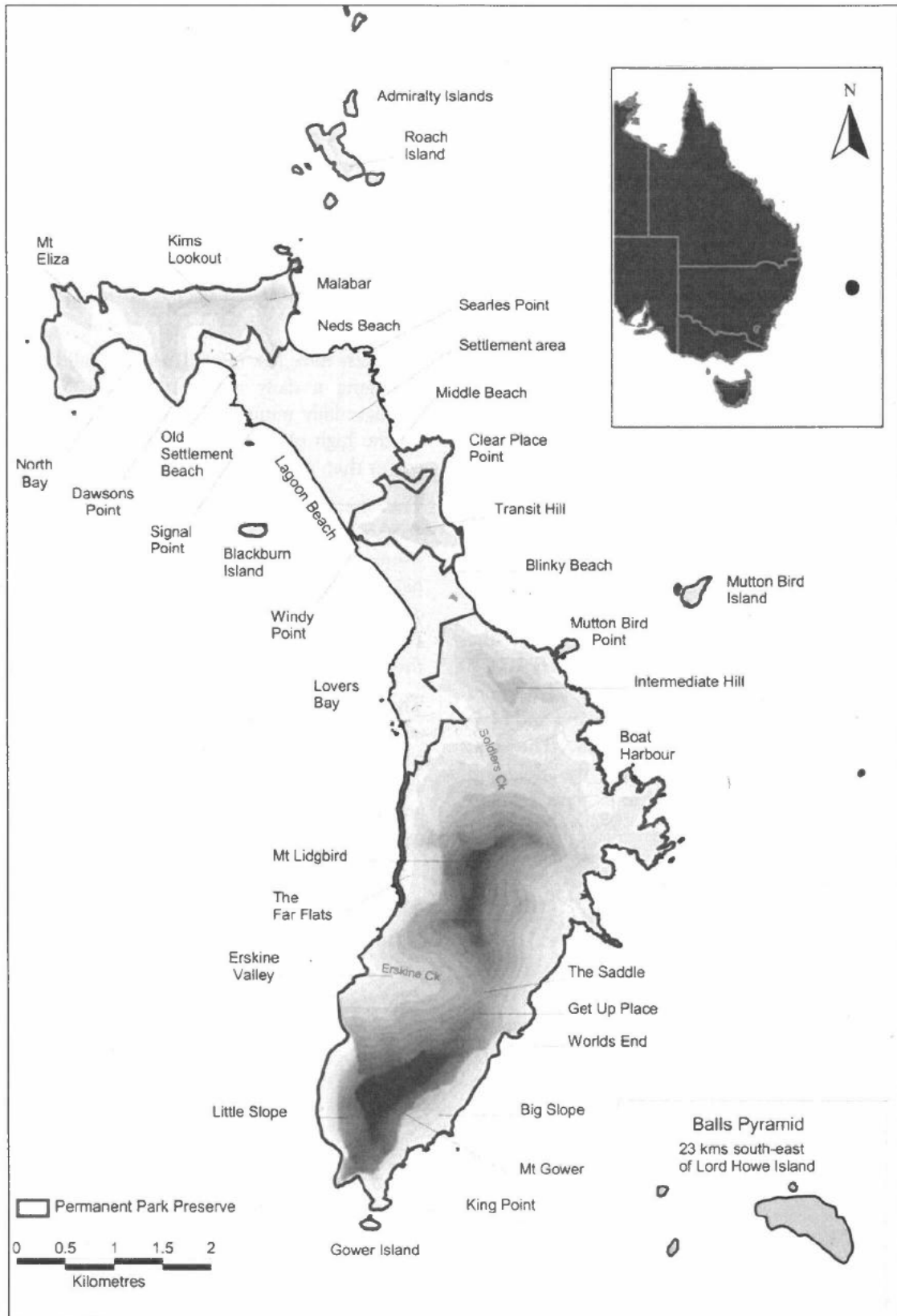


Figure 1. The Lord Howe Island Group

2 Legislative Context

The LHI BMP constitutes the Recovery Plan for LHIG species and ecological communities that are listed as Critically Endangered, Endangered or Vulnerable under the TSC Act and the EPBC Act. There are eight flora, 21 fauna and one ecological community listed on the NSW TSC Act that are covered by this plan. Seven fauna species and one flora species are listed as threatened on the EPBC Act, as well as 58 birds listed as protected migratory species on the EPBC Act, 41 of which are irregular visitors to, or vagrants on, the LHIG (Table 1). Appendix 1 (appendices document) lists all species recorded for the LHIG and their conservation status.

Table 1. Summary of the NSW Threatened Species Conservation Act 1995 and Commonwealth Environment Protection and Biodiversity Conservation Act 1999 listings

	TSC Act	EPBC Act	
	threatened	threatened	migratory
Flora	8	1	
Fauna	21	11	58
Ecological communities	1		
TOTAL	30	12	58

The LHI BMP intends to address any additional species, populations or communities that may be listed under the TSC or EPBC Acts during the ten years duration of the plan. It is proposed that as a species, population or community is listed, the intention to use this plan for the recovery plan for the entity will be advertised. Where necessary, addenda will be attached to the current plan and submissions during exhibition periods will be considered.

Once this plan has been approved by the NSW Minister for the Environment, it is the intention of the Director General of the DECC to forward it to the Australian Minister of the Environment and Water Resources for adoption.

2.1 Recovery plan preparation, exhibition and implementation

The TSC Act and the EPBC Act provide a legislative framework to protect and encourage the recovery of threatened species, populations and ecological communities.

Under the TSC Act the Director General of the DECC has a responsibility to prepare and adopt a Threatened Species Priorities Action Statement, which will establish priorities for the recovery of threatened species, populations and communities and for threat abatement for key threatening processes. Recovery plans and threat abatement plans will be required to be prepared in accordance with the priorities established by a Priorities Action Statement. The EPBC Act also includes specific requirements for both the matters to be addressed by recovery plans and the process for preparing recovery plans. This plan satisfies the provisions of the TSC Act and EPBC Act.

The draft LHI BMP was placed on public exhibition between 22 December 2006 and 22 February 2007 and submissions were invited from the public.

All submissions to this plan were considered and a summary of those submissions was provided to the NSW Minister for the Environment prior to final approval of the plan.

The TSC Act requires that a government agency must not undertake actions inconsistent with a Recovery Plan. The EPBC Act additionally specifies that the Australian Government must not take any action that contravenes a Recovery Plan. The actions identified in this plan for the recovery of the threatened and significant species of the LHIG in NSW are the responsibility of the LHIB, the Lord Howe Island recovery team and the DECC. Other public authorities may also have statutory responsibilities relevant to the conservation and protection of Lord Howe Island threatened species.

For species listed under the NSW TSC Act, any proposal that is likely to have a significant

impact on these species must prepare a Species Impact Statement, and the concurrence of the DECC is required. For those species that are listed nationally under the EPBC Act, any proposal that is likely to have a significant impact on these species should refer the action to the Australian Government Minister for the Environment and Water Resources for consideration. The Minister will then decide whether the action requires EPBC Act approval. This is in addition to any state or local government approval required.

2.2 Consultation with the Lord Howe Island community

The people of Lord Howe Island are deeply connected to the LHIG and its history. They play an integral part in the way in which the island is managed. Many members of the Lord Howe Island community have assisted in the preparation of this plan.

The Lord Howe Island community will have an important role in the successful implementation of this plan. In addition to the consultation processes that have taken place in the preparation of the preliminary draft plan, the draft LHI BMP was made available for the Lord Howe Island community to provide comment. These comments were considered during the finalisation of this plan.

2.3 Critical Habitat

The TSC Act makes provision for the identification and declaration of Critical Habitat. Under the TSC Act, Critical Habitat may be identified for any endangered species, population or ecological community occurring on NSW lands. Once declared, it becomes an offence to damage Critical Habitat (unless the action is specifically exempted under the provisions of the TSC Act) and a Species Impact Statement (SIS) is mandatory for all developments and activities proposed within declared Critical Habitat. To date, Critical Habitat has not been declared for any LHIG species. The declaration of Critical Habitat is not considered to be a priority for LHIG species at this stage, as other mechanisms provide for their protection.

2.4 Habitat Critical to Survival

The EPBC Act requires that habitat critical to the survival of a threatened species or community, and the actions needed to protect that habitat must be included in a recovery plan. Habitat critical to survival has been identified in the LHI BMP, including habitat that meets the essential life cycle requirements of a species or community under normal conditions, and habitat requirements during periods of stress. Habitat critical to survival also includes corridors that freely connect populations, and provide sufficient habitat to meet a species genetic diversity and long-term evolutionary development requirements, or any other essential function.

2.5 Key Threatening Processes

As of August 2007 there are 12 Key Threatening Processes (KTPs) listed under either the TSC Act or the EPBC Act considered to be relevant to the LHIG. These KTPs are outlined in more detail in Section 4 and Table 6.

2.6 Other conservation measures

The TSC Act includes provision for other measures that may be taken to conserve threatened species and their habitat, including the making of a Stop Work Order or Joint Management Agreement.

Additionally, the LHIG is listed as a World Heritage site and therefore must be managed in accordance with the provisions of the EPBC Act pertaining to World Heritage sites.

2.7 Additional relevant NSW Legislation

Lord Howe Island Act 1953

The LHI Act was enacted to make provision for the care, control and management of the LHIG and to establish the LHIB.

The PPP is established under Section 19A of the LHI Act. It covers approximately 75% of the

island, and includes all offshore islands and Balls Pyramid. The PPP is managed in accordance with a Plan of Management. This Plan of Management (NSW NPWS 1986) is currently being updated.

Additional NSW legislation relevant to the conservation and recovery of threatened species and ecological communities recorded from LHIG includes the following:

- *National Parks and Wildlife Act 1974;*
- *Environmental Planning and Assessment Act 1979;*
- *Local Government Act 1993;*
- *Rural Fires Act 1997;* and
- *Rural Fires and Environmental Assessment Legislation Amendment Act 2002.*

3 Overview of Species

3.1 Introduction

The LHIG supports a diverse terrestrial flora and fauna with a high degree of endemic species and communities. Many biogeographical relationships are discernible, with components of the terrestrial flora and fauna exhibiting affinities with eastern Australia, New Zealand, Norfolk Island and New Caledonia (Hedley 1893; Manidis Roberts 2000; Cassis *et al.* 2003).

Appendices which provide the full list of species and profiles of the target species addressed in this plan are provided in a separate document (Appendix 5 of the appendices document).

3.2 Flora species

There are 239 species of indigenous vascular plant recorded from the LHIG, of which 113 (47%) are endemic. The high degree of endemism is illustrated not only at the species level, but also at the generic level, where there are five endemic vascular plant genera (*Negria*, *Lordhowea*, *Howea*, *Lepidorrhachis* and *Hedyscepe*) (Hunter 2002).

The non-vascular flora of terrestrial and freshwater habitats (bryophytes, lichens and freshwater algae) is less well known, but is also considered to be diverse with many endemic species. For example, 105 species of mosses are known, 21 (20%) of which are endemic (Ramsay 1984).

New species of endemic vascular and non-vascular plants from the LHIG continue to be described.

Approximately 271 species of vascular flora have naturalised (introduced species that are reproducing in the wild) on the LHIG since settlement. Some of these, including Bitou Bush (*Chrysanthemoides monilifera*), Ground Asparagus (*Asparagus aethiopicus*), Climbing Asparagus (*Asparagus plumosus*), Bridal Creeper (*Asparagus asparagoides*), Cherry Guava (*Psidium cattleianum*), Sweet Pittosporum (*Pittosporum undulatum*), Kikuyu Grass (*Pennisetum clandestinum*), Crofton Weed (*Ageratina adenophora*) and Tiger Lily (*Lilium formosanum*), pose serious problems as environmental weeds, and 18 species are declared noxious for the LHIG (Table 7). Around 400

additional species occur in cultivation within the settlement area. Many of these have the potential to become weeds. Weeds are discussed more fully in Section 4.3. Table 2 provides a summary of the number of vascular flora species in each of four categories, while Appendix 1 (in the appendices document) is a comprehensive list of the vascular flora species known from the LHIG.

3.3 Vegetation communities

The vegetation communities of the LHIG have been described by Pickard (1983) and Hunter (2002). Many of these communities are unique to the LHIG, are dominated by endemic species, or have highly restricted distributions within the island group. Pickard (1983) identified seven structural formations and 25 vegetation associations, with a number of subformations and alliances, and another four physiographic units to identify cliffs and shorelines. Closed forest is the most extensive structural formation, covering over half of the main island and extending from the lowlands to the mountain tops. The remaining natural vegetation cover consists of scrubs, herbfields, grasslands and the vegetation of exposed cliff and littoral terrains.

Thirty four vegetation communities are defined for the LHIG for the purposes of this plan (Appendix 1) (appendices document). These are based on Pickard (1983) with refinements by Hunter (2002) and Hutton (*pers. comm.*).

Eighteen vegetation communities of the LHIG are considered to be of particular conservation concern, due to threatening processes that are causing, or likely to cause their decline (Table 3).

Table 2. Summary of vascular flora species known from the Lord Howe Island Group

Species group	Number
Indigenous species (endemic)	113
Indigenous species (non-endemic)	126
Introduced species (naturalised)	c. 271
Introduced species (non-naturalised i.e. in cultivation)	c. 400
Total	c. 910

Table 3. Vegetation communities of particular conservation concern of the Lord Howe Island Group

Community	Status/threat
Closed forest communities	
Blackbutt (<i>Cryptocarya gregsonii</i>) Closed Forest	Restricted distribution; threatened by Crofton Weed
Greybark-Blackbutt (<i>Drypetes deplanchei</i> - <i>Cryptocarya triplinervis</i>) Closed Forest on calcarenite/coral sand	Extent of clearing/fragmentation; weed invasion
Big Mountain Palm (<i>Hedyscepe canterburyana</i>) Closed Sclerophyll Forest	Climate change
Kentia Palm (<i>Howea forsteriana</i>) Closed Sclerophyll Forest on calcarenite/coral sand	Extent of clearing; fragmentation
Sallywood (<i>Lagunaria patersonia</i>) Closed Swamp Forest*	Restricted distribution; extent of clearing
Lowland Mixed Closed Forest	Threatened by weed invasion
Hotbark-Fitzgeraldii (<i>Zygogynum howeanum</i> - <i>Dracophyllum fitzgeraldii</i>) Gnarled Mossy Closed Forest (Cloud Forest)	Restricted distribution; climate change
Scrub communities	
Mangrove (<i>Aegiceras corniculatum</i>) Closed Scrub	Restricted distribution; grazing and trampling; weed invasion; climate change
<i>Alyxia squamulosa</i> – <i>Coprosma inopinata</i> Dwarf Scrub	Very restricted distribution, weed invasion
Saltbush (<i>Atriplex cinerea</i>) Dwarf Scrub	Very restricted distribution
Mangrove (<i>Avicennia marina</i> v. <i>australasica</i>) Open Scrub	Very restricted distribution
Mixed Fern and Herb	Restricted distribution; weed invasion, particularly by Crofton Weed & Tiger Lily; climate change
Fitzgeraldii-Mountain Rose (<i>Dracophyllum fitzgeraldii</i> - <i>Metrosideros nervulosa</i>) Closed Scrub	Climate change
Grass communities	
<i>Poa poiformis</i> Grassland	Restricted distribution on main island; invasion by Kikuyu; risk of Kikuyu reaching offshore islands
Specialised landform communities	
Coral Sand Beach and Dune Community	Moderately restricted distribution; clearing; disturbance
Waterfall Cliff Community	Threatened by weed invasion, particularly Crofton Weed
Aquatic communities	
Upland Freshwater Instream Community	Restricted distribution; climate change
Lowland Freshwater Instream Community	Restricted distribution; clearing, grazing and trampling; climate change

* Listed as an Endangered Ecological Community on the TSC Act.

3.4 Vertebrate fauna

Typical of remote oceanic islands, the terrestrial vertebrate fauna of the LHIG is dominated by birds. One hundred and eighty two species of birds are recorded from the LHIG, of which 20 are resident landbirds, 14 are breeding seabirds, 17 are regular visitors and 120 are vagrants (McAllan *et al.* 2004). At the time of European settlement the native avifauna consisted of 26 species of land bird (including 13 migratory waders) and 13 species of sea bird (refer to Table 4 and Appendix 1). Thirteen (50%) of the land birds were endemic species or subspecies. Eleven of the sea bird species continue to have important breeding populations in the LHIG, with Lord Howe Island reputed to have more sea bird species breeding in higher numbers than anywhere else in Australia (P. Fullagar, in Hutton 1998). Two species of birds are classified as locally extinct as they are only known from subfossil remains (McAllan *et al.* 2004). In contrast to the sea birds, nine of the land bird species have become extinct in the period since human settlement (all endemic species or subspecies). The most recent extinction was the Lord Howe subspecies of Southern Boobook (*Ninox novaeseelandiae albaria*), which was last recorded in the 1950s.

An additional 18 land bird species and five sea bird species have established populations on the LHIG since settlement, either through intentional human introduction or unassisted colonisation.

Two species of reptile (the Lord Howe Island Gecko *Christinus guentheri* and the Lord Howe Island Skink *Cyclodina lichenigera*) and two species of microchiropteran bat complete the indigenous terrestrial vertebrate fauna of the LHIG at the time of European settlement. The two reptiles also occur on Norfolk Island. One of the bats, the Lord Howe Long-eared Bat (*Nyctophilus howensis*) was endemic but is thought to be extinct, while the surviving bat species the Large Forest Bat (*Vespadelus darlingtoni*) is also found widely in south eastern Australia.

Five species of mammal, two species of reptile and a species of frog have been introduced to the LHIG since settlement and established feral populations. Two of the introduced mammals (the Feral Cat and Feral Pig) have since been eradicated, while a third (the Feral Goat) has been reduced to a few wild non-reproductive animals.

Three species of freshwater fish (two eels and a galaxias) occur on the LHIG. All three species are catadromous (spend their adult life in freshwater but spawn in marine waters) and all have wider distributions, including the Australian mainland. The marine fish of the LHIG are outside the scope of this plan.

Appendix 1 (appendices document) lists all the vertebrate fauna species known from the LHIG and Table 4 summarises information on the groups of native vertebrate fauna.

3.5 Invertebrate fauna

The following information has been extracted from Cassis *et al.* (2003). The terrestrial invertebrate fauna of the LHIG is characterised by relatively high species richness and high endemism with up to 60% of some groups comprising endemic species. More than 1600 terrestrial invertebrate species have been recorded, including 157 land and freshwater snails, 464 beetles, 27 ants, 183 spiders, 21 earthworms, 137 butterflies and moths and 71 springtails. The rate of discovery of new species remains high, indicating that numerous endemic species are yet to be discovered.

Information concerning declines and extinctions amongst the indigenous invertebrate fauna since European settlement is incomplete. Cassis *et al.* (2003) provides a preliminary assessment of the conservation status of the Formicidae (ants), Coleoptera (beetles) and Araneae (spiders), identifying one endemic ant and ten endemic beetles which may be extinct and six endemic ants, 38 endemic beetles and nine endemic spiders at risk of extinction (Appendix 2, appendices document). The majority of beetles classified as presumed extinct were large, often flightless species. Other invertebrates thought to be extinct or 'at risk' include a number of land snails and freshwater snails, as well as an earthworm, a phasmid and a cockroach.

Introduced invertebrate species currently comprise about 5% of the recorded invertebrate fauna, including ten land snails and slugs, at least 19 beetles, at least four ants, four spiders, five earthworms and six butterflies and moths. Some introduced invertebrate species are restricted to the settlement area, as they are dependent on human habitation, exotic garden plants or exotic pasture, while others are now widely distributed in

natural habitats across the main island and at least some of the offshore islands.

3.6 Current TSC Act and EPBC Act listings

A number of species and ecological communities on the LHIG are listed as threatened under the TSC Act and/or the EPBC Act, and additional species and ecological communities may warrant consideration for listing in the future. Under the TSC Act, the Schedules must be regularly reviewed. Amendments to the TSC Act allowing for species and communities to be listed as Critically Endangered will probably mean that a number of species and communities currently listed as Endangered may be upgraded to Critically Endangered within the life of this plan.

A summary of the threatened flora, fauna and vegetation communities of the LHIG is provided in Table 5.

Flora and communities

Eight flora species from the LHIG are listed as Endangered under the TSC Act. One vegetation community from the LHIG (Sallywood (*Lagunaria*) Swamp Forest) is listed as an Endangered Ecological Community under the TSC Act. One flora species is listed under the EPBC Act.

Fauna

Thirty five species of birds are listed on the TSC Act, three as Endangered and 23 as Vulnerable,

with the remainder (9) listed as Presumed Extinct. Of the 26 extant threatened species, 10 are classified as vagrants or irregular visitors, four of the resident or breeding threatened species are landbirds (one Endangered and three Vulnerable) and 12 are sea birds. Two of the listed species that breed on the LHIG (the Vulnerable Black-winged Petrel (*Pterodroma nigripennis*) and the Vulnerable White Tern (*Gygis alba*)) are recent colonisers, arriving on the LHIG in the 1940s (Hutton 1991).

Twelve bird species are listed under the EPBC Act, one Endangered sea bird, two Vulnerable landbirds and nine Extinct landbirds. Another 43 birds (eight resident or regular visitors and 35 irregular visitors or vagrants) are listed as protected migratory species under the EPBC Act.

The Lord Howe Island Gecko and Lord Howe Island Skink are listed as Vulnerable under both the TSC Act and EPBC Act, while the endemic Lord Howe Long-eared Bat is listed as Presumed Extinct under the TSC Act and EPBC Act.

