Background and implementation information for the Orange-bellied Parrot Recovery Plan

The Orange-bellied Parrot Recovery Team

CONTENTS

PREFACE

This document is based on information prepared by Jonathan Starks and Mark Holdsworth, on behalf of the Orange-bellied Parrot Recovery Team. This document provides more detailed information about the species and recovery actions identified within the *National Recovery Plan for the Orange-bellied Parrot (Neophema chrysogaster)*.

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BACKGROUND

The plight of the Orange-bellied Parrot *Neophema chrysogaster* (OBP) was first recognised by Howard Jarman who, in 1965, summarised what was then known of species, and concluded it is "undoubtedly one of our rarest birds" (Jarman 1965).

The first actions to conserve the OBP were taken in 1978 when ICI (Australia) Pty Ltd planned to construct a petrochemical plant at Point Wilson, on the western shore of Port Phillip Bay, Victoria, one of the main over-wintering refuges of the species. The company commissioned research into the use of the area by the OBP (Loyn and Chandler 1978; Carr and Kinhill Planners 1979; Lane *et al.* 1980)[1].

In 1979, the conservation agencies of Victoria, Tasmania, South Australia and the Commonwealth, and representatives from ICI, World Wide Fund for Nature (WWF), Birds Australia, and Birdlife International agreed to undertake research into the status and ecology of the OBP. In 1980, the Tasmanian Parks and Wildlife Service (PWS) initiated a study of the entire OBP range, with funds from WWF and assistance from volunteers, non-government organisations and governments (Brown and Wilson 1980, 1981, 1982). Also in 1980, landholders in the vicinity of Point Wilson formed the Murtcaim Wildlife Area Management Committee to facilitate local planning and management of habitat within a key wintering site for the species (Menkhorst *et al.* 1990).

The Orange-bellied Parrot Recovery Team (OBPRT) was established in 1983 to coordinate conservation activities and to guide the implementation of a recovery plan. The OBPRT has met every year since 1984 to review progress of recovery plan implementation, consider new developments, provide advice to government, promote the recovery effort and recommend new initiatives. The OBPRT comprises representatives of the Federal and range State conservation agencies, as well as non-government organisations (see Appendix 1). Meetings are held in each of the three core range states (Tas, Vic and SA) on a rotating basis. The Host State holds the Chair and resolutions are reached through consensus. The OBPRT generally holds open meetings to provide the opportunity for local land managers, landowners and other stakeholders to contribute to recovery program management.

The first OBP Recovery Plan was produced in 1984 (Brown and Wilson 1984)[2]. It contained 128 recommendations for recovery, but lacked an implementation schedule. In contrast, the second plan (Stephenson 1991) included a costed five-year implementation schedule to guide the recovery effort. Funding for implementation of recovery actions was provided by Australian Nature Conservation Agency (ANCA), under the Endangered Species Program and supported by the State conservation agencies of Tasmania, Victoria and South Australia. Progress on actions was subject to review by various authors (eg. Menkhorst et al. 1990, Edgar and Menkhorst 1993; Brown *et al.* 1995; Menkhorst 1996; Holdsworth et *al.* 1997). The results from the actions of the first two plans laid the foundations for developing strategies for the third plan covering the years 1998 to 2002 (OBPRT 1999). Actions within the third plan included some on-going actions from the previous plan (Stephenson 1991) and some new actions. Major achievements of the 1998–2002 plan were:

- A stable wild population at Melaleuca.
- A secure a captive population equivalent to the wild population.
- Implementation of a reintroduction program at Birchs Inlet.
- Improved protection and management of key breeding, migratory and winter habitats.
- Promotion of the importance of collision risk assessment, mitigation measures and compensatory mechanisms in managing OBP values at wind energy developments.
- Establishment of regional groups in South Australia and western Victoria to assist with recovery program tasks.

[1] Economic considerations later resulted in the ICI petrochemical plant at Point Wilson being abandoned.