Four LHIG invertebrate species, the Lord Howe Island Placostylus (a land snail), the Lord Howe Island Wood-feeding Cockroach (*Panesthia lata*) the Lord Howe Island Earthworm (*Pericryptodrilus nanus*), and the Lord Howe Island Phasmid (*Dryococelus australis*) are listed as Endangered under the TSC Act. The Lord Howe Island Phasmid and Lord Howe Island Placostylus are also listed as Critically Endangered under the EPBC Act. The Lord Howe Island Ground Weevil (*Hybomorphus melanosomus*) is listed as Presumed Extinct under the TSC Act.

Table 4. Summary of vertebrate species (excluding domestic animals) of the LHIG

Group	Endemic native species (presumed extinct in brackets)	Native species (presumed extinct in brackets)	Non-native species* (residents or regular visitors)	Vagrants/ irregular visitors
Land birds	4 (9)	13	18	83
Sea birds	0	11 (2)	5	37
Mammals	1	1	3	6#
Reptiles	0	2	2	3#
Amphibians	0	0	1	0
Freshwater Fish	0	3	0	0
Total	14	45	29	129

* species that have established since settlement; # marine species

Table 5. Summary of threatened flora, fauna and communities of the LHIG (August 2007)

	Flora	Communities	Land birds	Sea birds	Vagrants	Reptiles	Mammals	Invertebrates	TOTAL
TSC Act									
Critically Endangered									
Endangered	8	1	1		2			4	16
Vulnerable			3	12	8	2			25
Presumed Extinct			9				1	1	11
TOTAL									52
EPBC Act									
Critically Endangered	2							1	3
Endangered					2			1	3
Vulnerable			2	2	1	2			7
Extinct			9						9
TOTAL									22
Protected Migratory									43

3.7 Biodiversity hot spots

The richness of biodiversity of the LHIG is unevenly distributed across the landscape and patterns of biodiversity richness can be identified. Areas where species richness or endemism are high are known as biodiversity "hot spots". Hot spot analysis assists with the prioritisation of management actions that will maximise the overall benefits to the biodiversity of the LHIG. A GIS database of species distributions was used to conduct a hot spot analysis. Due to database size constraints, Balls Pyramid was not included in the GIS hot spot analysis.

Flora

The southern mountains are a hot spot for the flora of the LHIG. Within the southern mountains, 56% of the total number of threatened and endemic flora of the LHIG occur, while 33% of LHIG threatened and endemic flora occur only in this region. The northern and central hills region, in contrast, contains 22% of all

threatened, endemic and restricted flora of the LHIG.

The southern mountains are considered a high conservation priority by Auld and Hutton (2004) as they contain the majority of endemic species, and significant endemic plant communities such as Cloud Forest (*Hotbark-Fitzgeraldii* forest), Big Mountain Palm forest (*Hedyscepe canterburyana*) and Blue Plum (*Chionanthus quadristamineus*) closed forest.

Several Endangered plant species (*Carmichaelia exsul*, *Coprosma inopinata*, *Geniostoma huttonii*, *Polystichum moorei* and *Xylosma parvifolium*) are confined to the southern mountains, while two of the three known populations of the Endangered *Calystegia affinis* occur there. Three of the five endemic plant genera of the LHIG only occur in the southern mountains. There are also a number of significant non-vascular plants in the area, particularly on the mountain summits.

Figure 2 illustrates flora species richness for the LHIG. Mounts Gower and Lidgbird both are indicated with the highest overall species richness, with relatively high species richness in adjacent

parts of the southern mountains. Conversely, the northern hills and central lowlands generally display relatively low levels of species richness. Areas of endemism display similar patterns to that of overall species richness, i.e. the highest levels of endemism in the southern mountains.

Vegetation communities

As well as flora, the southern mountains are also a hot spot for vegetation communities, both in terms of richness and endemism. Thirty four of the 44 vegetation communities (77%) for the LHIG occur in the southern mountains, with 17 (39%) of these being restricted to the southern mountains. In contrast, the northern hills have 24 vegetation communities, three of which are unique to this area, while the central lowlands, which includes the settlement area, has 16 vegetation communities, one (Sallywood Swamp Forest Endangered Ecological Community) of which is unique to this area.

Vertebrate fauna

Overall patterns of native fauna distribution are less clear than for flora. Due to the diverse nature of fauna habitats, fauna were analysed in assemblages, namely; sea birds, vertebrates other than sea birds (land birds, reptiles, mammal) and invertebrates.

Sea bird species richness (Figure 3) is highest on the offshore islands, cliffs of the northern hills and down through Searles Point to Middle Beach and Clear Place. Muttonbird Point, Gower Island, the southern tip of the main island and much of the coastline is also highlighted as rich habitat for sea birds. Balls Pyramid is also recognised as being a significant area for sea birds.

Patterns of species richness for vertebrates other than sea birds are less obvious (Figure 4). High species richness is indicated for much of the shoreline areas. This is due to the inclusion of shore birds in this group. Other areas of high species richness are scattered throughout the main island. These areas are most likely triggered by the distribution of land birds such as the Lord Howe Woodhen and the Emerald Ground-dove (*Chalcophaps indica*). Creeklines are highlighted due to the presence of the Long-finned Eel (*Anguilla reinhardtii*), the Short-finned Eel (*Anguilla australis*) and the freshwater fish Common Jollytail (*Galaxias maculatus*).

Invertebrate fauna

For invertebrates, distinctive patterns of endemism, species richness and dissimilarity (distinctiveness of species assemblages) are apparent (Cassis *et al.* 2003) (Figures 5 and 6). Overall levels of endemism for the four groups of invertebrates studied (ants, spiders, beetles and snails) are highest in the southern mountains. However, individual groups show more complex patterns. For example, the beetle group has a high level of endemism in parts of the central lowlands, the northern hills and the southern mountains. Spiders show high levels of endemism in the southern mountains and also on the Admiralty Islands to the north of the main island. The highest areas of ant endemism are limited to the southern mountains, particularly Mount Lidgbird. Snails and ants display a high level of local endemism in the southern mountains. The summits of Mounts Gower and Lidgbird have the highest invertebrate endemism.

Species richness patterns for invertebrates are more complex, with high levels of species richness located in parts of the southern mountains, the northern hills, Steven's Reserve and Transit Hill. Areas with the greatest average dissimilarity occur in the southern mountains, Transit Hill, headlands of the northern hills and the Admiralty Islands.

Specific vegetation types are significant to the distribution of snails, namely the Cloud Forest on the summits of Mounts Gower and Lidgbird, Tea Tree (*Melaleuca howeana*) vegetation around the base of the southern mountains, and Curly Palm (*Howea belmoreana*) vegetation around the base of Mount Lidgbird.

For spiders, Leafy Flat Sedge (*Cyperus lucidus*) on Roach Island, Tea Tree, Cloud Forest and Big Mountain Palm occurring on the slopes of the southern mountains above 600m are significant to their distribution.

Beetle distribution is influenced by elevation and geology and, to a lesser extent, vegetation type. The most significant vegetation types for beetle distribution are Cloud Forest and Fitzgeraldii-Mountain Rose closed scrub at mid altitudes in the southern mountains.

Three vegetation types have a significant influence on ant distribution. These are Five-leaf Morning Glory-Pig Face (*Ipomoea cairica-Carpobrotus glaucescens*) on Roach Island, and Curly Palm around Mount Lidgbird and the

northern hills, and Scalybark (*Cleistocalyx fullageri*) at higher altitudes on the northern hills and southern mountains. The Boat Harbour breccia geology also significantly influences ant fauna composition.

Summary of hot spot areas

Overall, the southern mountains display the highest levels of species richness and endemism

for flora, vegetation communities, invertebrates, and, to a lesser extent, vertebrate fauna.

It is important to recognise, however, that significant species and patterns of species occur outside these areas. Other hot spot areas include Balls Pyramid, the eastern settlement area, the northern hills, offshore islands, Steven's Reserve and Transit Hill.

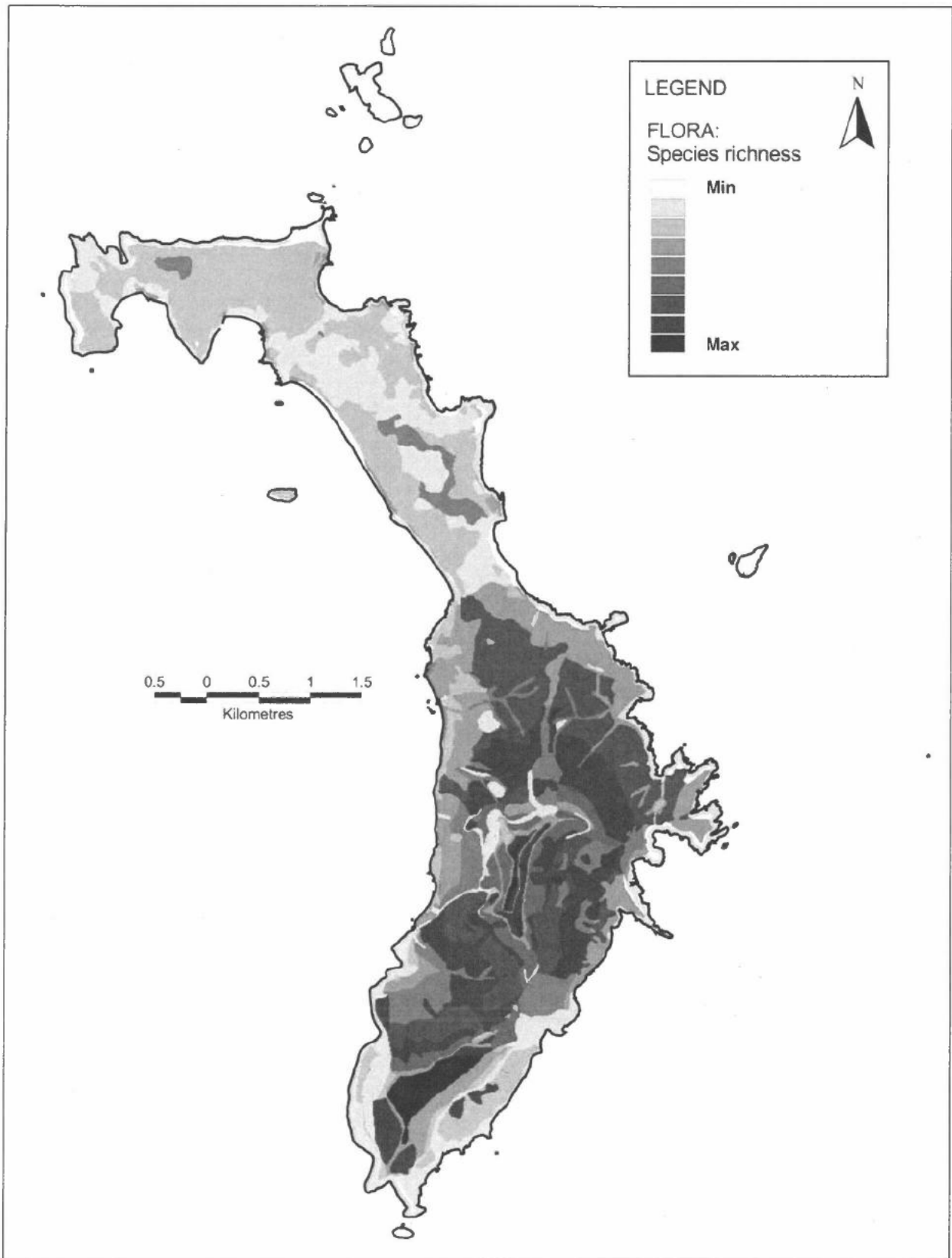


Figure 2. Flora species richness of the Lord Howe Island Group

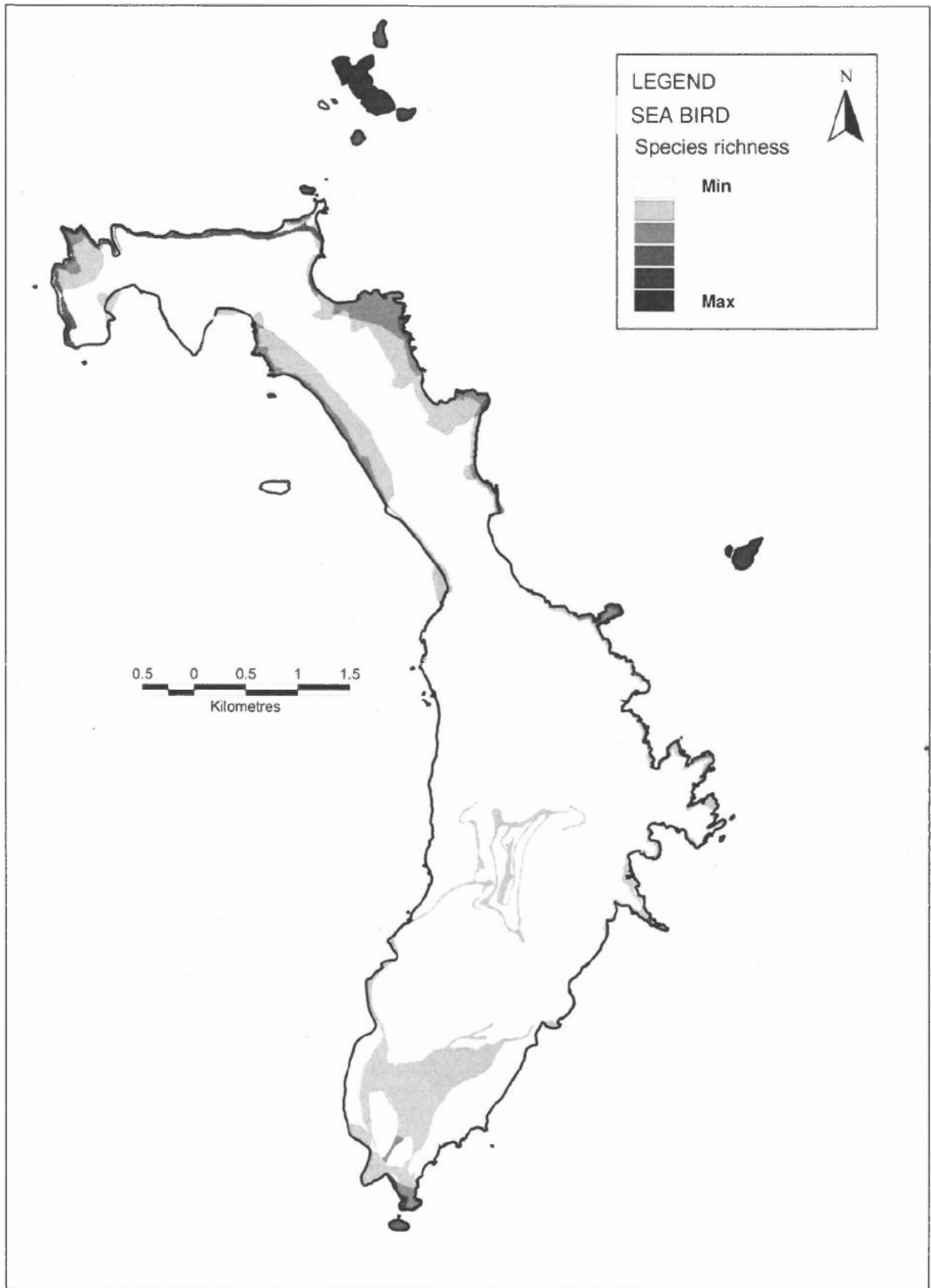


Figure 3. Sea bird species richness for the Lord Howe Island Group

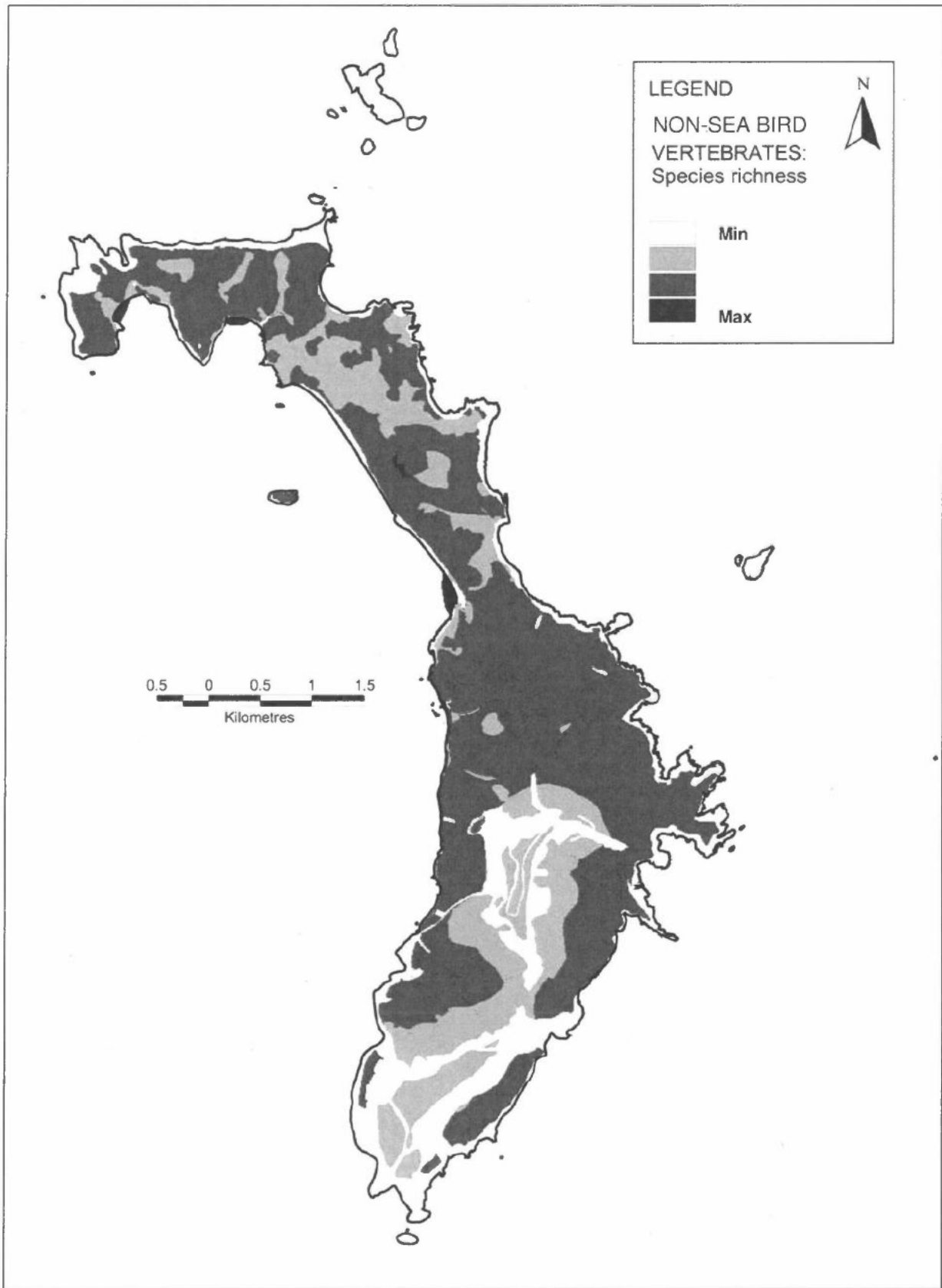


Figure 4. Non-sea bird vertebrate species richness of the Lord Howe Island Group.

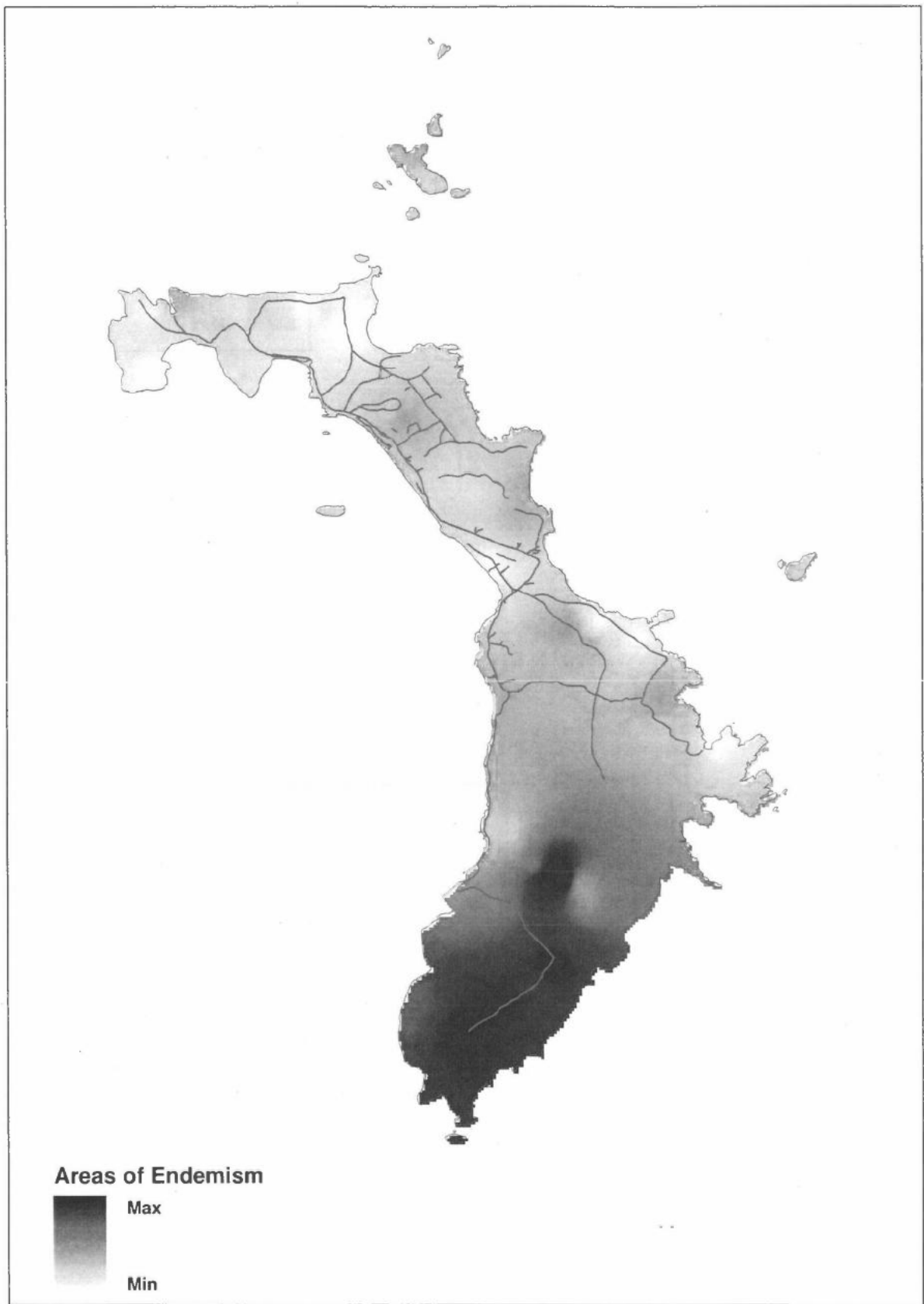


Figure 5. Overall levels of invertebrate endemism for the Lord Howe Island Group. Combined analysis of snails, spiders, beetles and ants (from Cassis *et al.* 2003).

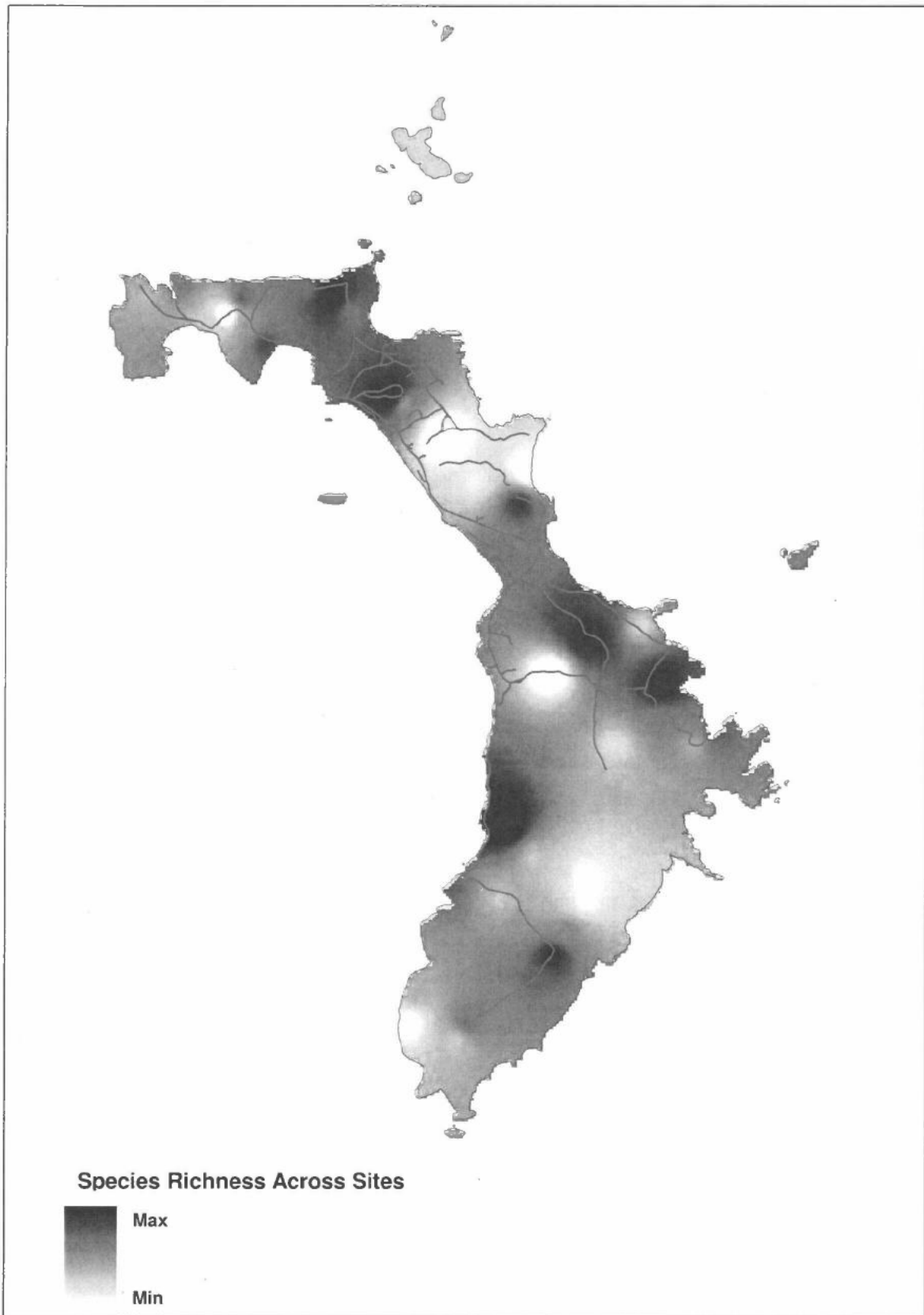


Figure 6. Species richness of snails, spiders, beetles and ants for the Lord Howe Island Group (from Cassis *et al.* 2003).

4 Threats

4.1 Introduction

Like other small oceanic islands, the LHIG has suffered significant species loss due to the impacts of human activities and exotic species introductions. Nine species of land bird and one species of sea bird have disappeared from Lord Howe Island (Hutton 1991), while two species of plants are presumed to be extinct (refer to Appendix 1, appendices document). Two vertebrate species (Lord Howe Island Skink and Lord Howe Island Gecko) are greatly reduced in number on the main island. Several invertebrate species, including two threatened species (Lord Howe Island Wood-feeding Cockroach and Lord

Howe Island Phasmid) are locally extinct on the main island and are now confined to offshore islands.

Often, threatening processes on the LHIG are common to several species. Some of these threats occur broadly across the island, such as predation by the Ship Rat (*Rattus rattus*). Others are more geographically identifiable, such as invasion by the introduced weed Climbing Asparagus, which is predominantly a localised problem. Threats are discussed below in more detail and summarised for each species and community in Appendix 3 (appendices document).

Table 6. Key Threatening Processes relevant to Lord Howe Island (August 2007).

TSC Act	EPBC Act
Anthropogenic Climate Change	Loss of Climatic Habitat Caused By Anthropogenic Emissions of Greenhouse Gases
Clearing of Native Vegetation	Land clearance
Competition and habitat degradation by Feral Goats, <i>Capra hircus</i>	Competition and Land Degradation by Feral Goats
Infection of Native Plants by <i>Phytophthora cinnamomi</i>	Dieback Caused by the Root-rot Fungus <i>Phytophthora cinnamomi</i>
Importation of Red Imported Fire Ants <i>Solenopsis invicta</i>	The Reduction in the Biodiversity of Australian Native Fauna and Flora due to the Red Imported Fire Ant (<i>Solenopsis invicta</i>)
Invasion and establishment of exotic vines and scramblers	
Invasion and establishment of the Cane Toad <i>Bufo marinus</i>	The biological effects, including lethal toxic ingestion, caused by Cane Toads (<i>Bufo marinus</i>)
Invasion, establishment and spread of Lantana (<i>Lantana camara</i>)	
Invasion of the Yellow Crazy Ant	
Invasion of Native Plant Communities by Bitou Bush and Boneseed	
Invasion of Native Plant Communities by Exotic Perennial Grasses	
Predation by the Ship Rat on Lord Howe Island	Predation by exotic rats on Australian offshore islands of less than 100km ² (100,000 ha)
Removal of dead wood and dead trees	
	Incidental Catch (or Bycatch) of Sea Birds during Oceanic Longline Fishing Operations
Entanglement in or Ingestion of Anthropogenic Debris in Marine and Estuarine Environments	Injury and Fatality to Vertebrate Marine Life Caused by Ingestion of, or Entanglement in, Harmful Marine Debris

4.2 Key Threatening Processes

The TSC Act and EPBC Act Key Threatening Processes (KTPs) that are relevant to the LHIG are listed in Table 6. There are 15 KTPs listed that are relevant to the LHIG; 14 of these are listed on the TSC Act and nine on the EPBC Act. Some of these KTPs are common to both Acts. These threats are discussed in more detail in Sections 4.3 and 4.4.

4.3 Current and past threats

Habitat clearing and modification

Clearing of Native Vegetation is a Key Threatening Process on the TSC Act, and Land Clearance is a Key Threatening Process on the EPBC Act.

Much of the retention of the biodiversity values of the LHIG can be attributed to the low degree of disturbance to its native vegetation. Less than 13% of the native vegetation of Lord Howe Island is cleared, and less than 24% is disturbed (Hunter 2002; Pickard 1983). Clearing has occurred in the settlement area for both houses and farmland.

While large scale clearing of native vegetation no longer occurs on Lord Howe Island, the impact of vegetation clearing on a smaller scale needs to be assessed. The loss of individual trees in the settlement area through approved felling, natural senescence or as a result of dense weed invasion can have a significant local impact by adding to habitat loss and creating conditions suitable for weed invasion or vegetation dieback.

Although a large proportion of native vegetation remains on Lord Howe Island, certain vegetation types have been cleared more than others. The vegetation types that were dominant in the settlement area have been subject to the greatest amount of clearing (approximately 48% of the settlement area is cleared). For example, the Greybark-Blackbutt (*Drypetes deplanchei* ssp. *affinis*-*Cryptocarya triplinervis*) closed forest is a dominant vegetation type in the settlement area and, therefore, has had a larger proportion cleared than vegetation types such as Cloud Forest (Hotbark-Fitzgeraldii Closed Forest) which is

restricted to the higher parts of the southern mountains and not subject to clearing. If clearing for further development in the settlement area continues, significant vegetation communities and habitats may be threatened. For example, the vegetation community Sallywood Swamp Forest, which has always had a restricted distribution, is listed as an Endangered Ecological Community on the TSC Act due to the ongoing impacts of clearing and grazing in the settlement area.

It is considered that a possible past reduction in the Flesh-footed Shearwater (*Puffinus carneipes*) population may be due to increased residential buildings in the settlement area which has reduced their habitat. Priddel *et al.* (2006) has calculated that the total extent of nesting habitat for this species has been reduced by 35.6% since 1978. This is associated with increased urbanisation and development, especially around Stevens Point and Middle Beach. In addition, low numbers of Flesh-footed Shearwaters are killed by traffic on roads at night (Hutton 2003).

Fragmentation also poses a threat to vegetation on the LHIG. The PPP is split into northern and southern sections, separated by the settlement area. There is no continuous vegetation corridor between these areas (Olsen 2002).

For terrestrial invertebrates, the modification of ecosystems through land clearance and habitat fragmentation is considered to be the most critical threatening process (New 1995 in Cassis *et al.* 2003). A higher proportion of clearing in the settlement area is likely to have had an adverse impact on the Endangered Lord Howe Island Placostylus, whose preferred habitat coincides with this area. Removal of dead wood and trees is also likely to have a negative impact on other invertebrates on the LHIG. This activity is listed as a Key Threatening Process on the TSC Act.

Vegetation windshear

Vegetation windshear and resulting canopy dieback is evident in many parts of the LHIG, particularly in the settlement area, mostly from the impact of salt-laden winds. When protective vegetation on the windward edge is removed, windshear and damage to the canopy often results. Introduced pasture grasses, particularly Kikuyu and Buffalo Grass (*Stenotaphrum secundatum*), can impede or prevent regeneration of native species in these areas, thus exacerbating windshear.

Vegetation windshear and dieback can also occur in areas which are not adjacent to cleared areas or natural edges. Windshear and dieback in these areas often occurs as a result of damage from storm events, which bring strong salt-laden winds.

Certain vegetation communities and flora species are more susceptible to windshear than others. For example, the Greybark-Blackbutt lowland rainforest association is particularly susceptible to dieback. The small remnants of the Endangered Sallywood Swamp Forest community have suffered from windshear due to exposure. In some sites, only remnant trees remain, and these exposed trees continue to decline due to a lack of any protective surrounding vegetation. Two species of trees which are particularly susceptible to wind damage are Scalybark (*Syzygium fullargarii*) and Banyan (*Ficus macrophylla* ssp. *columnaris*) (Olsen 2002).

Trampling, browsing and grazing

Cattle and Horses were introduced to Lord Howe Island soon after settlement. Cattle still provide a source of fresh meat and milk for the islanders and visitors (Havilah & Blackwood 1996).

Pastures maintained for Cattle and Horse grazing are predominantly cleared of native vegetation, and any remaining native vegetation within these areas can be trampled and browsed, preventing or inhibiting regeneration. Where grazing occurs amongst unfenced native vegetation, the understorey is lost, and pasture grasses and other annual weeds may invade. Remnants of Sallywood Swamp Forest and Mangrove Communities (*Aegiceras corniculatum*) show damage from trampling by cattle (Figure 7). The Endangered Lord Howe Island Placostylus is thought to be impacted by trampling of domestic cattle (Ponder & Chapman 1999).

Pigs and Goats were presumably first introduced to the island by sailors as a source of fresh meat (Flora of Australia 1994). Pigs caused a great deal of damage to vegetation, including rooting for rhizomes, eating seeds (Pickard 1983), disturbing soil invertebrates and causing erosion (NSW NPWS 2002). It is also recorded that Pigs ate

Lord Howe Woodhens and their nest contents (Miller & Mullette 1985). Feral Pigs were eradicated by the early 1980s.

Competition and land degradation by the Feral Goat is listed as a Key Threatening Process on the EPBC Act and the TSC Act. Goat browsing on vegetation, particularly in the southern mountains, was a cause for concern as early as the late 1800s and prompted a control program in the 1970s. Prior to this, Goats roamed the northern hills and southern mountains and, as well as browsing vegetation, denuded areas in and around cave camps and caused faecal downwash from camps. The control program has reduced the number of Goats to a few non-reproductive animals. Goat damage to vegetation, such as scars on trees from chewed bark, is still visible in some areas.

Predation by the Ship Rat *Rattus rattus*

Predation by the Ship Rat is listed on the TSC Act as a Key Threatening Process. The Ship Rat (or Black Rat) was introduced accidentally to Lord Howe Island after the grounding offshore of the supply ship *Makambo* in 1918. The population of Ship Rats increased dramatically soon after establishment, and the Ship Rat is now distributed widely in terrestrial habitats on the main island.

The Ship Rat has a generalised diet, and is known to take seeds, green plant material, fungi, invertebrates, small vertebrates and eggs as food (NSW Scientific Committee 2000).

On Lord Howe Island, the Ship Rat has been implicated in the decline and extinction of five species of birds, the Island Thrush (*Turdus poliocephalus vinitinctus*), the Robust White-eye (*Zosterops strenuus*), the Lord Howe Island Gerygone (*Gerygone insularis*), the Tasman Starling (Lord Howe Island subspecies, *Aplonis fuscus hullianus*) and the Grey Fantail (Lord Howe Island subspecies, *Rhipidura fuliginosa cervina*).



Figure 7. Degraded Sallywood Swamp Forest showing impacts from grazing. This area has now been fenced off for revegetation.

Two sea bird species, the Kermadec Petrel and the White-bellied Storm Petrel, are now restricted to breeding on Balls Pyramid, where previously they were known to breed on the main island. This loss of breeding habitat is thought to be an impact of Rat predation.

The two species of lizards (the Lord Howe Island Gecko and the Lord Howe Island Skink) are scarce on the main island of Lord Howe, where the Ship Rat occurs. They are both more abundant on small islands where Rats are absent.

Invertebrate species have also been impacted by the introduction of the Ship Rat. The Endangered land snail, the Lord Howe Island Placostylus is at risk from Ship Rat predation (NSW NPWS 2001), as is the large land snail *Gudeoconcha sophiae*. The Ship Rat has been linked with the extinction of two large-sized land snails that lived in the southern mountains of Lord Howe Island, a subspecies of the Lord Howe Island Placostylus and an endemic genus and species *Epiglypta howinsulae*.

The Ship Rat has been implicated in the extinction of the Lord Howe Island Phasmid from the main island. This species was recently rediscovered on Balls Pyramid where Ship Rats are absent. Similarly, the Lord Howe Island Wood-feeding Cockroach and the Darkling Beetle (*Promethis sterrha*) are no longer found on the main island, but are restricted to outlying, rat-free islands.

Ten beetle species, the majority of which were large and often flightless, are thought to be extinct (Cassis *et al.* 2003). Their decline is possibly correlated with the introduction of the Ship Rat. The rarity of some of the larger species of ground-dwelling and bark-dwelling spiders may also be due to predation by introduced rodents (Cassis *et al.* 2003). The Ship Rat is likely to directly compete with invertebrate seed-predators, a common group on Lord Howe Island.

In addition to impacts to fauna, the Ship Rat is known to damage the vegetative parts of several species of plants on Lord Howe Island. It depletes seed yields of the commercially-harvested *Kentia*

Palm (*Howea forsteriana*), as well as other endemic island palm species e.g. the Big Mountain Palm, the Curly Palm and the Little Mountain Palm (*Lepidorrhachis mooreana*). Species threatened by the Ship Rat are listed in Appendix 3 (appendices document).

Competition and predation from other introduced animals

Two types of introduced species are recognised in this plan. Self-introduced, naturalised species are those that have arrived on the island and have established populations without human intervention. Many of these species are land birds. Some of these species have been able to establish populations due to human habitat modifications, such as the creation of cleared areas which support species such as Buff-banded Rail. Others can be considered part of natural island ecological processes of establishment of new species. Self-introduced species are listed in Section 3 of Appendix 1.3.

Deliberate introductions are those species that have been introduced to the island by humans. These have either established self-perpetuating populations, or are domestic animals such as cattle and horses.

Both self-introduced and deliberately introduced species impact upon native and endemic species to varying degrees. The degree of impact, and interaction with native and endemic species, needs to be assessed in order to determine which introduced species may warrant control programs.

It is thought that the Songthrush (*Turdus philomelos*) and the Blackbird (*Turdus merula*) were brought to the island in 1944 in an attempt to control the weevils that were eating palm flowers and reducing seed yield (Pickard 1983). These birds are still present on the Island and eat a variety of native and endemic insects and snails, including the Endangered Lord Howe Island Placostylus (Hutton 1991).

Masked Owls (*Tyto novaehollandiae*) were introduced to Lord Howe Island to control Ship Rats in the 1920s, without success. Masked Owls persist in most parts of the island but are more common in the southern mountains (NSW NPWS 2002). They are now considered a pest on Lord Howe Island (Hutton 1991) however, are listed as Vulnerable on the TSC Act.

The Masked Owl preys upon House Mice (*Mus domesticus*), Ship Rats and birds (White Terns,

Black-winged Petrel, Providence Petrel (*Pterodroma solandri*) chicks and Lord Howe Woodhens), (Hutton 1991) and the Lord Howe Island Skink and Lord Howe Island Gecko (Cogger unpub). They may be preventing Kermadec Petrels (*Pterodroma neglecta*) and White-bellied Storm-Petrels (*Fregatta grallaria*) from recolonising the main island (Hutton 2003).

Barn Owls (*Tyto alba*) were also introduced to Lord Howe Island, but are thought to be no longer present.

Cats were brought to the island probably in the 1840s or 1850s (Hutton 2001b). These had an impact on the birds, reptiles and possibly some invertebrates. Feral Cats were removed from the island in 1979 as part of the Lord Howe Woodhen recovery program. In addition to benefits to the Lord Howe Woodhen, other positive impacts of feral Cat removal have been noted. For example, Wedge-tailed Shearwaters (*Puffinus pacificus*) are increasing on dune areas and Little Shearwaters (*Puffinus assimilis*) have returned to breed on the main island after an absence brought about by Cat predation. In 1982, a local law banned domestic Cats (with a "grandfather" clause to allow current owners to keep pet Cats if they were desexed) (Hutton 2001b). There is now only one pet Cat on Lord Howe Island.

The House Mouse reached the island probably as early as 1860, and most likely has an impact on some plant and invertebrate life (Hutton 2001b). House Mice eat a variety of plant fruits, seeds and invertebrates. House Mice have been reported to have caused a decline of the gecko (*Hoplodactylus maculatus*) and skink (*Cyclodina macgregori*) on Mana Island, New Zealand. Both species recovered when the mice were removed (Cogger unpub).

Two of the most recent introductions to Lord Howe Island are that of the Bleating Tree Frog (*Litoria dentata*) and the Grass Skink (*Lampropholis delicata*). The Bleating Tree Frog can be heard calling in many parts of the settlement area and northern hills, while the Grass Skink can commonly be seen in leaf litter in these places. It is not known what impact these species have, but they are likely to compete with, and prey upon, native invertebrates.

Feral Pigeons (*Columba livia*) nest in the sea cliff areas of the northern hills. They are currently being fed by some community members. Feral Pigeons have the potential to increase their

numbers rapidly and compete with native bird species, for nesting, roosting sites and food.