[2] The Orange-bellied Parrot Recovery Plan was the first to be written for any threatened species in Australia.

- Increased the awareness of the OBP and, as an icon species, contributions to the understanding of coastal habitat degradation.
- Improved understanding of the species' breeding ecology.
- Studies of the potential impact on the species caused by disturbance sources (ie vehicle, fixed-winged aircraft, helicopters and people).

On-going and achievable actions within the third plan formed the basis of implementation during the period 2003-2004. These included continuation of summer and winter range population monitoring, captive-breeding and reintroduction programs.

Issues covered by previous plans

Conservation and management of habitat

Since the launch of the first recovery plan (1984), significant habitat protection measures have been implemented throughout the species' range. Most of the natural areas used by the species are now either reserved for nature conservation or afforded some level of protection through other forms of reservation, planning regulations, heritage agreements or cooperative conservation agreements between landholders. Five areas of winter habitat: Corner Inlet, Western Port and western Port Phillip Bay in Victoria, Lavinia State Reserve on King Island, Tasmania, and the Coorong in South Australia are listed under the Ramsar Convention as wetlands of international significance.

Management plans have been prepared for State managed parks and reserves, which support habitat for OBPs. These include Canunda National Park (NPWS 1986), Coorong National Park and Coorong Game Reserve (NPWS 1989), Beachport Conservation Park (Sutherland 1990), Carpenter Rocks (Owers 1994), Swan Bay Marine and Wildlife Reserves (Edgar 1991), Jack Smith Lake State Game Reserve (DCE 1991), Lake Connewarre State Game Reserve (Lee 1993), Port Campbell National Park and Bay of Islands Coastal Park (Parks Victoria 1998), French Island National Park (Parks Victoria 1998), Wilsons Promontory National Park (Parks Victoria 2002), Discovery Bay (Parks Victoria 2004), Lavinia State Reserve (Parks and Wildlife Service 2000), Tasmanian Wilderness World Heritage Area (Parks and Wildlife Service 1999) and Arthur-Pieman Conservation Area (Parks and Wildlife Service 2002).

The management of remnant habitat (and possibly of sub-optimal quality) on land owned and managed by many different organisations and private landowners is also important but has proved more difficult due to complex social, economic and ecological factors (Menkhorst *et al.* 1990).

Since research into the ecology and status of the OBP began in 1979, many detailed studies of the ecology of saltmarsh have been carried out. These have aimed to improve our ability to maintain or increase the carrying capacity of the habitat (eg. Lane *et al.* 1984; Loyn *et al.* 1986; Carr 1987; McMahon and Carr 1988; Carr *et al*. 1991; McMahon *et al.* 1994; Hill 1995; Lee 2000; Carr *et al*. 2002). These studies have greatly improved our understanding of saltmarsh ecology and form a valuable basis for the development of management actions for saltmarsh restoration, rehabilitation and cultivation. Active management of habitat for birds at the former Altona saltworks by Parks Victoria (Lane and Tweedy 1994) and planned decommissioning of Melbourne Water's Western Treatment Plant near Werribee may affect the future use of habitat by OBPs in western Port Phillip Bay.

Willingness to protect the species and its habitat has been demonstrated by effective community actions and cooperation throughout its range. For example, in western Port Phillip Bay, proposals by the Department of Defence to construct an airfield suitable for Hercules transport aircraft on Swan Island, and a proposal to construct a marina within Swan Bay at Queenscliff, were abandoned because of public concerns on the impact on the environment and public amenity. Some coastal development proposals at Queenscliff were modified, and alternatives found to the extraction of shell-grit at Point Wilson and Point Lonsdale (Edgar and Menkhorst 1993) to avoid loss of habitat. Staff of the Queenscliff Golf Club, which is situated on Swan Island, in the Swan Bay Marine Reserve, won a national environmental award for managing the course as habitat for the OBP (Australian Golf Course Superintendents Association 1996).