Domestic animals such as Chickens and Ducks have a small but potentially significant impact on native fauna. Chickens are frequently seen foraging in leaf litter amongst native forest in the settlement area, and may feed upon native snails and other invertebrates, including the Endangered Lord Howe Island *Placostylus*. Ducks that are allowed to forage in such areas would also prey upon native invertebrates.

Introduced invertebrates

Approximately 5% of the almost 2000 species of invertebrates on Lord Howe Island are introduced (Cassis *et al.* 2003). The impact of these on native biota is unknown, however, likely impacts on native plants have been identified. For example, it is thought that the chrysomelid *Arsipoda*, which feeds on the Endangered *Calystegia affinis*, may have been introduced with exotic species of *Ipomoea*. The impact of browsing is not known, however, it may affect the flowering, and thus seed-producing, ability of the plant.

The African Big-headed Ant (*Pheidole megacephala*) was most likely introduced to Lord Howe Island about ten years ago and a survey into its distribution was conducted. In 2005 it was found that the ant's distribution was located in the settlement area, generally in disturbed sites, but significantly including Stevens Reserve, which is known for its high level of endemic and restricted invertebrate fauna. The African Big-headed Ant is recognised as a major threat to biodiversity and ecosystem integrity by its ability to out-compete and displace native invertebrates, particularly native ant species and has had major impacts on the biota of other islands where it has colonised. On Lord Howe Island, field assessments of known African Big-headed Ant infestations on the island have indicated that they are displacing native ant species and other native invertebrate fauna.

A large, introduced slug has established in the lowland forests and is a carnivorous species that preys upon smaller endemic snails and slugs (Hutton 2001b). It could have an impact on the Endangered Lord Howe Island *Placostylus*, as well as other significant species. An introduced earthworm is thought to have the potential to compete with native soil fauna, and is considered a potential threat to the Endangered Lord Howe Island Earthworm.

The potential impacts of future invertebrate introductions is discussed further in Section 4.4.

Weed invasion

Weed invasion is a major issue for the biodiversity of the LHIG, and affects all vegetation communities to some extent. Weeds threaten native habitats by competing with native species and have the potential to transform habitats to the detriment of native species.

For the purposes of this plan, a weed is defined as a plant that was not present on Lord Howe Island prior to human settlement, and that is naturalised on the island. The focus of this plan in terms of threats is on existing significant weed species, although it must be recognised that many introduced plant species already on the island (e.g. those growing in gardens) have the potential to become weeds in the future. These species are discussed in more detail in Section 4.4.

There are over 670 species of introduced plants on the island, and approximately 40% (271) of these can be defined as weeds. Forty species have established in the PPP while 13 species are classified as very invasive and have colonised extensive areas of the settlement and PPP. They pose a serious threat to LHIG habitats (Smith, 2002; Le Cussan (in prep; 2003b) (Table 7).

About half the weed species present on the island have originated from introduced pasture seeds and fodder, or are weeds of wastelands and disturbed areas. A few weeds have established via ocean currents, for example the American Sea Rocket (*Cakile edentula*), and the Sea Spurge (*Euphorbia paralias*). The other half of the weed species originated as garden plants. As 11 of the 13 major weed species listed in Table 7 originated as garden plants, the settlement area has historically been, and remains, the major source of both new weed species and a seed source for existing weed species. The major weed species currently found in native vegetation on the LHIG produce seeds which are dispersed either by wind, birds, water or gravity. The walking track network may also be an important transport vector for some noxious and significant weeds such as Cherry Guava (when walkers eat fruit and spit out the seeds further along the track), and plants which produce seed that stick to passers by such as Farmer's Friends (*Bidens pilosa*) (Smith 2002).

Table 7. Noxious and significant weeds of the Lord Howe Island Group

Common name (*)	Scientific name	Major Weed
# African Boxthorn (4)	<i>Lycium ferocissimum</i>	□
# Arundinaria Reed (3)	<i>Arundinaria</i> sp.	
# Bamboo	<i>Bambusa</i> spp.	
# Bitou Bush (2)	<i>Chrysanthemoides monilifera</i>	□
# Bridal Creeper (4)	<i>Asparagus asparagoides</i>	□
Buffalo Grass	<i>Stenotaphrum secundatum</i>	
# Castor Oil Plant (3)	<i>Ricinus communis</i>	
# Cherry Guava (3)	<i>Psidium cattleianum</i>	□
# Climbing Asparagus (4)	<i>Asparagus plumosus</i>	□
# Cotoneaster	<i>Cotoneaster glaucophyllus</i>	□
# Crofton Weed (4)	<i>Ageratina adenophora</i>	□
# Elephant Grass (3)	<i>Arundo donax</i>	
# Glory Lily (3)	<i>Gloriosa superba</i>	
# Ground Asparagus (4)	<i>Asparagus aethiopicus</i>	□
Kikuyu Grass	<i>Pennisetum clandestinum</i>	
# Lantana (3)	<i>Lantana camara</i>	□
# Madeira Vine (4)	<i>Anredera cordifolia</i>	□
Norfolk Island Pine	<i>Araucaria heterophylla</i>	
# Ochna (4)	<i>Ochna serrulata</i>	□
# Palm Grass	<i>Setaria palmifolia</i>	
Rhizomatus Bamboo (3)	<i>Phyllostachys</i> sp.	
# Rhus Tree (4)	<i>Toxicodendron succedaneum</i>	
# Sweet Pittosporum (3)	<i>Pittosporum undulatum</i>	□
# Tiger Lily (4)	<i>Lilium formosanum</i>	□
# Umbrella Tree	<i>Schefflera actinophylla</i>	
# White Cedar	<i>Melia azederach</i>	

Listed on Schedule 3 (noxious plants) of the Lord Howe Island Regulation 2004. The LHIB may take such measures as it considers necessary to control plants declared to be noxious.

* Noxious weed class (in brackets):

- 2 = The plant must be eradicated from the land and the land must be kept free of the plant.
 3 = The plant must be fully and continuously suppressed and destroyed.

4 = The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.

It appears that certain vegetation communities such as *Howea* forest have a fairly low degree of weed invasion (Smith 2002) and, conversely, some vegetation communities, such as grasslands (*Poa*) are significantly affected by weeds across their range. The Greybark-Blackbutt Community also has a high degree of weed invasion, having ten of the 14 major weed species present.

The impact of weeds on terrestrial invertebrates is unknown, but is unlikely to be beneficial (Cassis *et al.* 2003). Weeds usually lack herbivore predators to feed on them, or they support introduced herbivores, which may then attack native plants. Leaf litter of exotic plants may not be palatable to indigenous detritivores.

Three TSC Act Key Threatening Processes concerning weeds are relevant to Lord Howe Island: "Invasion and establishment of exotic vines and scramblers", "Invasion, establishment and spread of Lantana" and "Invasion of native plant communities by Bitou Bush and Boneseed".

Following are brief descriptions of the location and impacts of the major weeds of the LHIG. Much of this information has been sourced from Le Cussan (in prep; 2002a; 2002b; 2003a & 2003b), Hutton and Le Cussan (2001) and Smith (2002).

African Boxthorn (*Lycium ferocissimum*)

A dense infestation of African Boxthorn occurs on the Middle Beach cliffs to Ned's Beach, with one occurrence on Malabar. This plant is dispersed by birds.

African Boxthorn is a declared Noxious plant in all states of Australia.

Climbing Asparagus (*Asparagus plumosus*)

A very large infestation of Climbing Asparagus is located on Transit Hill but it is also reasonably widespread throughout the settlement area. In addition it occurs on Malabar.

This species is a vigorous climber and can cause significant forest canopy damage.

Climbing *Asparagus* is not known to occur in the southern mountains at present.

Climbing *Asparagus* is present in three vegetation associations, namely Greybark-Blackbutt, Kentia Palm, and Lowland Mixed Forest.

Crofton Weed and Tiger Lily

Crofton Weed and Tiger Lily are widespread on Lord Howe Island, and often occur together. Crofton Weed generally requires moist sites whereas Tiger Lily appears to have a wider environmental tolerance. They pose a particularly severe threat in the southern mountains and Intermediate Hill. They are also present in the settlement area, on Transit Hill and the Malabar Range. They have wind-dispersed seed. Tiger Lily can also reproduce from subterranean bulbs.

Crofton Weed and Tiger Lily are both weeds of disturbed areas. Landslips are a significant feature of the southern mountains and represent a large-scale natural disturbance, where weeds such as Crofton Weed and Tiger Lily are often the primary colonisers. In this situation, once Crofton Weed and Tiger Lily have established, it is very difficult for native species to reestablish. In the southern mountains, native fern, herb and moss areas that would have naturally recolonised landslip areas are being replaced by Crofton Weed and Tiger Lily. There are several threatened and significant plant species e.g. the Endangered *Carmichaelia exsul* that are under risk from invasion by these species.

Tiger Lily, while being a weed of disturbed areas, does not require disturbance for colonisation. It is widely established throughout most plant communities on Lord Howe Island, from the mountain tops to the coastal sand dunes.

Crofton Weed and Tiger Lily occur in Greybark-Blackbutt, Kentia Palm, Lowland Mixed Forest, Scalybark-Blue Plum (*Syzygium fullargarii-Chionanthus quadristamineus*), Bully Bush (*Cassinia tenuifolia*), Big Mountain Palm, and Cliff Communities. Invasion by Crofton Weed poses a major threat to the Mixed Fern and Herbfield Community, which is one of the most significant vegetation communities for invertebrates.

One of the major issues for control of these species is the inaccessibility of the terrain they often inhabit, namely, remote parts of the southern mountains including cliffs and rocky slopes. In addition, it appears that very little work has been done on control of bulbous weeds such as Tiger

Lily in Australia. Even in accessible areas, no treatment is undertaken as effective techniques are not known.

Ground Asparagus (Asparagus aethiopicus)

Ground *Asparagus* is a major weed in the Transit Hill area, with the notable exceptions being the fig and palm forests of Middle Beach/Valley of the Shadows area and part of the south facing slope of Transit Hill. This species is the most abundant and widespread weed species on Transit Hill.

On the north-west slopes of Mount Lidgbird and East Point in the southern mountains, Ground *Asparagus* occurs in relatively low densities, suggesting that it is in the initial stages of establishment in these areas.

In the northern hills, Ground *Asparagus* is reasonably widespread, although not in great numbers. It is also present in the settlement area and Intermediate Hill.

Ground *Asparagus* has the ability to completely dominate understorey vegetation, and thus prevent native regeneration. In such a situation, when damage to the canopy occurs, native seedlings are unlikely to be able to regenerate to replace lost or damaged canopy species, thus leading to a progressive decline and dieback of the forest.

As this species has the ability to dominate, and has been recorded in undisturbed areas of forest via bird-dispersed seed, it is considered a serious problem.

Ground *Asparagus* has been recorded in a range of vegetation types including Greybark-Blackbutt, Bully Bush, Kentia Palm, Scalybark-Blue Plum, Cliff and Lowland Mixed Forest.

Bridal Creeper (Asparagus asparagoides)

Bridal Creeper is classified as a weed of national significance. It is widespread across a range of habitats. It can invade undisturbed vegetation and has the potential to eliminate most understorey species in the long term (Walton *et al.* 1991).

On the LHIG, Bridal Creeper is known from the north of the main island, particularly in the Curio Point-Kims Lookout-Malabar area of the northern hills, but also Transit Hill, Middle Beach and in the settlement area. Studies indicate that Bridal

Creeper is actively spreading in this area, and is likely to be bird-dispersed (Le Cussan 2002b).

Bridal Creeper has been recorded in Greybark-Blackbutt, Bully Bush, Kentia Palm, Scalybark-Blue Plum, Cliff, and Lowland Mixed Closed Forest Communities.

***Bitou Bush* (Chrysanthemoides monilifera)**

“Invasion of native plant communities by Bitou Bush” is listed as a Key Threatening Process under the TSC Act. Bitou Bush is also classified as a weed of national significance.

Bitou Bush occurs on cliffs in the northern hills (Malabar area), parts of the settlement area, Transit Hill, and the southern mountains. It occurs in a variety of vegetation types, from rainforest and palm forest to more open vegetation types such as those dominated by Bully Bush.

Bitou Bush occurs mostly as scattered plants, but in some locations it grows in larger clumps consisting of many plants (e.g. cliffs in the northern hills, parts of the coastline, and Grey Face).

Bitou Bush is classified as a W1 noxious weed on the LHIG, which means the LHIB must be notified of the presence of the weed within three days and the weed must be fully and continuously suppressed and destroyed. The location of this species in remote areas, however, makes this action difficult to implement.

***Cotoneaster* (Cotoneaster glaucophyllus)**

Cotoneaster is a garden escape and mostly occurs in highly disturbed areas in paddocks of the southern settlement area. Several plants have also been found on Intermediate Hill and the Grey Face. It is found in Greybark-Blackbutt and Kentia Palm Communities. As it has a bird-dispersed seed, it must be considered a serious weed threat.

***Lantana* (Lantana camara)**

Lantana is a weed of national significance, and has devastating impacts on mainland Australia. Invasion, establishment and spread of Lantana is listed as a Key Threatening Process under the TSC Act. It is classified as a class 3 weed by the LHIB, meaning that the weed must be fully and continually suppressed and destroyed.

Currently, Lantana exists on the LHIG as relatively isolated patches in the northern half of the island, mostly around the settlement area and Transit Hill. It is not known why Lantana has not proliferated on the LHIG. The Island's basalt soil, rainfall and climate appear to be ideal conditions for Lantana to thrive. Lantana, therefore, has the potential to significantly impact upon the biota of the LHIG.

***Madeira Vine* (Anredera cordifolia)**

Madeira vine is a significant problem weed species in many parts of Australia, where it can modify native vegetation, particularly rainforest. It is thought that it may be spread by rats in (Parsons & Cuthbertson 2001).

Madeira Vine was introduced to Lord Howe Island as an ornamental. At present it is confined to several leases in the settlement area.

***Norfolk Island Pine* (Araucaria heterophylla)**

The mature Norfolk Island Pines in the settlement area have significant cultural associations and are now an integral part of the landscape there. The pines are restricted to the settlement area, except for an outlier population at North Bay. The species, however, is spreading rapidly in some areas, to the detriment of native species. Norfolk Island Pines have the ability to change the soil chemistry, making soil conditions unsuitable for germination of many native species.

***Ochna* (Ochna serrulata)**

The major distribution of Ochna is in the central parts of Lord Howe Island, on the north-west slopes of Mount Lidgbird, Intermediate Hill and in the Transit Hill area. It is often recorded in disturbed areas, principally previously cleared, but also in isolated patches in intact forest. Generally, hundreds of juveniles are recorded beneath one or two mature plants.

Ochna has the potential to spread at an exponential rate once wildlings become reproductively mature (Brown 1998). Being a bird-dispersed species, this may have significant consequences for as-yet uncolonised parts of the LHIG.

This species is known from Greybark-Blackbutt, Kentia Palm, Lowland Mixed Closed Forest, and Scalybark-Blue Plum Communities.



Figure 8. Buffalo grass invasion on Lord Howe Island

Sweet Pittosporum (*Pittosporum undulatum*)

Sweet Pittosporum is a relatively long-lived species. Its bird-dispersed seed is capable of germination in low-light and relatively undisturbed situations, and has the potential to form virtual monocultures. It must therefore be considered a serious risk to the habitats of the LHIG.

This species is predominantly a problem in the Transit Hill area, although individual shrubs have been recorded on Intermediate Hill and the Malabar Range. The main infestations of Pittosporum are in the vicinity of cleared areas or paddocks. The presence of many seedlings and young plants spreading out from main areas of infestation is evidence of active recruitment.

Sweet Pittosporum has been recorded in Greybark-Blackbutt, Kentia Palm, and Lowland Mixed Closed Forest Communities.

Cherry Guava (*Psidium cattleianum*)

The International Union for the Conservation of Nature and Natural Resources (IUCN) consider Cherry Guava to be the worst woody weed of subtropical island ecosystems in the world (Auld & Hutton 2004). It is the major woody weed on

the Galapagos Islands, Mauritius, Seychelles, Hawaii and Norfolk Island.

Cherry Guava is recorded in most forest types on Lord Howe Island. With an edible, fleshy fruit, its seed is dispersed primarily by birds and, to a lesser extent, by water, gravity and humans.

The main infestations of Cherry Guava on the LHIG are in the Transit Hill area, Intermediate Hill and disturbed areas and abandoned paddocks on the forest edge of the north-west slopes of Mount Lidgbird. The worst infestations are often linked to the vicinity of cleared areas or paddocks or old landslip areas. From these dense infestations, Cherry Guava penetrates into intact forest. Its spread is then assured by means of suckering, prolific fruiting and allelopathic properties of the leaf litter, inhibiting growth of native species.

There are significant concerns that Cherry Guava will penetrate further into the southern mountains, particularly as this species has been recorded on the slopes around Mt Gower. This infestation has since been treated, however, ongoing monitoring will be required.

Exotic grasses

Invasion of exotic grasses, particularly Kikuyu (*Pennisetum clandestinum*) and Buffalo Grass pose a

significant threat to habitats of Lord Howe Island. "Invasion of native plant communities by exotic perennial grasses" is listed as a Key Threatening Process on the TSC Act.

Kikuyu has been deliberately planted in many parts of the island for pasture and also to prevent erosion (e.g. the Get Up place on the Mount Gower track). Kikuyu now covers virtually the entire summit of Muttonbird Point, having spread rapidly from 1970 to 1980. This has reduced the number of Wedge-tailed Shearwaters breeding here, and at Signal Point, as the grass chokes the burrows and has been reported to strangle birds (Hutton 2003).

Both Kikuyu and Buffalo Grass severely restricts regeneration of native species, as they form a thick barrier which is virtually impossible for seedlings to penetrate. Buffalo Grass is a particular problem in the settlement area and forest edges on Transit Hill, inhibiting the regeneration of these areas.

At least two threatened plant species are at risk from exotic grass invasion, namely *Calystegia affinis* and Knicker Nut (*Caesalpinia bonduc*).

Vasey Grass (*Paspalum urvilleana*) and Panic Veldtgrass (*Erihata erecta*) are two additional potentially serious exotic grasses, which establish in moist shaded areas. Both are present in the southern mountains (Le Cussan pers. comm.).

Other weed species

Several other species present on the LHIG have the potential to become major weeds. These are discussed in Section 4.4. Some of these have already established wild populations on the LHIG. All weed species recorded for the LHIG are listed in Appendix I (appendices document).

Domestic dogs

Domestic Dogs on the main island have been reported on occasion to attack sea birds such as Flesh-footed Shearwaters. This is thought to be a minor threat to sea bird populations. Under the *Companion Animals Act 1998*, domestic Dogs are required to be on a leash when in public areas, which, if complied with, minimises the risk of wildlife attack. As the settlement area is major seabird nesting habitat some level of attack may occur unnoticed and unreported on individual leasehold properties.

Tourism

The impacts of tourism on the LHIG are generally considered to be low, being mostly erosion and trampling of small areas on and beside tracks and lookouts. This has the associated impact of weed invasion along track edges. Some greater cause for concern is the impact of tourists to Mount Gower. Although the overall number of visitors is relatively low, visitation to the summit may have a negative impact on the Cloud Forest vegetation, primarily through trampling and pollution.

Groundwater pollution

Two of the four groundwater catchments of the island currently show levels of contamination which restrict their use for domestic purposes.

Current effluent disposal arrangements have been shown to impact upon groundwater quality. Limits are required on calcarenite soil types to minimise impacts. Biodiversity implications include potential nutrification of low-lying vegetation communities and streams, and introduction of pathogens.

Hunting and collecting

At least three species of birds are believed to have been hunted to extinction soon after settlement of Lord Howe Island, both for food and because of their predation on crops.

Both the White Gallinule (*Porphyrio albus*) and the White-throated Pigeon (*Columba vitiensis godmanae*) were large, quiet birds and were hunted in large numbers for food in the early years of settlement (Hutton 1991). The White Gallinule was thought to have become extinct around the time of settlement in 1834, while the White-throated Pigeon was not able to be found by 1853 (Hutton 1991). The Red-crowned Parakeet (*Cyanoramphus novaezelandiae subflavescens*) was shot and trapped because it damaged gardens on Lord Howe Island (Garnett 1992). It was last seen in 1869.

Sea bird eggs were collected as a traditional food source for islanders and sailors visiting the island (Etheridge 1889). This is likely to have historically impacted upon population numbers. It is reported that some island residents continue to remove a small number of sea bird eggs for food which would constitute a minor threat to sea bird populations. Native fauna are protected under the *NSW National Parks and Wildlife Act 1974*

(NP&W Act) and any collecting activity requires licensing.

Hunting is not considered to constitute a significant threat for LHIG species any longer.

Over-collection, or illegal collection, of rare invertebrate species may pose a significant threat to some species. In 2002, two collectors were arrested in the possession of over 1000 individuals of two endemic species of stag beetle. Associated with the direct impacts from the loss of the individuals is damage to habitat, such as damage to rotting logs, that can be sustained during collection.

Collection of native plants

Several traditional activities are, or have been, undertaken on the LHIG which may impact upon native flora and fauna. These include collecting native palm seed from within native vegetation, cutting Pandanus (*Pandanus forsteri*) foliage and fern and orchid collection. Palm seeding and Pandanus cutting are not considered to constitute a significant threat to biodiversity, however, collection of rare orchids and ferns may have a detrimental effect on population numbers. Collection of any native plant species requires licensing under the NP&W Act.

Human interactions

In the settlement area, people provide Lord Howe Woodhens with food and water. Woodhens have also been observed eating food provided for domestic poultry (NSW NPWS 2002). A recent study suggests that inappropriate feeding may impact on the health of some birds (Hiscox & Crane 2005). Woodhens are observed in the vicinity of the waste facility and may ingest items deleterious to their health.

It is reported that Woodhens and Flesh-footed Shearwaters are occasionally killed by vehicles, although this is considered a rare occurrence.

Long-line fishing and ingestion of plastic

"Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris" is listed as a Key Threatening Processes under the EPBC Act. "Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments", a Key Threatening Process under the TSC Act, also threatens LHIB fauna. The long-line fishing

industry operating in waters off eastern Australia is responsible for the drowning deaths of many thousands of sea birds annually, including Flesh-footed Shearwaters (Baker & Wise 2005). Plastic ingested by adult birds is subsequently regurgitated and fed to chicks (Hutton 2003). The impact of such ingestion is unknown and warrants investigation. Sizeable quantities of plastic have been found within skeletal remains of Flesh-footed Shearwaters on the Island. Ingested plastics may also be a threat to Black-winged Petrel, Sooty Tern (*Sterna fuscata*), Masked Booby (*Sula dactylatra*) and White Terns.

Both the above threats are likely to have a negative impact on the populations of these species in the LHIG.

Interaction between species

The Vulnerable Lord Howe Currawong (*Strepera graculina crissalis*) preys on the chicks of the Vulnerable White Tern. While the White Tern has a secure global population and is a relatively recent coloniser of the LHIG, its charismatic status amongst locals and visitors can engender negative sentiment towards the conservation of the Lord Howe Currawong. The Lord Howe Currawong is also a disperser of the seeds of fleshy-fruited weeds.

The popularity of the White Tern has an influence on weed control actions, as one of its favoured nesting sites are the semi-horizontal branches of the Norfolk Island Pine, a weed of the LHIG. This may impact upon the prioritisation of weed control programs.

Lord Howe Woodhens occasionally take Providence Petrel chicks, however, this constitutes a minor threat for the Providence Petrel (Bester 2004).

4.4 Potential threats

Climate change

"Anthropogenic climate change" is listed as a Key Threatening Process under the TSC Act and "Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases" is listed under the EPBC Act.

At highest risk from climate change are those unique communities and species restricted to the southern mountains, in particular, those associated with Cloud Forest vegetation, which is

the most extensive vegetation community on the summit of Mount Gower.

The micro-climate of Mount Gower is produced when moist air is forced to rise over the summit, the resulting condensation forming cloud cover over the mountains, particularly during summer. The resulting high humidity provides conditions for many unique species to exist.

Climate change predictions indicate both an upward altitudinal shift in the relative humidity surface (Still *et al.* 1999) and an increase in temperature for Australia of between 0.4°C and 2.0°C by 2030 (Hughes 2003). If cloud cover is reduced and temperatures (thus evapo-transpiration) increase, severe impacts could result on vegetation types such as Cloud Forest that rely on high moisture levels.

Climate change is also likely to alter sea-surface temperatures around Lord Howe Island. The associated changes in the marine ecosystem are likely to have severe consequences for the seabirds breeding within the LHIG, similar to those already observed in the northern hemisphere. Many of the seabirds that breed within the LHIG are at the extremity of their breeding range and breeding birds can travel long distances to forage. A shift in the distribution of prey species can greatly affect breeding success and fledgling survival.

Climate change may alter the frequency and severity of storm events, or lead to an increase in drought events which could have a significant impact on the flora and fauna. Lowland parts of the LHIG are at risk from sea level rise as a result of global warming. A summary of species and communities at risk from climate change is provided in Appendix 3 (appendices document).

Climate change is considered to be a significant threat for LHIG terrestrial invertebrates (Cassis *et al.* 2003).

Introduction of pests, weeds and disease

Introduction of new exotic fauna and flora constitutes a major ongoing threat to the biodiversity of the LHIG. There is a continual risk of the introduction of new pathogens, weeds, invertebrates and vertebrates with the arrival of every ship or aircraft.

The impact of introduced invertebrates is potentially one of the most critical threatening processes affecting the survival of native species

and ecosystems of the LHIG (Cassis *et al.* 2003). Alien invertebrate species have the potential to have severe impacts on the native biota. Invasion by the Red Imported Fire Ant is listed as a Key Threatening Process on both the TSC Act and the EPBC Act and would have severe impacts on the biota of the LHIG if introduced.

Aside from the Red Imported Fire Ant, other exotic ant species have had dramatic impacts on the ecosystems of other islands. For example, Yellow Crazy Ants (*Anoplolepis gracilipes*) have invaded Christmas Island and have killed 20-25% of the entire population of land crabs in seven years (www.wilderness.org.au/campaign/marine/christmas_island/ants_ci). If introduced to the LHIG, this species could significantly affect native fauna as they prey heavily on ground invertebrates and attack any slow moving vertebrates such as bird nestlings. They damage plants by eating fruit, seeds, tunnelling into stems and girdling seedlings. This species was recently detected at a Lord Howe Island cargo loading wharf in Iluka, highlighting the high risk of potential invasion by this, and other, exotic invertebrate species. Invasion of the Yellow Crazy Ant is listed as a Key Threatening Process on the TSC Act.

Cane Toads (*Bufo marinus*) represent a significant potential risk of being introduced to the LHIG. If introduced, Cane Toads are likely to have dramatic impacts on the fauna of the LHIG. Vertebrates that may prey upon Cane Toads are likely to be poisoned, and invertebrates would be prey for the Cane Toad. Cane Toad populations are located in the vicinity of wharf areas where Lord Howe Island cargo boats are loaded in Yamba and Iluka.

The invasion, establishment and impacts of Cane Toads are listed as Key Threatening Processes on the TSC and EPBC Acts.

The impact of weeds has already been discussed in some detail (section 4.2). It is important to note the potential threat from the introduction of new weed species, as well as the threat of exotic species already present on Lord Howe Island that have not yet naturalised. There are approximately 271 species that have escaped from cultivation on Lord Howe Island, and around 400 species present in gardens on Lord Howe Island with unknown weed potential. In addition to these species, many garden plants present on Lord Howe Island are environmental weeds in similar habitats on mainland Australia, thus are potential weed problems for the LHIG (Le Cussan 2003b).

“Infection of native plants by *Phytophthora cinnamomi*” is listed as a Key Threatening Process under the TSC Act, and ‘Dieback caused by the root-rot fungus *Phytophthora cinnamomi*’ is listed as a Key Threatening Process under the EPBC Act.

Introduction of pathogens such as *P. cinnamomi* to forest areas could have a significant negative impact on native vegetation. *P. cinnamomi* has been detected from one lease in the southern settlement area of Lord Howe Island and could potentially be spread via footwear. There are a number of plant taxa in the LHIG that are closely related to taxa in other parts of the world that have been severely impacted by *P. cinnamomi* (Auld & Hutton 2004). These are listed in Table 8.

Herbicide use

There is some concern that herbicide use to control weeds may have a negative impact on non-target species, particularly invertebrates. Studies indicate that large arthropods such as ground predators (spiders and beetles) and fish are not at risk, or at a very low risk, from glyphosate formulations, however, several foliar dwelling species are potentially affected (Gomez & Sagardoy 1985). Reproduction and development of aquatic snails may be impacted by glyphosate use (Tate *et al.* 1997).

Habitat modification is the most likely impact from herbicide use. Methods of weed control or eradication may impact heavily on fauna. For example, modification of vegetation in treated areas can affect invertebrates (Cassis *et al.* 2003) and other fauna through loss of protective habitat or nest sites. Broad scale sprays of infested areas, depending on the spray used, could be toxic to foliage and stem boring species.

Stochastic events

Stochastic (chance) events such as severe storms, cyclones, drought and disease outbreaks constitute a significant threat to the biodiversity of the LHIG. Many species, especially endemic species, are particularly at risk due to limited population size and distribution.

Research projects

Some forms of research may represent a minor threat to species or biodiversity of the LHIG. For example, the only location of an Endangered plant on Lord Howe Island occurs on a narrow ridgeline which is used by researchers to access a remote part of the island. Although visitation to such areas is low, it is important to recognise the potential impacts to threatened or restricted species and communities.

Table 8. Species from the Lord Howe Island Group with conspecifics elsewhere in the world that have been impacted by *Phytophthora cinnamomi* (from Auld & Hutton 2004)

Lord Howe Island species	Conspecific affected elsewhere
<i>Cassinia tenuifolia</i>	<i>C. aculeata</i> (eastern Australia)
<i>Coprosma huttoniana</i> ; <i>C. inopinata</i> ; <i>C. lanceolaris</i> ; <i>C. prisca</i> ; <i>C. putida</i>	<i>C. australis</i> (New Zealand)
<i>Drypetes deplanchei</i> ; <i>Cryptocarya triplinervis</i>	<i>C. cinnamomifolia</i> , <i>C. corrugata</i> , <i>C. glaucescens</i> (Tropical Queensland)
<i>Dodonaea viscosa</i>	<i>D. viscosa</i> (eastern Australia)
<i>Drachophyllum fitzgeraldii</i>	A range of Epacridaceae
<i>Exocarpus homalocladus</i>	<i>E. cupressiformis</i> (eastern Australia)
<i>Gahnia howeana</i>	<i>G. xanthocarpa</i> (New Zealand)
<i>Gonocarpus</i> sp.	<i>Gonocarpus teucrioides</i> (eastern Australia)
<i>Leptospermum polygalifolium</i> ssp. <i>howense</i>	<i>Leptospermum</i> spp. (eastern Australia)
<i>Leucopogon parviflorus</i>	<i>Leucopogon</i> spp. (eastern Australia)
<i>Metrosideros nervulosa</i> ; <i>M. sclerocarpa</i>	<i>Metrosideros</i> spp. (Hawaii)
<i>Olearia ballii</i> ; <i>O. elliptica</i> ssp. <i>praetermissa</i> ; <i>O. mooneyi</i>	<i>O. oppositifolia</i> (eastern Australia)
<i>Syzygium fullagarii</i>	<i>S. erythrodaxa</i> , <i>S. wesa</i> (tropical Queensland)
<i>Symplocos candelabrum</i>	<i>S. stawellii</i> (tropical Queensland)

5 Current Management and Documents

The LHIB, other government agencies and individuals have been responsible for the preparation and implementation of several management and biodiversity inventory documents for the LHIG.

One of the aims of the LHI BMP is to synthesise biodiversity management documents and management practices to enable prioritisation of management actions to maximise biodiversity outcomes and cost efficiencies. The synthesis of documents may also indicate areas of conflicting management actions.

Documents relevant to the management of biodiversity in the LHIG, including a brief description of their contents and purpose, are listed below.

5.1 Plans of management

Permanent Park Preserve Plan of Management (DECC in prep)

The Plan of Management currently in preparation updates the 1986 Plan. It details management of natural and cultural values of the PPP. The draft plan is due to be exhibited in the near future.

Regional Environment Plan (DIPNR 2005)

A Regional Environment Plan (REP) was adopted in October 2005 to update the 1986 REP. The new REP updates the current planning framework for development for the LHIG.

The REP includes a mapped layer of 'significant vegetation'. Under the REP no development can result in any damage or removal of significant vegetation.

Lord Howe Island World Heritage Property Strategic Plan for Management 2000-2005 (Manidis Roberts 2000)

This document provides a framework for the protection of the world heritage values of the

LHIG consistent with the requirements of the World Heritage Convention.

The major goals in the plan are to protect, conserve, rehabilitate, present and transmit the World Heritage values of the property to future generations. A further goal is to integrate the island community in decision making and management of the LHIG World Heritage values.

Lord Howe Island Board Corporate Plan (2004)

The LHIB Corporate Plan identifies key objectives, strategies and performance indicators for the natural environment. The overall objective is to protect, enhance and promote the LHIGs natural environment and cultural heritage. This is to be achieved through weed and pest control, improvements to ground water quality, protection and conservation of threatened species, identification of gaps in scientific knowledge, and promotion of public awareness of conservation.

5.2 Recovery Plans and unpublished reports

There are currently two approved single species Recovery Plans and one draft multi species Recovery Plan relevant to the LHIG.

Lord Howe Island Placostylus Recovery Plan (NSW NPWS 2001)

The Lord Howe Island Placostylus is listed on the TSC Act as Endangered and the EPBC Act as Critically Endangered. The Recovery Plan describes the current understanding of the species and the research and management actions necessary to maximise the likelihood of the species' ongoing viability in the wild. Major actions include survey and monitoring, Ship Rat control at key sites, captive breeding and community awareness. A summary of the actions contained in the plan and their status are provided in Table 9. Refer to the Recovery Plan for a more detailed description of actions.

Table 9. Recovery actions from the *Lord Howe Island Placostylus Recovery Plan*

Action (priority in brackets)	Status
Survey and research	
Survey areas of high potential habitat in the southern mountains (1)	commenced
Establish long-term monitoring at selected <i>Lord Howe Island Placostylus</i> sites (1)	commenced
Study the impact of the Blackbird and Songthrush on the <i>Lord Howe Island Placostylus</i> and the feasibility of eradicating these bird species from Lord Howe Island (1)	
Support research on threats to the <i>Lord Howe Island Placostylus</i> and actions to control these agents, including predation by introduced species, habitat degradation by weeds, and impacts of herbicide and pesticide usage (1)	
Conduct research into the ecology and lifecycle of the <i>Lord Howe Island Placostylus</i> (2)	commenced
Support research into genetics (3)	
Ensure that licence applications for any research and field survey projects observe the guidelines provided in Appendix 3 of the Recovery Plan (2)	ongoing
Protection of extant populations and habitat	
Continue Rat baiting program at the eleven high priority areas. Support additional baiting areas relevant to the <i>Lord Howe Island Placostylus</i> (1)	underway
Enter locational data onto Wildlife Atlas database and provide to LHIB (1)	complete
Prepare maps of high potential habitat and provide to the LHIB to assist with environmental assessment (1)	complete
Approval authorities to include consideration of potential impacts on the <i>Lord Howe Island Placostylus</i> and its habitat for proposed developments and activities (S5A EP&A Act) as per the impact assessment guidelines in Appendix 2 of the Recovery Plan (1)	ongoing
Commonwealth listing	
Prepare nomination for the <i>Lord Howe Island Placostylus</i> to be listed as threatened under the Commonwealth EPBC Act (1)	complete
Community awareness and involvement	
Prepare and distribute a brochure on the <i>Lord Howe Island Placostylus</i> for residents and tourists (1)	
Prepare a permanent display for the Lord Howe Island Museum to promote awareness of the Lord Howe Island Placostylus (2)	
Undertake media publicity of the status of the Lord Howe Island Placostylus (2)	ongoing
Ensure up to date information is provided for the Australian Museum's invertebrate web site (2)	complete
Ex-situ conservation measures	
Establish a captive breeding program for the Lord Howe Island Placostylus (2)	commenced
Regenerate an area of Greybark-Blackbutt forest on Blackburn Island (3)	commenced
Recovery team	
Form a Lord Howe Island recovery team (1)	complete
Conduct an annual review of the Recovery Plan priorities (1)	ongoing

Lord Howe Woodhen Recovery Plan (NSW NPWS 2002)

The Lord Howe Woodhen is listed on the TSC Act as Endangered and on the EPBC Act as Vulnerable. A number of recovery actions have already been implemented since the approval of the plan. Recovery actions in the Recovery Plan are summarised in Table 10.

Norfolk Island and Lord Howe Island Threatened Lizards Draft Recovery Plan (Cogger, unpub.)

This draft recovery plan addresses two lizard species native to both Norfolk and Lord Howe Islands: the Lord Howe Island Gecko and the Lord Howe Island Skink. Actions relevant to the LHIG are incorporated into this plan.

5.3 Weed and vegetation management

Weed management activities have been a primary long-term focus of the LHIB. To this end, several strategic weed and vegetation management reports have been prepared. These are outlined below.

Weed management strategy for Lord Howe Island (Le Cussan in prep)

The draft weed management strategy updates the 2002 Lord Howe Island Strategic Plan for Weed Management described below. Following a review of weed management on Lord Howe Island and overseas, the LHIB has changed the focus of weed management from control of highest priority environmental weeds to eradication. This has been made possible by a grant from the NSW Environmental Trust. The program is based on one that was developed by the New Zealand Department of Conservation which is currently in use for their island ecosystem management programs. Methods include dividing Lord Howe Island into 414 work units or blocks and systematically treating and recording weed infestations. Blocks and known infestations are permanently marked and details of treatments and infestations recorded in a database. It is intended to treat every block at least once every two years while infestations remain high.

Lord Howe Island Strategic Plan for Weed Management (Smith 2002)

This document is the precursor to the draft plan described above. It includes broad scale distribution and abundance maps for noxious weeds.

This document is in two parts. Part A provides a suggested framework for the development of a strategic and comprehensive program of management of the LHIG's most significant environmental weed problems. Part B is a checklist of all the known environmental weeds for the LHIG. Table 11 lists the key components from this plan.

Density Distribution of Major Weeds of Lord Howe Island (Le Cussan 2002a, 2002b, 2003a, 2003b)

The densities and distributions of key weed species in three areas of the LHIG are mapped in these three reports. The reports document surveys for Bridal Creeper, Cherry Guava, Climbing Asparagus, Coastal Morning Glory, Cotoneaster, Crofton Weed, Ground Asparagus, Ochna, Tiger Lily and Sweet Pittosporum. The three areas mapped are the north-west slopes of Mount Lidgbird and Intermediate Hill (in the southern mountains), Transit Hill and the Malabar Range in the north of the island.

Lord Howe Island Revegetation Plan (Olsen 2002)

This revegetation plan provides strategic directions for revegetation projects. The focus is on restoration or reconstruction of vegetation most under threat from past vegetation clearing. It identifies ways to manage threats to minimise their degrading effects on core areas of native vegetation.

The plan covers the main island and Blackburn Island only and is intended to be active between 2002 and 2007. Key components from this plan are listed in Table 12.

Table 10. Task summary from the *Lord Howe Woodhen Recovery Plan*

Management	
Action (priority in brackets)	Status
Continue to implement strict procedures for managing the PPP. Ensure that a full assessment of proposals that may impact upon the Lord Howe Woodhen is undertaken as required by the EP&A Act (1)	ongoing
Ensure that the revised REP considers protection of the Woodhen and continue implementing planning controls to ensure protection of habitat for the Woodhen (1)	ongoing
Enforce current Dog controls and, if required, review current Dog controls, to ensure protection of the Woodhen (2)	ongoing
Eradicate feral Goats on Lord Howe Island and manage domestic Goats to prevent reintroduction to the wild. Ensure that any potential impacts of eradication upon the Woodhen population are assessed (3)	ongoing
Liaise with the Rodent Eradication Taskforce regarding potential impacts and mitigation measures relating to Woodhens (1)	ongoing
Assess the impacts of the introduced Masked Owl on Woodhen population levels and develop an appropriate management response (2)	
Ensure that weed control programs protect Woodhen habitat (3)	ongoing
Ensure that the quarantine plan addresses issues of avian disease and the introduction of plants or animals that may impact on the Woodhen (2)	complete
Establish a recovery team to coordinate the implementation of recovery plans (1)	complete
Research	
Assess the impact on the Woodhen of food competition from Buff-banded Rails, Purple Swamphens, Blackbirds and Songthrushes and, if necessary, formulate and implement a control strategy (2)	
Continue the Woodhen monitoring program. Ensure that LHIB staff are trained in the management of the Woodhen database (1)	ongoing
Determine the carrying capacity of Lord Howe Island for Woodhens and the critical number of Woodhens to trigger an on-island captive breeding program (1)	ongoing
Formulate and implement guidelines for the protection, management and enhancement of Woodhen habitat on leasehold land. Undertake a study to determine the most appropriate supplementary food types (2)	complete
Establish and manage captive populations of the Woodhen in appropriate off-island institutions, consistent with the protocols of the Australian Species Management Program (2)	ongoing
Develop a plan for establishing and resourcing an on-island captive breeding facility, for implementation in the event of a substantial reduction in Woodhen numbers or if the rodent eradication program is approved (1)	
Community awareness	
Prepare a community information brochure on Lord Howe Woodhen monitoring and management (2)	ongoing

Table 11. Key priority components of the *Lord Howe Island Strategic Plan for Weed Management*

Action	Status
Continue noxious weed inspection program	ongoing
Review and update the noxious weeds list	complete/ongoing
Investigate options for providing funding for cooperative programs with special leaseholders, for undertaking noxious weed control, particularly those adjacent to the PPP	ongoing
Seek funding for new projects and undertake review and reporting on projects	ongoing
Develop and review monitoring outcomes and update strategy accordingly	ongoing
Provide bush regeneration training to relevant LHIB staff and interested Island residents	ongoing
Treat all W1 weed incursions on LHIB land and control all new incursions of W1 species	ongoing

Treat incursions of invasive species on PPP boundaries. Provide for long-term planning for eradication of key invasive species from Island	ongoing
Seek and implement new weed control tasks where appropriate	ongoing
Maintain treatment of existing sites	ongoing

Table 12. Key priority components of the Lord Howe Island Vegetation Rehabilitation Plan 2002-2007

Action	Status
Fence, weed and replant selected riparian areas (Sallywood Swamp Forest, Mangrove and significant watercourses in the settlement area, namely; Old Settlement, Cobby's Creek, Soldiers Creek and tributaries)	underway
Restore native grassland on Muttonbird Point	
Continue revegetation of Greybark-Blackbutt forest on Blackburn Island	underway
Undertake gradual weed control along the forest edge at Old Settlement at the Endangered <i>Calystegia affinis</i> site	underway
Undertake weed control and encourage natural regeneration in Flesh-footed Shearwater habitat between Neds Beach and Middle Beach	underway
Maintain current revegetation sites	ongoing
Landslips on special leases to be fenced off from cattle and planted out if necessary until vegetation stabilises the slope	commenced
Support prevention of the use of barbed wire fencing within Flesh-footed Shearwater habitat areas	
Support the addition of conditions for special leases relating to removal of noxious weeds and fencing riparian areas off from cattle	underway

5.4 On-ground management programs

Many management activities have been undertaken as part of implementation of existing management documents. Other actions have been implemented on a more *ad hoc* basis due to perceived need or opportunistic funding. Significant biodiversity management actions that have been undertaken, or are still current, are described below.