In 1990, the PWS constructed a public observatory[3] at Melaleuca, with World Heritage Area funds provided by the Department of Arts, Sport, Environment, Tourism and Territories. The observatory is primarily used to monitor the summer population of OBPs but also provides an opportunity for visitors to the area to view OBPs and learn more about the recovery program through an interpretative display.

A Victorian Working Group (VWG) was formed in 1990, comprising representatives of the major Victorian government and non-government bodies active in OBP management. The aim of the VWG was to provide a focus for coordination and stimulation of greater effort towards the OBP recovery in Victoria. The meetings of the VWG were informal and were held annually, usually in March, prior to OBPs arrival on the mainland. The VWG last convened a meeting in March 1997 but has been replaced by regional groups (see below). An action statement for the OBP for the period 1993 to 1998 was prepared under the Victorian *Flora and Fauna Guarantee Act 1988* (Edgar and Menkhorst 1993).

In 1991, a major fire at the Coode Island (Port of Melbourne) chemical storage facility, prompted the Victorian Government to commission an investigation to identify an alternative site for the facility. West Point Wilson, then subsequently Point Lillias, was selected after exhaustive investigations (Point Lillias Project Unit 1995). The Point Lillias environmental effects statement concluded construction at the 36 ha site (which contains Ramsar listed wetlands) would disturb OBPs among other bird species. The disturbance level would also be exacerbated by nearby construction of the East Coast Armaments Complex at Point Wilson (see below) (Point Lillias Project Unit 1995). In an attempt to compensate for this potential impact, the Victorian Government proposed to add significant new areas of high quality habitat to local Ramsar sites and to improve management and habitat enhancement work for the OBP. The OBP became a subject of much community concern during the Point Lillias environmental surveys. In some quarters the species and supporters of its conservation was derided as 'anti-development'[4]. For economic reasons the development has since been abandoned, as were the proposed compensation measures.

In April 1994, the Federal Government nominated Point Wilson as the site for the East Coast Armaments Complex, replacing the Royal Australian Navy Armaments Depot at Newington in Sydney. A Commonwealth Commission of Inquiry conducted in 1994–95 into the environmental impact of the complex paid particular attention to the OBP (eg. Hill 1995). The Commission supported the project subject to some modifications. The recommendations from the inquiry (Anon 1996) resulted in the erection of a predator-proof fence around the eastern and southern saltmarsh habitat at Point Wilson, and the installation of new culverts beneath 29 Mile Road to improve tidal penetration to the upper saltmarsh.

In 1996, Australian Titanium Minerals Limited (ATM) applied to mine sand on King Island, between Naracoopa and the Sea Elephant River, including critical migratory habitat for the OBP adjacent to the Lavinia State Reserve. A consultant for ATM (Lane *et al.* 1997) recognised the potential impact this development could have on the species and, through negotiations between the company, PWS and the Commonwealth, recommended the establishment of a 1.5 km Mining Exclusion Zone (Anon 1997)[5].

In 1999, a South Australian Working Group (SAWG) was formed, comprising representatives from SA Department of Environment and Heritage, local field naturalists clubs, Birds Australia (BA) and local birdwatchers with an active interest in the OBP. Like the VWG, the SAWG provides a focus for coordination and stimulation of greater effort towards the OBP recovery effort in SA. The SAWG

[3] The bird observatory at Melaleuca is constructed on land leased by the family of the late Charles 'Deny' King. The observatory is named in memorial to Deny to honour his commitment to protecting the OBP.

[4] The illfeeling toward the OBP being seen as stopping development was typified by the (then) Premier of Victoria, Jeff Kennett, when he candidly labeled the OBP as a 'trumped-up corella'. Mr Kennett provided his approval of using 'trumped-up-corella' as the name of the recovery program's newselltter soon after the point Lillias project was abandoned.