Weed and revegetation programs

Weed control programs have been undertaken both by the LHIB and by the Friends of Lord Howe Island in conjunction with the LHIB. Revegetation programs have been developed with direction from the revegetation strategy, but also opportunistically when grants for specific projects were received.

The LHIB received large grants during the 2004-2005 and 2005-2006 financial years which enabled the focus of weed control programs to switch from control to eradication of all noxious weeds on Lord Howe Island, with the exception of Crofton Weed and Tiger Lily, with the initial aim to eradicate Category 1, 2 and 3 weeds. Table 13 lists target weed species and their category.

Over the past 20 months, a total of 64 of the 414 blocks have been treated (40% of the known infested areas of the island), and over 1,000,000 weeds removed. It is estimated that a high level of investment will be required until 2009. The current work is funded until 2007. The localities of any particularly dense infestations of weeds are recorded by GPS to alert weeders to look out for infestations in these areas in future weed treatment.

Additional funding from the NSW Environmental Trust has enabled the Board to commence a Bitou Bush eradication program. Over winter 2005, the LHIB contracted DECC to undertake herbicide spraying on the sea cliffs below the northern hills using a helicopter equipped with a specifically-designed spray unit. Over 100 mature plants were treated in this area and further south on the east coast and on the flanks of Mt Lidgbird. Follow up work involving abseiling was undertaken in 2006.

Rat baiting

Rat baiting has been done primarily as a protection measure for the palm industry, seeds of which are preyed upon heavily by Rats (see section 4). Some low level baiting has also been done for biodiversity reasons, for example, for the Lord Howe Island *Placostylus*.

Table 13. Invasive plants targeted for eradication on the LHIG (from Le Cussan (in prep))

Common Name	Scientific Name
Category 1 weeds	
Cherry Guava	<i>Psidium cattleianum</i>
Crofton Weed	<i>Ageratina adenophora</i>
Tiger Lily	<i>Lilium formosanum</i>
Ground Asparagus	<i>Asparagus aethiopicus</i>
Bitou Bush	<i>Chrysanthemoides monilifera</i>
Pittosporum	<i>Pittosporum undulatum</i>
Bridal Creeper	<i>Asparagus asparagoides</i>
Climbing Asparagus	<i>Asparagus plumosus</i>
Ochna	<i>Ochna serrulata</i>
African Boxthorn	<i>Lycium ferocissimum</i>
Lantana	<i>Lantana camara</i>
Madeira Vine	<i>Anredera cordifolia</i>
Cotoneaster	<i>Cotoneaster glaucophyllus</i>
Category 2 weeds	
Glory Lily	<i>Gloriosa superba</i>
Simon's Bamboo	<i>Arundinaria simonii</i>
Elephant Grass	<i>Arundo donax</i>
Tipuana	<i>Tipuana tipu</i>
South African Iris	<i>Diets biflora</i>
Flame Tree	<i>Brachychiton acerifolius</i>
Umbrella Tree	<i>Schefflera actinosa</i>
Coffee	<i>Coffea arabica</i>
Loquat	<i>Eriobotrya japonica</i>
Ginger	<i>Hedychium roxburghii</i>
Castor Oil Plant	<i>Ricinis communis</i>
Rhus Tree	<i>Toxicodendron succedaneum</i>
Category 3 Weeds	
Singapore Daisy	<i>Sphagneticola trilobata</i>
Salvinia	<i>Salvinia molesta</i>
Water Hyacinth	<i>Eichornia crassipes</i>
Mauritian Hemp	<i>Furcraea foetida</i>
Category 4 Weeds	
Kikuyu	<i>Pennisetum clandestinum</i>
Everlasting Pea	<i>Lathyrus latifolius</i>
New Zealand Christmas Tree	<i>Metrosideros kermadecensis</i>
Small-leaved Privet	<i>Ligustrum sinense</i>

White Cedar	<i>Melia azederach</i>
Zebrina	<i>Tradescantia zebrina</i>
Ricepaper Plant	<i>Tetrapanax papyrifer</i>
Norfolk Island Pine	<i>Araucaria heterophylla</i>
Palm Grass	<i>Setaria palmifolia</i>
Buffalo Grass	<i>Stenotaphrum secundatum</i>
Purple Groundsel	<i>Senecio elegans</i>
Agapanthus	<i>Agapanthus praecox</i>
Kaffir Plum	<i>Harpephyllum caffrum</i>
Roldana	<i>Roldana petasitis</i>

Woodhen recovery program

The Woodhen recovery program has been conducted over many years. Major actions that have been implemented from the approved Recovery Plan are summarised below.

The LHIB maintains strict procedures for managing the PPP to minimise impacts on the Woodhen, including prohibition of Dogs and limited access to Mount Gower. In addition, the LHIB can implement its Dog Control Policy to minimise impacts to Woodhen.

Annual surveys are conducted to monitor Woodhen numbers around the main island. Information to date indicates that the Woodhen population is relatively stable. Data from previous and current surveys are being synthesised to map Woodhen distribution and to estimate the carrying capacity of the Island for Woodhens. Work is currently underway to formulate and implement guidelines for the protection, management and enhancement of Woodhen habitat on leasehold land. This is in conjunction with the consultation of the Lord Howe Island community on feeding practices of Woodhens in the settlement area. Recommendations will be made with regard to best practice feeding regimes and on habitat enhancement within the settlement area.

Options for establishing an *ex-situ* population are being investigated.

Culling of Masked Owls has been undertaken sporadically since 1985. However, evidence suggests that Masked Owls favour Rats and sea birds as prey rather than Woodhen. Culling is not considered a priority until evidence suggests that Masked Owls are adversely impacting upon Woodhens.

Lord Howe Island Placostylus recovery program

Potential habitat mapping for the species has been completed for the Lord Howe Island Placostylus. Habitat mapping can also assist with assessment of impacts of development on this species. In addition, the draft Lord Howe Island REP provides measures for the protection of some areas of Placostylus habitat.

Ongoing Rat control is undertaken at a number of preferred Placostylus habitat locations around the island, such as North Bay and the settlement area.

A research project into the species' life history and investigation into appropriate conditions for captive breeding, including humidity and food requirements, has commenced on the main island. Investigations indicate that high levels of humidity are required for breeding success. Preferred food sources have also been identified.

Surveys in 2006-2007 were undertaken at previously-known Placostylus locations. The survey effort focussed on warm, wet nights when Placostylus are most active. These surveys have resulted in improved knowledge of the population numbers and behaviour of Placostylus, and sites that can be used for ongoing monitoring.

Regeneration of suitable habitat on a small area on Blackburn Island has commenced, with limited success due to difficult environmental conditions. The aim of this ongoing project is to recreate habitat suitable for the Placostylus in a Rat-free environment as a potential site for translocation and as augmentation to the population on the main island.

Phytosanitary procedures

The LHIB is in the process of developing phytosanitary procedures for minimising the spread of soil-borne diseases such as *Phytophthora cinnamomi*. This program will primarily involve instructions and boot-cleaning stations at the heads of all walking tracks.

African Big-headed Ant Survey and Control

The LHIB conducted a number of surveys to accurately map infestations of the introduced African Big-headed Ant. Detailed population mapping was undertaken in 2005 and 2006. This survey found that the Ant was largely confined to disturbed areas of the island.

A trial control program using two types of granular agents was undertaken on the island during 2006. The two products were a juvenile hormone mimic and an insecticidal poison. This program targeted the Lord Howe Island Waste Management Facility being an area where infestations and supercolonies are located, and also due to the high risk of colonies spreading from this site.

Results from the program were very promising and indicated that both the hormone mimic and the insecticidal poison were highly effective in destroying colonies. The hormone mimic is only approved for research trials at this time so the Board has opted to undertake more widespread eradication of African Big-headed ants using a registered insecticidal poison product. The insecticide is ant specific with a protein base which is highly attractive to Big-headed ants. Given that this species exclude all other native ant species from their infestation areas, mortality of native ants is not anticipated.

Goat control program

A Goat control program was commenced on the LHIG in the 1970s. However, the feral Goat population was reduced to a few individuals as a result of a control program in 2002. Two Goats were released to lure in feral Goats and are still present in the southern mountains. These Goats are both desexed females and are being monitored.

5.5 Policies and strategies

Plant Importation policy

This policy was approved by the LHIB in 2003. The aim of the policy is to provide a list of bush friendly plants which can be used for garden plantings by island residents. Under this policy, any proposed plant imports will be dealt with in one of three ways:

1. If it is known to be benign (i.e. has not escaped gardens on Lord Howe Island or elsewhere) importation should be allowed subject to a Declaration of Intent to Import.
2. If it is known to be a threat (i.e. has escaped gardens on Lord Howe Island or in similar climatic regimes) importation is prohibited.
3. If it is unknown, and has never previously been imported to Lord Howe Island, importation is permitted only with an assessment of weed risk.

Quarantine Strategy for Lord Howe Island (Landos 2003)

The quarantine strategy aims to minimise the risk of serious unwanted incursions of pests, weeds or disease. The strategy makes a range of recommendations involving upgrading a number of key components but, wherever possible, either using existing resources or drawing on the resources of existing organisations where this is deemed appropriate. Major recommendations are summarised in Table 14.

The Quarantine strategy was adopted in 2003.

Significant advances to quarantine have been undertaken since the strategy was adopted. These include quarantine awareness training of staff, stevedores and all major mainland suppliers. This has resulted in improved standards in storage. Training has been undertaken twice, and will probably be continued annually. In addition, a new hard stand area is being constructed on the Lord Howe wharf to assist with early detection of pest species.

Dog Control Policy

The Dog Control Policy was adopted by the LHIB in 1998, and was drafted to reflect the provisions of the *Companion Animals Act* (CAA) 1998. The policy aims to outline Dog owners' responsibilities for effective Dog control on both leasehold and public land. The policy designates Dog exercise areas and where Dogs are prohibited. Penalties for impounding wandering Dogs and for other offences under the CAA are also identified.

Animal importation

Regulations under the LHI Act prohibit the importation of any animal without Board approval. Currently, the LHIB assesses each request for importation on a case by case basis. The LHIB is looking to establish a risk assessment process for animal importation. Risks to be assessed will include the likelihood of disease, weed and pest introduction. A risk assessment process is likely to include a list of proscribed species.

Domestic Animal Control Policy

Prior to the adoption of the *Lord Howe Island Regulation* 2004, the LHIB had limited capacity to enforce or obligate domestic animal control. There are now clauses that regulate the control of

certain domestic animals such as poultry and goats.

5.6 Inventory reports

Several inventory reports of flora and fauna of the LHIG have been compiled since early settlement. These are listed in Table 15. Full references are provided at the end of this document.

5.7 Research and survey

A broad range of research projects relevant to the biodiversity of the LHIG has been undertaken. Areas of investigation include rare plant surveys, breeding ecology of seabirds, invertebrate survey and research and investigations into the feasibility of rodent eradication. This Plan will assist with prioritising research and ensure that existing knowledge gaps are addressed.

Australian Museum invertebrate research

The Australian Museum has been collecting systematic terrestrial invertebrate data since 1977. Results of these surveys, and systematic surveys done since that time, have been collated in Cassis *et al.* (2003). This information allows changes in invertebrate biodiversity to be assessed, including species distributions, introductions and extinctions.

Nine enclosure plots were established in 2003/2004 to monitor the impact of rodents on invertebrates. Funding for this project is currently not available.

Research by the Australian Museum in collaboration with Macquarie University is underway to assess altitudinal patterns in invertebrate communities on Mounts Gower and Lidgbird to provide a baseline for future impact assessments and to identify whether any changes in communities have already occurred.

Rare plant surveys

Several surveys for rare plants have been undertaken by the DECC to determine the distribution, population size and threats to a number of species (Hutton 2005 and Hutton 2001b). Outcomes of these surveys have resulted in the listing of several plant species on the TSC Act.

Table 14. Key priority components of the Lord Howe Island Quarantine Strategy

Management/training/administrative
Establish a high priority list of pests and diseases for the Island
Lobby for legislative changes which strengthen the powers of the LHIB with regards to inspections, permit systems, cost recovery, and offence provisions
Future contractual arrangements for the movement of goods to the Island to include quarantine related standards for both the vessel and the departing (and arriving) wharf, appropriate surveillance, fumigation and baiting/trapping provisions, and the power for goods to be refused boarding at the ports of departure and arrival in the event that an infestation is found.
Training to be provided to LHIB staff in the areas of threat identification, assessment and management, rat inspection, baiting and cargo inspection techniques
Suitable surveillance training be developed and delivered to all relevant LHIB staff and contractors
Suitable training be developed and delivered to all participants in Lord Howe Island tourist and transport industries
No unloading of cargo to take place after dark
Establish a digital database to facilitate review and storage of key information
Baseline surveys to be undertaken for priority pests and diseases
Use the NSW Agriculture Regulatory Officer for inspection at the Goodwood Island wharf
Encourage LHIB staff to conduct regular random inspections of cargo arriving at the LHI wharf
Develop the capacity of the existing Island Trader crew and wharf staff and labourers at Goodwood Island wharf to undertake inspection of goods as they are loaded
A senior person at Goodwood Island wharf be provided with the power to refuse to load any goods that show evidence of unwanted pests or diseases
Ask the Island Trader to advise in advance of any high quarantine cargo observed during loading. Appropriate personnel to inspect this cargo on arrival
Seek specialist advice regarding the safety and practicality of in-transit fumigation of the cargo hold of the Island Trader
Make Goodwood Island and LHI wharves, the airport and associated buildings and surrounds as inhospitable as is practical for pests
Provide sealed "Amnesty" bins at the airport and seaport and label accordingly
Develop disposal procedures for any seized or confiscated goods
Broadcast a brief quarantine message on all flight arrivals
Animals/livestock
Conduct regular baiting and trapping at key areas such as on board all vessels and planes, around the wharf and airport and around accommodation houses and residences
Introduce measures for moored vessels that minimise the chances of rats getting ashore
All vessels visiting LHI to have current de-ratting certificates
All wharf and airport areas including buildings be maintained in a clean state
Undertake a risk analysis where any new plant or animal is proposed for introduction to LHI
No straw, hay or green feed be imported to LHI
Ask NSW Agriculture (and Fisheries as appropriate) to examine any controls that should be applied to imported animal feedstuffs
All animal importations to be in containers using clean sawdust and all waste to be appropriately destroyed on arrival
Ask NSW Agriculture for a set of livestock importation health conditions
Plants
All plants to be imported bare rooted or in soil-less medium or from an accredited supplier
All plants to have identification labels

Build a holding compound at the airport and wharf and hold all plants in this area until cleared by LHIB staff
All plant imports be subject to permit
Building materials/consumables
All second-hand and untreated timber be prohibited unless accompanied by a current fumigation certificate
No bark on timber to be imported to LHI
Regularly inspect hardwood pallets and other dunnage at Goodwood Island and Lord Howe wharves
All pavers and similar materials to be subject to inspection prior to boarding at Goodwood Island
Contracts for the importation of road base to include quarantine considerations such as the exclusion of soil and extraneous matter
Gas depots be requested to only supply gas bottles with clean undersides to LHI

Tiger Lily research

A PhD research project is being undertaken into the ecology of the major weed Tiger Lily. Results from this study will provide data to assist with selection of control or eradication options for this species.

Ecological studies of threatened seabirds

Several ecological studies of the threatened seabirds on Lord Howe Island have been completed. These studies have focussed on breeding productivity and foraging ecology as a means of evaluating conservation status and threats. References to some of these studies are included at the end of this report.

Lord Howe Island Currawong

Initial research on the population size, distribution, breeding and foraging ecology of the Lord Howe Currawong has been completed. The population is estimated at just over 200 individuals, including 48 juveniles.

The study indicated that preying on White Terns by Currawong has not been sufficient to halt the expansion of the White Tern population on Lord Howe Island.

This research could be used when undertaking environmental assessment associated with any rodent eradication program.

Lord Howe Island Phasmid

Previously thought to be extinct, the Lord Howe Island Phasmid was rediscovered on Balls Pyramid in 2001. Two pairs of Phasmids have formed the basis of a captive-breeding program (Priddel *et al.* 2003; Priddel *et al.* 2001). This program,

involving both Melbourne Zoo and the company Insektus, has been successful to date. Several new generations have been produced and the population, consisting of several dozen breeding adults in 2005, continues to increase. Development of best-practice techniques for maintaining the captive population is ongoing, along with other interim recovery actions.

Rodent eradication proposal

An assessment of the feasibility of eradicating rodents from the LHIG was conducted in 2001 (Saunders & Brown 2001). The report found that eradication is feasible but recommended that the risks inherent in such a program would need to be managed and the costs and benefits of engaging in such a program would need to be evaluated.

Subsequently, a cost/benefit analysis was prepared (Parkes *et al.* 2004). This review also considered eradication to be feasible and calculated that the costs of eradication would be recouped, in the form of higher yields of palm seed, within five years. Biodiversity values were not modelled in this study due to the difficulties of equating a dollar value to biodiversity, however, there are significant benefits to biodiversity of rodent eradication.

The LHIB in conjunction with DECC is currently working towards rodent eradication planning. This planning incorporates identification of environmental assessment requirements (including necessary environmental approvals), logistical planning and identification of research into potential impacts on non-target species essential for environmental assessment.

Environmental assessment of the potential impact on threatened species of any Rat eradication pilot or program is required under the EP&A Act. If it is assessed that a significant impact to threatened

species, populations or communities is likely, then a Species Impact Statement (SIS) under the TSC Act must be prepared. A SIS will investigate the types of impact on threatened species and proposed mitigation measures prior to approval being provided for the project to proceed.

A non-toxic bait trial to assess bait uptake by both rodents and non-target species is being conducted in 2007 in the settlement area.

Table 15. List of inventory reports of flora and fauna of the LHIG

Title	Author	Date	Description
The General Zoology of Lord Howe Island	Etheridge	1889	Anecdotal accounts of fauna sightings and collections made by the Australian Museum collecting party in 1887
Environmental Survey of Lord Howe Island	Recher & Clark	1974	Results and recommendations of a scientific survey undertaken in the early 1970s. The aim of the survey was to determine the current status of the flora and fauna and to recommend ways in which the long-term survival of the indigenous species could be assured.
Vegetation of Lord Howe Island	Pickard	1983	A description and map of the vegetation of the LHIG
Mosses of Lord Howe Island	Ramsay	1984	A checklist of the mosses of Lord Howe Island based on literature and collections in Australian herbaria together with a summary of their distribution patterns on the island
Birds of Lord Howe Island - Past and Present	Hutton	1991	Descriptions of sea birds and land birds, both extant and extinct
Flora of Australia Volume 49 Oceanic Islands I - Flora of Lord Howe Island	ABRS	1994	Lists the vascular plants of the LHIG, both exotic and native, that have been recorded on the LHIG
Vegetation and Habitat of Significance Within the Settlement Area of Lord Howe Island	Hunter	2002	An update of vegetation mapping within the settlement area. Mapping of the distribution of high conservation value vegetation within the settlement area and information on the distribution of habitat for threatened flora and fauna species.
Lord Howe Island: Terrestrial Invertebrate Biodiversity and Conservation Report	Australian Museum	2003	A synopsis of collated existing information on the terrestrial invertebrates of Lord Howe Island. It includes a statistical analysis of invertebrate biodiversity patterns across the LHIG, focussing on endemism and species richness, an assessment of the conservation status of selected terrestrial invertebrate taxa, and identifies threatening processes and conservation recommendations. This report was commissioned by DECC and the LHIB in 2003.
The Birds of the Lord Howe Island Group: A Review of Records	McAllen <i>et al.</i>	2004	A recent inventory of all known bird records from the LHIG. Management issues are discussed where relevant to the species concerned.

6 Proposed Recovery Actions

Recovery actions and sites selected for management have been prioritised using a combination of information and data sources. These involve expert knowledge, community consultation, existing management documents and analysis of outputs from a GIS decision support tool, the Biodiversity Forecasting Tool (BFT). Management actions in some instances have been refined using outputs from the BFT, either to define a specific locality where a high biodiversity benefit of an action has been indicated, or identify a particularly significant threat. A description of the BFT methods, data inputs and derived outputs is contained in Appendix 4 (appendices document). Where existing management documents are used, key relevant actions are listed in section 5 of this Plan.

This section is divided into four parts: priority areas for management; priority species and communities for management; priority threats; and a comprehensive set of management actions.

The description of priority threats and priority management areas in this section helps to set the scene for the comprehensive list of management actions later in the section.

6.1 Priority areas for management

The following priority areas for management actions were identified using a compilation of expert and community information, published and unpublished reports, and outputs from the BFT.

Areas highlighted as priorities by the BFT are primarily driven by a combination of a high priority ranking given to habitats by experts and the level of threat operating on a particular area. For example, if an area is habitat for an Endangered species it was given a high priority ranking. If this is combined with an area that has been defined as being affected by one or more priority threats, then these areas are highlighted as priority areas for management action.

Areas have been ranked from one to four to provide a level of prioritisation, however, these should be considered a guide and priorities may vary depending on resource availability and other factors.

Number 1 Priority

Sallywood Swamp Forest Community

The Sallywood Swamp Forest vegetation community receives a high priority ranking, primarily due to its listing as an Endangered Ecological Community under the TSC Act, but also due to its limited geographical extent and the level of threat acting upon this community. This resulted in these areas being highlighted as priority sites for management action by the BFT outputs.

Expert opinion agrees that these areas are a significant priority for management action, but consider priority needs to be balanced against competing resource requirements and the overall benefit to biodiversity of the LHIG.

Mangrove sites

The Mangrove community has a very limited extent on the LHIG and is subject to a number of threatening processes. Expert opinion classifies the Mangrove community as a community of conservation concern and thus it receives a high priority ranking. The BFT also identified these areas as a priority.

Watercourses and adjacent habitat in the settlement area

Lowland Freshwater communities are classified as communities of conservation concern, and thus receive a high priority ranking. Watercourses of particular priority are identified in the vicinity of Soldiers Creek, Cobby's Creek and Old Settlement Creek.

Habitat of the Endangered plant Calystegia affinis

Small areas that are habitat for the Endangered plant *Calystegia affinis* are identified as areas of high priority for management by the BFT. This habitat is located in two separate locations; at the Max Nicholls track in the north of the island, and in the southern mountains.

Southern Mountains

Expert opinion regards the southern mountains as being areas of significant conservation priority due

to the high level of endemism and significance of threatening processes such as climate change and human impacts operating in these areas.

The BFT also identifies these areas as a high priority for management.

Balls Pyramid

Balls Pyramid is a high priority management area particularly as it is the only location of the Lord Howe Phasmid. Management to protect this area from threatening processes is critical to the survival of this species in the wild. It is also significant for a number of threatened seabirds, especially as it is a breeding locality for the threatened Kermadec Petrel and the White-bellied Storm Petrel.

Mixed Fern and Herb Community

The Mixed Fern and Herb community is a vegetation community restricted to the southern mountains. It has been identified by both expert opinion and the BFT as being particularly under threat from weed invasion by Crofton Weed and Tiger Lily. As it is a community of limited extent, and contains threatened and significant plant species, it has been highlighted as a priority area for management.

Number 2 Priority

Eastern settlement area and shoreline between Neds Beach and Clear Place

This area is identified as a significant location for management due to its importance for seabirds and for the threats that are active in this area.

Selected threatened plant habitat

The habitat of three threatened plant species is highlighted as priority areas for management. These are: *Chamaesyce psammogeton* habitat at Blinky Beach, Knicker Nut habitat at Neds Beach and *Polystichum moorei* habitat at Kings Beach.

The *P. moorei* habitat indicated is the habitat that is likely to be affected by climate change.

Blackburn Island

Blackburn Island is a priority area for management due to its significance for fauna and the potential for threatening processes to significantly impact upon the biodiversity of this area.

Remnant vegetation in the settlement area

Remnant vegetation in the settlement area has a number of active threatening processes impacting upon it such as weed invasion, the potential for loss of habitat from clearing, and edge effects. These factors result in this habitat receiving management priority.

Number 3 Priority

Coral Sand and Beach Dune Community

This community received a moderate priority due to its restricted extent and its potential to be impacted by threatening processes such as climate change and weed invasion.

Muttonbird Point

A combination of active threatening processes and significant habitat areas has resulted in Muttonbird Point being highlighted as a moderate priority area for management action.

Intermediate Hill

Intermediate Hill has a range of active threatening processes, particularly weed invasion. It is also an important area for invertebrates.

Signal Point to Old Settlement

This area has been highlighted primarily due to it being habitat for the Endangered plant Knicker Nut. This area is also subject to a number of threatening processes such as climate change and weed invasion.

Far Flats

The Far Flats area is highlighted as a significant area for invertebrates. It is also indicated as being an area where threats may substantially reduce the invertebrate biodiversity.

Shorelines of settlement area

The shorelines of the settlement area are highlighted due to their significance for sea birds and wading birds as well as the level of threat operating in these areas.

Greybark-Blackbutt Community

This community is classified as a community of conservation concern primarily as it is subject to a

number of threats, including weed invasion and clearing.

Cliffs of the northern hills

The cliffs of the northern hills are important habitat areas for seabirds. They are also subject to a number of threatening processes that may adversely impact the quality of the habitat in this area.

Malabar and northern hills

The combination of threatening processes such as weed invasion and significant vegetation types results in this area being highlighted as a moderate priority area for management actions.

Number 4 Priority

Transit Hill

There are a number of active threats operating in this area including significant weed invasion, canopy windshear and dieback, and the impacts of trampling and grazing on native vegetation. The significance of Transit Hill includes the valuable weed control work that has been undertaken over a number of years in this area by the Friends of Lord Howe Island and the LHIB.

Lower slopes of north and south PPP

Threatening processes such as weed invasion, and a high level of endemism have resulted in the identification of this area as a moderate management priority.

Muttonbird Island and Admiralty Islands

These islands are identified due to their significance for seabirds and invertebrates as well as the potential for threatening processes to have significant adverse impacts.

Lowland Mixed Forest

Lowland Mixed Forest is a vegetation community of conservation concern and is under threat primarily from clearing and weed invasion.

Locations of restricted vegetation communities

A number of vegetation communities that are restricted in extent are highlighted for management action and include the following: Saltbush (*Atriplex*), Poa (*Poa poiformis*), Bully Bush-Poa (*Cassinia-Poa poiformis*), Leafy Flat

Sedge (*Cyperus lucidus*) and *Boehmeria calophleba*-Kava (*Macropiper hooglandii*).

Kentia Palm Communities

As *Kentia Palm* communities are subject to a range of threatening processes, they are identified as benefiting from a range of management actions.

6.2 Priority threatening processes

A number of threats have been identified as the most significant threatening processes influencing the biodiversity of the LHIG by a combination of expert opinion, existing information sources, the BFT and community opinion.

The four most significant threats to the biodiversity of the LHIG are considered to be the introduction of new pests, weeds and diseases, the impact of weeds that are currently present on the LHIG, the impact of rodents on flora and fauna and climate change.

Other significant threats include: habitat clearing and trampling, browsing and grazing and introduced invertebrates.

6.3 Priority species and communities for management

Flora

Flora species identified as a management priority are those that are either threatened or restricted endemics, with threatened flora receiving the highest priority. Four threatened flora species are indicated as being a particularly high priority for management action due to their restricted habitat and the threatening processes that are acting upon them. These are Knicker Nut, *Chamaesyce psammogeton* *Calystegia affinis*, and *Polystichum moorei*. In addition, the habitat of the critically endangered grass *Elymus multiflorus* var *kingianus* is a high priority for investigation as no specific current information is available.

Restricted endemic species not currently listed as threatened that have been identified by expert opinion as being a priority for management are *Passiflora herbertiana* ssp. *insulae-howeii*, *Coprosma* sp. nov. and *Senecio pauciradiatus*.

Vegetation communities

Five vegetation communities are identified as high priorities for management. Sallywood Swamp Forest, Mangrove, Lowland Freshwater and Upland Freshwater were previously identified in section 6.1 as priority areas for management. Cloud Forest (*Hotbark-Fitzgeraldii*) community is also identified as a high priority given its high degree of endemic species and susceptibility to threats such as climate change.

Vertebrate fauna

Vertebrate fauna identified as being of particular significance for management action include threatened species and species with particularly limited habitat areas or those species that are subject to a range of threatening processes. These species are listed below.

Lord Howe Island Gecko and Lord Howe Island Skink

The habitat of these threatened species is subject to a range of threatening processes such as weed invasion, clearing, trampling and rat predation.

Flesh-footed Shearwater

This threatened species has been identified primarily due to much of its habitat being within the settlement area and thus subject to a range of threats associated with this area.

Lord Howe Woodhen

The Lord Howe Woodhen is an iconic species and is subject to a range of active threatening processes on Lord Howe Island warranting ongoing management priority.

Long-finned Eel, Short-finned Eel and the Common Jollytail

These freshwater aquatic vertebrates are identified as priority species for management due to the threatening processes operating on their habitat in the settlement area.

Invertebrate fauna

Threatened invertebrate fauna are identified as being priority species for management. Three of the threatened invertebrates are identified by the BFT and expert opinion as most warranting management action.

Non-threatened invertebrates have not been included due to lack of specific information.

Lord Howe Island Phasmid

This species is identified due to its very limited distribution, active threats on the main island and small population size.

Lord Howe Island Wood-feeding Cockroach

Given limited habitat and potential impacts from threatening processes, this threatened species is identified as a high management priority.

Lord Howe Island Placostylus

The Lord Howe Island Placostylus is identified as a high management priority species due to the range of threatening processes affecting this species and its restricted distribution.

6.4 Management actions

A comprehensive list of management actions follows, including the location to which each action is relevant and specific tasks associated with each action. Table 16 provides a summary of recovery actions and the priority species they address, while Table 17 lists all recovery actions, including priority, estimated cost, and potential responsible partners.

The list of management actions has been derived primarily from expert opinion, existing reports and data and input from the LHI community. Where relevant and justified, some of the actions listed below have been refined using outputs from the BFT. These refinements include highlighting particular localities or species of conservation significance.

The actions listed below are both landscape level management actions based on threats and affected areas and management actions for specific threatened species where these species are not adequately covered by broad landscape-based actions.

Objective 1: To prevent the introduction of exotic fauna, flora and pathogens to the LHIG

Introduction of new exotic fauna and flora constitutes one of the major ongoing threats to the biodiversity of the LHIG. There is a continual risk of the introduction of new pathogens, weeds, invertebrates and vertebrates with the arrival of every ship or aircraft (section 4.4).

Keeping further exotics from entering the LHIG will require enforcement of strict quarantine, a high level of surveillance and a rapid response to new introductions.

Action 1.1: Review the LHIB Quarantine Strategy

Location: LHIG

Tasks:

1.1.1 Review the current LHIB Quarantine Strategy to ensure that it reflects the most up-to-date information regarding quarantine and new species introductions. Amend or add tasks as required. The strategy should be reviewed at least every five years.

1.1.2 Ensure that an invasive ant risk assessment and control strategy is included in the LHIB Quarantine Strategy.

1.1.3 Ensure that an offshore island quarantine strategy is included in the LHIB Quarantine Strategy to prevent rodents and other introduced pests and diseases from establishing on these islands. This strategy is to include regular surveillance of significant offshore islands for invasion by exotic fauna and weed species. The potential to include prior approvals to act immediately if introductions occur needs to be investigated.

1.1.4 Develop a public awareness program that highlights the significance of Blackburn Island for biodiversity, specifically targeting Lord Howe Island residents.

1.1.5 Develop a protocol to minimise the risk of rodent introduction for operators that hire watercraft that visit Blackburn Island.

Action 1.2: Implement the LHIB Quarantine Strategy

Location: LHIG and mainland departure points.

Task:

Implement the LHIB Quarantine Strategy as a matter of priority (section 5 summarises the main

actions from the current LHIB Quarantine Strategy).

Action 1.3: Review the Lord Howe Island Plant Importation Policy

Location: LHIG

Task:

Review the current Lord Howe Island Plant Importation Policy to ensure that it reflects the most up-to-date information and amend or add tasks as required. The policy should be reviewed at least every five years.

Action 1.4: Implement the Lord Howe Island Plant Importation Policy

Location: LHIG

Task:

Implement the LHI Plant Importation Policy (section 5 summarises the main actions from the current LHI Plant Importation Policy) in conjunction with relevant actions from the LHIB Quarantine Strategy.

Action 1.5: Increase local native plant production and use

Location: settlement area

Task:

1.5.1 Expand the LHIG nursery facilities to allow for increased local native plant production for residents, while making local native plants available to residents at low cost.

Action 1.6: Prepare a rapid response and detection protocol for new introductions of weeds and exotic fauna

Location: LHIG.

Tasks:

1.6.1 Develop an early detection protocols and procedures document to deal with new introductions as soon as possible after incursion. This would include information on how to identify high priority invasive species (e.g. Cane Toad, Yellow Crazy Ant), relevant contact personnel and treatment procedures.

1.6.2 Ensure relevant LHIB staff are trained and equipped to be able to implement early detection protocols and procedures.

Objective 2: To retain native vegetation

Past and any potential future clearing and habitat modification of native vegetation are a significant threat to biodiversity on the LHIG.

Action 2.1 Ensure appropriate environmental assessment is undertaken when assessing development proposals

Location: LHIG

Task:

Ensure that the appropriate level of environmental assessment is undertaken under the EP&A Act and the TSC Act, particularly when development proposals require clearing of native vegetation. The potential impact of proposed clearing and development on flora and fauna should be considered. This includes development proposals both in the settlement area and within the PPP.

Action 2.2: Liaise with leaseholders regarding protection and management of remnant and significant vegetation

Location: Settlement area, particularly any leases where Sallywood Swamp Forest or Mangrove is mapped. Also leases in the vicinity of the Soldiers Creek and Cobbys Creek basins, in the watercourses around Old Settlement, and any identified threatened fauna habitat for species such as the Flesh-footed Shearwater, Lord Howe Island Gecko, Lord Howe Island Placostylus, Lord Howe Island Skink and Lord Howe Woodhen.

Task:

Leaseholders to be informed of the value of remnant vegetation on leases, provided with information on methods of protection and enhancement and encouraged to undertake protection and rehabilitation of native vegetation on their leases.

Action 2.3: Provide assistance for leaseholders to protect native vegetation

Location: LHIG

Task:

Provide financial assistance where funding is available for leaseholders to fence and rehabilitate native vegetation, particularly significant remnant vegetation. Significant remnant vegetation includes Sallywood Swamp Forest, Mangrove, Lowland Mixed Forest, Greybark-Blackbutt on calcarenite/coral sand and threatened species habitat.

Action 2.4: Encourage protection of vegetation and habitat features that constitutes invertebrate habitat

Location: LHIG

Task:

Monitor and discourage the removal and use of native dead wood and trees by visitors and residents where it may offer habitat to invertebrate fauna.

Objective 3: To control the impacts of introduced pathogens on native species

A primary threatening process for the LHIG is posed by introduced pathogens impacting on native species and their habitats (section 4.3).

Action 3.1: Develop and implement measures to minimise the impacts of introduced flora and fauna pathogens

Location: LHIG

Tasks:

3.1.1 Develop and implement a set of phytosanitary guidelines for walkers and palm seeders to minimise the risk of introducing and spreading pests, weeds and disease within the LHIG.

3.1.2 Conduct a detailed survey for the presence of *Phytophthora cinnamomi*.

3.1.3 Develop and implement a strategy for the control of the spread of *Phytophthora cinnamomi*.

3.1.4 Test native species that may be susceptible to *Phytophthora cinnamomi*.

3.1.5 Investigate the potential for poultry pathogens to adversely impact LHI fauna, particularly the LH Woodhen, and implement quarantine measures where appropriate.

Objective 4: To eradicate (where feasible) and control existing weeds to reduce their impact on the biodiversity of the LHIG

Weeds present a major threat to the biodiversity of the LHIG. Many weed species are widespread, some are location specific and there are many species that have the potential to become threats (sections 4.3 and 4.4).

Action 4.1: Review the Weed Management Strategy for Lord Howe Island

Location: LHIG

Task:

Review the Weed Management Strategy for Lord Howe Island on a regular basis to ensure that it reflects the most up-to-date information regarding quarantine and new species introductions and amend or add tasks as required. The strategy should be reviewed at least every five years.

Action 4.2: Implement the Weed Management Strategy for Lord Howe Island

Location: LHIG**Tasks:**

4.2.1 Eradicate Category 1, 2 and 3 weeds (except Tiger Lily and Crofton Weed) (refer to Section 5.4) as a priority.

4.2.2 Eradicate Category 4 weeds (refer to Section 5.4) when Category 1, 2 and 3 weeds have been eradicated.

4.2.3 Continue searching for new recruits and missed plants, and new invaders.

4.2.4 Prevent new threats arising through removal of latent invasive alien plants from settlement gardens and removal of non-native vectors.

Action 4.3: Extend current weed inventory, mapping and monitoring work

Location: LHIG**Tasks:**

4.3.1 Extend current weed mapping programs to include problem species that have not been mapped such as exotic grasses on offshore islands.

4.3.2 Develop a comprehensive weed monitoring program which identifies parameters to be monitored and includes feedback loops, e.g. mapping outcomes to provide data for future analysis.

4.3.3 Continue current inventory and mapping of weed distribution and spread.

Action 4.4: Continue regular weed inspections of leases

Location: settlement area**Tasks:**

4.4.1 The staff of the LHIB to continue to conduct regular inspection of leases for weeds that are at risk of spreading into native vegetation, in addition to those species listed as noxious.

4.4.2 Investigate the potential to include weed control conditions on all vacant crown land leases.

This may be appropriate via a Property Management Plan for each lease.

Action 4.5: Investigate and implement funding incentive schemes for weed management on leases

Location: settlement area

Task: Investigate the availability and source of funding for leaseholders to undertake weed control on their leases.

Action 4.6: Develop and implement a community awareness and control program on the impacts of weeds and prevention of spread

Location: LHIG**Tasks:**

4.6.1 Increase weed awareness by developing and implementing a community awareness program on the impacts of weeds for both islanders and visitors. The preparation of promotional and educational material is to be included. Educational material should cover weed identification, how visitors and residents can be involved in preventing their spread and encouraging the use of LHIG native plant species in gardens and landscaping (see action 1.5).

4.6.2 Encourage the establishment of a leaseholders' weed control group. Encourage leaseholders to undertake a coordinated approach to weed control. Conduct weed control in conjunction with the LHIB's control programs and using assistance of the LHIB where appropriate.

Action 4.7: Develop a strategy for remote area weed control

Many weed infestations are located in difficult access situations. Development of appropriate techniques and training for staff is necessary to treat weeds in such locations. It is important to continue treatment of previously treated areas, particularly those treated for Bitou Bush, to prevent reinfestation.

Location: PPP, specifically cliffs and remote terrain in southern mountains and northern hills.

Tasks:

4.7.1 Identify training needs and implement training in safe techniques for weed control in remote and dangerous terrain, targeting weed species such as Bitou Bush, Crofton Weed and Tiger Lily.

4.7.2 Monitor remote area weed spread and distribution on a regular basis to provide information on weed status.

4.7.3 Establish a rapid response protocol to control any outbreaks of significant weed species in the southern mountains.

Action 4.8: Manage herbicide use to minimise any adverse impacts

Location: LHIG

Tasks:

4.8.1 Ensure careful use of herbicide, particularly in invertebrate hotspot areas (Figures 5 and 6) and threatened flora and fauna habitat.

4.8.2 Use a gradual approach to weed control in important invertebrate habitats (Figures 5 and 6), so invertebrates have an opportunity to move or recover in untreated or previously treated areas.

4.8.3 Ensure staff and volunteers are adequately trained in herbicide use and are using the most effective and target-specific chemical and application methods.

Action 4.9: Conduct research into weed control and biology

Location: LHIG

Tasks:

4.9.1 Support research into the control techniques and biology of major weed species of the LHIG.

4.9.2 Monitor current research into the biological control of weed species in inaccessible areas, particularly Crofton Weed and Tiger Lily. Initiate and support any funding proposals for research in this area.

Action 4.10: Control exotic grasses

Location: Lagoon Foreshores, Lovers Bay, Muttonbird Point, Dawsons Point, Admiralty Islands, Muttonbird Island

Task:

4.10.1 Exotic grasses to be gradually controlled and replaced by native grass species. Areas to be targeted are those vegetation communities mapped by Pickard (1983) as *Poa poiformis*.

Location: Old Settlement

Task:

4.10.2 Kikuyu to be controlled where it is threatening the population of the Endangered

plant *Calystegia affinis*. Due to the twining nature of *C. affinis*, a great deal of care is needed to minimise any adverse impacts of Kikuyu control on the species.

Location: Neds Beach

Task:

4.10.3 The two sites of the Endangered Knicker Nut to be treated to reduce the impacts of Buffalo Grass and Kikuyu. Care is needed to minimise any adverse impacts of grass control on the Endangered species.

Location: Blinky Beach and Lagoon Foreshores

Task:

4.10.4 Exotic grasses such as Buffalo Grass and Kikuyu to be replaced with native grass species in the habitat of the Endangered plant *Chamaesyce psammogeton*. Other problematic exotic species, e.g. Five-leaf Morning Glory (*Ipomoea cairica*) and *Euphorbia paralias*, to be controlled where necessary.

Action 4.11: Support current LHIB Norfolk Island Pine control procedure

Location: Settlement area, particularly Lagoon Foreshores

Task:

Continue the current procedure by the LHIB to remove Norfolk Island Pines that are less than 6m tall. Encourage the removal of larger Norfolk Island Pines outside areas that are culturally significant for the Lord Howe Island community.

Action 4.12: Control weeds in selected priority sites

Location: Blackburn Island, Muttonbird Island

Task:

4.12.1 Monitor for any new weed species on offshore islands, particularly of exotic grasses. Any new weed species to be treated as a priority.

Location: Little Island

Task:

4.12.2 Undertake weed control and encourage regeneration of native species.

Objective 5: To undertake revegetation/ rehabilitation works in high conservation priority areas

Clearing has had a significant impact on the biodiversity of the LHIG. This objective identifies

key high conservation priority areas that have been cleared or substantially modified where a significant biodiversity benefit would result from revegetation and rehabilitation. High priority areas are identified in Figure 9.

Action 5.1 Regularly review the Lord Howe Island Vegetation Rehabilitation Plan

Location: LHIG

Task:

Review the current Lord Howe Island Vegetation Rehabilitation Plan to ensure that it reflects the most up-to-date information regarding vegetation rehabilitation and amend or add tasks as required. The plan to be reviewed at least every five years.

5.2 Implement the Lord Howe Island Vegetation Rehabilitation Plan

Location: LHIG

Task:

Implement the Lord Howe Island Vegetation Rehabilitation Plan tasks listed in Section 5 of this plan.

Action 5.3 Revegetate and rehabilitate degraded high conservation priority sites

Location: LHIG

Tasks:

5.3.1 Sallywood Swamp Forest sites 1, 2 and 5 (see Figure 9) to be revegetated and rehabilitated using appropriate native species. Site 3 is at the end of the airport runway and is unable to be revegetated for safety reasons. Site 4 is in fair condition, but would benefit from expansion and regeneration of the edges.

5.3.2 Mangrove Communities in the settlement area are a high priority for revegetation. Staff of the LHIB to work with leaseholders to revegetate these areas.

5.3.3 Where possible, revegetate selected high conservation priority watercourses, specifically, those in the vicinity of Old Settlement, Cobby's Creek and in the Soldiers Creek basin using appropriate native species (Figure 9).

5.3.4 Encourage revegetation of cleared parts in the settlement area, e.g. Flesh-footed Shearwater habitat between Stevens Point and Middle Beach. This includes enlarging patches of isolated vegetation and regenerating gaps in remnant vegetation.

5.3.5 Establish a restoration program for *Poa poiformis* Communities. Locate *Poa poiformis* Communities as mapped by Pickard (1983) that have not already been targeted in previous actions. Identify any weed problems and undertake a restoration program to encourage the reestablishment of the native *Poa poiformis* Community.

5.3.6 Revegetate old clearing and garden sites, particularly those within or adjacent to the PPP, and those that pose a weed risk to the southern mountains.

Action 5.4: Use best-practice regeneration and rehabilitation principles

Location: LHIG

Tasks:

5.4.1 Use local provenance plant stock.

5.4.2 Restore vegetation communities as near as possible to their original composition and condition.

5.4.3 Use appropriate herbicide applications.

5.4.4 Investigate training opportunities to maintain up to date skills for LHIB staff undertaking bush regeneration works.

Action 5.5: Establish a monitoring program for revegetation projects

Monitoring is essential to determine the effectiveness or otherwise of revegetation programs.

Location: LHIG

Tasks:

5.5.1 Establish revegetation monitoring programs to measure their success.

5.5.2 Establish a set of marked photo points in a range of sites to assist with the monitoring of revegetation projects.

5.5.3 Undertake quadrat or transect sampling to measure changes to vegetation, including species composition, height and canopy cover.

5.5.4 Undertake mapping of implementation of management actions suitable for inclusion in GIS biodiversity forecasting analyses.

Action 5.6 Control the impacts of trampling, browsing and grazing by domestic stock on native vegetation communities

Location: Settlement area

Tasks:

5.6.1 Staff of the LHIB to work with leaseholders to fence high conservation priority vegetation communities from domestic stock (Sallywood Swamp Forest, Mangrove and significant watercourse areas at Old Settlement, Cobbys Creek and Soldiers Creek) (refer to Figure 9). Fences to be constructed outside existing habitat areas (i.e. in already cleared areas).

5.6.2 The LHIB to encourage fencing of vegetation remnants other than those listed above from domestic stock.

5.6.3 Erosion control measures to be put in place in fenced-off vegetation wherever necessary.

Action 5.7: Buffer vegetation of high conservation value

Location: LHIG

Tasks:

5.7.1 Plant a buffer of hardy species on the edges of significant remnant vegetation patches, particularly those patches suffering from windshear and exposure due to loss of canopy. Use hardy native species include Bully Bush and Hop Bush (*Dodonaea viscosa*). Natural regeneration of native species to be encouraged on the edges of remnant vegetation patches.

5.7.2 Monitor the success of herbicide treatments for regeneration at vegetation edges.

Objective 6: To eradicate (where feasible and where there is a worthwhile biodiversity outcome) or control introduced fauna and reduce their impact on biodiversity

Action 6.1: Control introduced rodents

The Ship Rat has been well documented as causing a number of extinctions on the LHIG and being a major threat to extant native species, particularly terrestrial invertebrates (Section 4.3). The impact of the House Mouse on the LHIG biodiversity has not been documented.

Location: Targeted sites on the main Island. These targeted sites were chosen to both continue the existing baiting program, and to increase baiting in areas where there is the potential for a

significant biodiversity benefit. These areas, listed below, include high biodiversity areas for seabirds and other vertebrates, invertebrates and selected vegetation communities.

- Existing rodent baiting grids;
- Muttonbird Point and to a lesser extent in the northern hills and cliffs, Lagoon Foreshores and Neds Beach to Clear Place for sea birds;
- Native vegetation in the settlement area;
- Far Flats, Boat Harbour, Malabar and Stevens Reserve;
- Cloud Forest on Mount Lidgbird and Mount Gower;
- Accessible areas in southern mountains, and North Bay;
- Kentia Palm areas in the settlement area; and
- Kentia Palm-Curly Palm communities and Kentia Palm-Blue Plum Communities in the southern mountains.
- Seasonal baiting of sea bird breeding areas for affected sea birds.

Tasks:

6.1.1 Continue current rodent baiting program.

6.1.2 Expand existing rodent baiting program to include additional baiting sites for biodiversity-based outcomes, such as those listed under Objective 6.

6.1.3 Design and implement a monitoring program to evaluate the effectiveness of the program on reducing the threat of rodent predation on target species and locations.

6.1.4 Investigate any impacts from the current rodent control program and use of rodent poisons by residents on the LHIG Currawong population.

Action 6.2 Eradicate introduced rodents

The ongoing existence of the Ship Rat on the main Island continues to place significant pressure on extant vertebrate and invertebrate fauna. Their presence also precludes the potential reintroduction of threatened species now restricted to offshore islands.

Location: Main Island

Tasks:

6.2.1 Convene a Rodent Eradication Taskforce to oversee the planning and implementation of a rodent eradication program for the LHIG.

6.2.2 Assess, and where appropriate, undertake the recommendations contained in the Feasibility and Cost-benefit studies.

6.2.3 Evaluate the potential use of toxins other than brodifacoum that have less potential impact on non-target species.

6.2.4 Prepare a Logistics Plan for the eradication of rodents from the LHIG.

6.2.5 Continue studies where necessary to minimise the potential impacts on non-target species such as the Lord Howe Woodhen and the Lord Howe Currawong.

6.2.6 Undertake environmental assessment for the proposal to eradicate introduced rodents. If the proposal is assessed as likely to have a significant impact to threatened species, prepare a SIS under the TSC Act.

Action 6.3 Eradicate Mallard-Black Duck hybrids from LHIG

Hybrids of Mallard and Black Ducks on Lord Howe Island provide a stepping stone for the continued hybridisation of the Black Duck across the Pacific. These ducks also provide a potential reservoir for avian influenza.

Task:

Eradicate Mallard-Black Duck hybrids from LHIG.

Action 6.4 Conduct research into the impacts of introduced vertebrate fauna on the biodiversity of the LHIG and investigate techniques for control or eradication

The impact of non-rodent introduced vertebrates on the biodiversity of the LHIG is not well documented or understood. Research is necessary to gain a better understanding of the impacts of these exotic species.

Location: Main Island

Tasks:

6.4.1 Investigate the degree of threat through competition and predation posed by introduced faunal species, particularly the Blackbird, Bleating Tree Frog, Feral Pigeon, Grass Skink, Masked Owl, Snake-necked Tortoise and the Songthrush, and self-introduced species, particularly the Australian Kestrel, Purple Swamphen and the Buff-Banded Rail.

6.4.2 Investigate techniques and feasibility for control or eradication of introduced faunal species

based on the level of threat each species poses to native species of the LHIG.

6.4.3 Implement control or eradication techniques where available, feasible and where there is a significant biodiversity benefit.

Action 6.5 Conduct research into the impacts of introduced invertebrate fauna on the biodiversity of the LHIG and investigate techniques for control or eradication

Location: Main Island

Tasks:

6.5.1 Investigate the threat posed by established introduced invertebrates through targeted monitoring sites and research.

6.5.2 Investigate techniques and feasibility for control or eradication based on the level of threat each species poses to the native species of the LHIG.

6.5.3 Implement control or eradication techniques where available, feasible and effective.

Action 6.6 Control introduced invertebrates in targeted locations.

Location: *Calystegia affinis* site at Max Nicholls track.

Tasks:

6.6.1 Investigate control methods for the *Arsipoda* beetle on *Calystegia affinis* site on Max Nicholls track.

6.6.2 If control methods are found that are effective and that do not pose a risk to *Calystegia affinis*, undertake a control program.

Objective 7: To reduce impacts of groundwater pollution

Septic systems in parts of the settlement area have the potential to adversely impact on the biodiversity of the watercourses in this area.

Action 7.1 Protect water quality in freshwater creeks

Location: Settlement area

Tasks:

7.1.1 Develop a ground water management strategy to prevent adverse impacts of groundwater pollution to biodiversity in the settlement area. Strategy to include investigation into waste water treatment.

7.1.2 Undertake water quality monitoring in streams, including monitoring of macroinvertebrates.

Objective 8: To enhance positive interactions and reduce negative interactions between humans and wildlife

Action 8.1 Enhance positive interactions between Humans and wildlife through development of guidelines and a public awareness campaign

Tasks:

8.1.1 Ensure any artificial feeding of native fauna is undertaken in accordance with guidelines provided by the LHIB.

8.1.2 Develop wildlife interaction guidelines for all tour operators and include as a condition on licences.

8.1.3 Regularly review and revise Dog importation and management policies, and vehicle and traffic management policies to ensure they contain measures to reduce the impacts of dogs and vehicular traffic on native fauna.

8.1.4 Develop and implement a strategy for the control of non-native fauna which is, or has been, kept as a pet, companion animal, agricultural animal or for some other human use, and which has an ongoing impact on, or poses a threat to native fauna, for example feral pigeons, uncontrolled poultry, non-sterile goats and cats.

8.1.5 Produce and distribute to residents and visitors a plain-language booklet detailing ethics, practices, techniques and behaviours which will minimise negative human impacts on, and encourage positive interaction with, native fauna.

Objective 9: To reduce the impact of commercial, cultural and illegal collecting

There are three main forms of collecting on Lord Howe Island; collecting of the natural materials such as *Kentia* palm seed and *Pandanus*, collecting for scientific research purposes and the illegal collection of fauna (such as sea bird eggs or invertebrates) and flora (e.g. orchids, ferns).

Action 9.1 Minimise impacts on biodiversity of commercial Kentia Palm seed collecting

Location: LHIG

Task:

Monitor the impacts of palm seed collection in non-plantation areas. If monitoring indicates

negative impacts, encourage collection from less-significant areas.

Action 9.2 Control the illegal collection of fauna

Location: LHIG

Tasks:

9.2.1 Conduct a review of the LHI Act Regulations 2004 to ensure all appropriate taxa that may be subject to illegal collection are addressed.

9.2.2 Raise awareness of the issue of illegal collection by enhancing relationships with customs and the federal police.

9.2.3 Ensure the LHIB has issued appropriate licences for persons undertaking invertebrate collections for research purposes.

9.2.4 Restrict access to all offshore islands outside the lagoon that have significant biodiversity value.

9.2.5 Establish protocols to keep significant invertebrate localities secure.

9.2.6 Ensure the Lord Howe Island community is aware of the impacts and licensing requirements of seabird egg collection.

Objective 10: To reduce human impacts

Action 10.1: Protect vegetation in the vicinity of walking tracks and in areas where research and management activities require walking off-track

Location: LHIG

Tasks:

10.1.1 Promote awareness of the importance of staying on walking tracks.

10.1.2 Establish and implement an appropriate hygiene protocol for access to the PPP, including investigating options for placement of composting toilet at the entrance to the Mount Gower walking track and development of a strategy to protect significant habitats from adverse impacts of visitation.

10.1.3 Ensure field workers accessing the PPP are aware of sensitive areas prior to field work commencing.

10.1.4 Encourage tourists, residents, seed collectors, researchers and management staff to adopt minimal impact bushwalking practices.

Objective 11: To monitor consequences of climate change and develop contingency plans for 'at risk' species

Action 11.1 Monitor areas identified at risk from climate change

Location: LHIG, particularly areas identified most at risk from climate change impacts.

Tasks:

11.1.1 Establish biodiversity monitoring sites in as many 'at risk' areas as possible, including Mangroves, Sallywood Swamp Forest, Cloud Forest, high parts of the northern hills.

11.1.2 Establish long-term monitoring sites of flora and fauna along an altitudinal gradient in the southern mountains.

11.1.3 Undertake research to monitor the impact of climate change on seabird populations, particularly those species breeding within the LHIG that are at the extremity of their breeding range.

11.1.4 Develop and implement a monitoring program to assess the impacts of climate change on invertebrate lifecycles and 'at risk' flora (e.g. Knicker Nut, *Chamaesyce psammogeton*, *Geniostoma huttonii*, *Polystichum moorei*, and *Xylosma parvifolium*).

11.1.5 Establish a climate monitoring station on Mt Gower.

Action 11.2 Investigate options for securing species identified as most at risk from climate change

Location: LHIG

Task:

Investigate propagation and *ex-situ* storage techniques for species restricted to Cloud Forests, including both seed banking and living collections.

Objective 12: To encourage the conservation and protection of significant species, populations and ecological communities

Action 12.1 Prepare nominations for species, populations, ecological communities or critical habitat as required

Location: LHIG

Tasks:

12.1.1 Nominate taxa and communities that are assessed as being threatened for listing under State

and Commonwealth legislation, particularly any that may not be adequately covered by actions in this plan.

12.1.2 Where appropriate, potential nominations to be endorsed by the recovery team prior to proceeding with a formal nomination.

12.1.3 A list of significant taxa and communities (Appendix 1) (appendices document) to be maintained and regularly updated.

Objective 13: To promote recovery of individual threatened flora taxa

In addition to landscape-level recovery actions that are designed to provide broad biodiversity benefits across the LHIG, there are also species-specific recovery actions for those species that have particular conservation significance, or are particularly under threat where these species are not adequately addressed by broad-scale actions.

The following actions are targeted at individual listed flora threatened species.

Action 13.1 Protect habitat of threatened flora

Threatened flora species that occur within the settlement area (Knicker Nut, *Calystegia affinis*, *Chamaesyce psammogeton* and *Elymus multiflorus* var *kingianus*) may be at risk of clearing, trampling or grazing.

Location: Settlement area

Tasks:

13.1.1 Habitat of Knicker Nut, *Calystegia affinis*, *Chamaesyce psammogeton* and *Elymus multiflorus* var *kingianus* must be protected from clearing.

13.1.2 Habitat of Knicker Nut, *Calystegia affinis*, *Chamaesyce psammogeton* and *Elymus multiflorus* var *kingianus* to be fenced where possible to protect from trampling or grazing, particularly where expansion of the plant's habitat is possible.

Action 13.2 Undertake weed control in the habitat of threatened flora

Location: LHIG

Tasks:

13.2.1 *Calystegia affinis*

Grass invasion, specifically Kikuyu, is impacting the viability of the *Calystegia affinis* population at Old Settlement. Control of introduced grass to be undertaken at this site. Control will need to be done gradually and with extreme care due to

potential impacts to *C. affinis* given its twining habit around the Kikuyu.

13.2.2 Knicker Nut

The introduced grasses Buffalo and Kikuyu are threatening the Knicker Nut population at Neds Beach. These exotic species need to be eradicated or controlled.

13.2.3 *Carmichaelia exsul*

Cherry Guava, Crofton Weed and Tiger Lily to be eradicated or controlled in *Carmichaelia exsul* sites.

13.2.4 *Chamaesyce psammaegeton*

As this species occurs on the dunes of Blinky Beach, weed control will need to be opportunistically undertaken to protect its habitat from any new weed species incursions.

13.2.5 *Coprosma inopinata*

C. inopinata habitat should be monitored for any weed incursions, and any weeds treated as a priority.

13.2.6 *Elymus multiflorus* var *kingianus*

Investigate weed control needs for *Elymus* var *kingianus* and undertake weed control if necessary.

13.2.7 *Polystichum moorei*

Crofton weed and Tiger Lily are threatening *Polystichum moorei* habitat in the southern mountains. This needs to be eradicated or controlled where sites are accessible and when suitable techniques are available.

Action 13.3 Undertake monitoring of, and targeted research into, threatened and key endemic flora

Location: LHIG

Tasks:

13.3.1 Develop a monitoring and targeted research program for threatened and key endemic flora. The monitoring program to include measures of the area of the population, the population structure, mapping the extent of populations, threats and specify the time period of the monitoring. The research program to investigate autecological requirements of threatened flora that will assist with management.

13.3.2 Implement a threatened and key endemic flora monitoring program to determine any changes that may influence the long-term viability of the species. Include mapping outcomes from implementation suitable for input into GIS biodiversity forecasting analyses. Results from this

program may be used to prioritise species for *ex-situ* conservation actions.

Action 13.4 Establish ex-situ collections of threatened and key endemic flora

The threatened flora, and some endemic flora, of Lord Howe Island have critically small populations.

Location: LHIG, mainland

Tasks:

13.4.1 Establish *ex-situ* populations or seedbanks for all threatened flora.

13.4.2 Investigate whether any endemic non-threatened species with small populations warrant *ex-situ* conservation.

Action 13.5 Reduce adverse human impacts on threatened flora and communities

Location: Threatened flora species sites

Tasks:

Some threatened species are potentially at risk from the impacts of tourism and site visitation.

13.5.1 *Calystegia affinis*

A walking track dissects the *Calystegia affinis* population in the north of the island. Adverse impacts from tourism at this site to be minimised, and the boardwalk in the area to be maintained.

13.5.2 Knicker Nut

Two Knicker Nut sites are located near popular areas of Neds Beach and could be impacted on by visitors. Impacts of visitation needs to be monitored and any adverse impacts need to be minimised, by either signage or fencing.

13.5.3 *Coprosma inopinata*

Access to the *C. inopinata* site in the south end of the island should be restricted to essential research and management only, and require approval by the LHIB. Any permitted access to be provided with information on the significance of the site, and ways to minimise any adverse impacts.

13.5.4 Implement a strategy that minimises the risk of introduction of *Phytophthora cinnamomi* to threatened flora and community sites.

Action 13.6 Promote public awareness of threatened plants and communities

Location: LHIG

Task:

Prepare appropriate promotional and public awareness material on the threatened flora of the LHIG.

Objective 14: To improve knowledge and management of threatened and significant fauna species

There is a lack of knowledge regarding the ecology of most of the threatened and significant vertebrate and invertebrate fauna of the LHIG and the threatening processes impacting on them. This lack of knowledge has a considerable impact on the LHIB's ability to adequately protect and manage these species.

Action 14.1: Conduct research into priority fauna species

Location: LHIG

Tasks:

14.1.1 Conduct species-specific fauna research based on identified research priorities into the ecology of priority species, particularly with regards to reproductive ecology and habitat requirements, the impact of threatening processes, and population monitoring. Research should aim to identify management actions that will improve the long-term viability of the species.

14.1.2 Map species distributions, including point locality data as well as habitat mapping to allow for future biodiversity forecasting analyses.

14.1.3 Improve species habitat maps produced for this plan for input to GIS-based biodiversity forecasting analyses.

Action 14.2 Design and implement monitoring programs to evaluate effectiveness of recovery actions on threatened fauna

Tasks:

14.2.1 Implement monitoring programs to measure the success or failure of recovery programs for threatened fauna.

14.2.2 Map any changes to distribution or abundance in a form suitable for input into GIS-based biodiversity forecasting analyses.

Objective 15: To protect and enhance threatened fauna habitat

Action 15.1 Protect and enhance Flesh-footed Shearwater habitat

Location: Eastern settlement area

Tasks:

15.1.1 Zone all mapped Flesh-footed Shearwater nesting habitat (Priddel *et al.* 2006) as Environmental Protection or Significant Vegetation.

15.1.2 Rehabilitate areas within grazing leases where Flesh-footed Shearwaters are continuing to nest, as well as additional areas within the 1978 mapped distribution (Priddel *et al.* 2006).

Action 15.2 Protect and enhance habitat for the Lord Howe Island Silvereye

Location: Main Island

Task:

Encourage planting of native trees and understorey plants in cleared parts of the settlement area.

Action 15.3 Enhance and protect habitat for the Lord Howe Island Wood-feeding Cockroach

Location: Blackburn Island, Admiralty Islands

Tasks:

15.3.1 Control Rhodes Grass on Blackburn Island and revegetate with native grasses and species from the Greybark-Blackbutt Closed Forest Community.

15.3.2 Monitor Admiralty Islands for arrival of introduced grasses.

Action 15.4 Protect habitat of the White-bellied Storm-Petrel and Kermadec Petrel

Location: Balls Pyramid and Roach Island

Task:

Continue to restrict access to Balls Pyramid and control access to Roach Island.

Action 15.5 Protect and enhance Red-tailed Tropicbird habitat

Location: LHIG

Task:

Eradicate Bitou Bush in breeding areas on seacliffs from North Head to Malabar and cliffs of Mounts Lidgbird and Gower.