[5] The sand mining at Sea Elephant River has not been commissioned for economic reasons and therefore the enviromnetal conditions relating to OBPs under the licence have not been implemented.

has been pro-active in tackling OBP issues and shown initiative in undertaking population surveys and research. As a result of the success of the SAWG, and discoveries of OBPs in western Victoria, a Western Victorian Working Group (WVWG) was formed in 2001. This group comprises representatives from Department of Sustainability and Environment, Parks Victoria, Portland and Warrnambool Field Naturalists Clubs, BA, Southwest Bird Observers Club, local landowners and birdwatchers. The WVWG have since taken a lead role in recovery efforts in western Victoria. The success of the SAWG and WVWG, combined with the Australian Government's initiative to implement conservation through regional Natural Resource Management approaches under the Natural Heritage Trust, prompted the OBPRT to form groups in other regions. Regional groups have now been established in northwest Tasmania (including King Island), Coorong (SA) and Bellerine Peninsula (Vic).

A newsletter, *Trumped-up Corella* (TUC), promoting the OBP recovery program was launched in 1999. The newsletter was circulated to over 300 volunteers and supporters. Publication of this newsletter has stalled in recent years due to increasing demands on Project Officer time; however, will be again be published in 2006 under the newly funded winter project (see below). An OBP website, set up as part of the BA website (http://www.birdsaustralia.com.au/birds/obp.html), was established in 2000. The website is an important avenue of communication about the recovery effort and currently has details of the Mainland Habitat Research Project. During the 2000/2001 breeding season a webcam was set up at a nest box allowing on-line viewing of the breeding cycle of a pair of captive OBPs at Taroona (Tas). This proved a popular event and was repeated during the 2004/2005 breeding season to promote the 200th anniversary exhibition of John Gould Birds at the Tasmanian Museum and Art Gallery.

Captive breeding and release

Small numbers of OBPs were captured from the wild to supply the cage bird trade during the late 1800's up until the 1960s (Lewitzka 1980). However, the species proved difficult to breed in captivity and by the late 1970s no captive specimens where known to be alive. The lack of a captive population was seen as a limitation on the capacity to ensure the species long-term survival. In 1981, an aviary complex was built at Green Point, north of Hobart, to trial husbandry techniques using two closely related species, the Blue-winged Parrot *N. chysostoma* and Rock Parrot *N. petrophila*. The success of these trials and the subsequent release of captive-bred progeny of both species into the wild (Brown 1988; Brown *et al.* 1995) gave the OBPRT the confidence to begin captive-breeding OBPs in 1985 with 10 founder birds collected from Melaleuca.

During the first five years the results of captive-breeding were promising, but the survival of juveniles was poor due to the prevalence of Psittacine Circoviral Disease (PCD), which was exacerbated by cold, damp conditions experienced during winter at Green Point (Menkhorst *et al.* 1990; Brown *et al.* 1995). The site was also subject to security problems with several minor break-ins occurring. In 1989, the captive-breeding facility was relocated to a less-exposed and more secure location at Taroona, south of Hobart. Breeding productivity and winter survival consistently improved thereafter (Brown *et al.* 1995) and clinical expression of PCD has been prevented with no further breaches of security.

In 1994, the OBPRT moved to establish a second captive colony at Healesville Sanctuary (Vic), using founder stock from the Taroona facility. This measure was taken as insurance against catastrophic events (ie fire and disease) destroying the entire captive population. The inclusion of Healesville Sanctuary in the captive-breeding program has provided additional access to important captive management support systems and professional threatened species advice through Zoos Victoria. In 1995, a Captive Management Group (CMG) was formed to oversee the management and operation of the captive-breeding program. The CMG consists of representatives from each of the institutions holding OBPs including keepers, veterinarians and conservation management staff. The CMG meets at least annually and reports to the OBPRT.

A captive population of at least 100 OBPs has been maintained since the mid-1990s and is held at two core locations – Taroona (Tas) and Healesville Sanctuary (Vic). Adelaide Zoo, Melbourne Zoo and a private aviculturist in Victoria also hold smaller populations under authority. These secondary sites are used to house non-breeding stock, experiment with different husbandry techniques to improve

productivity and for limited public display. As of April 2006, the captive-breeding program has produced a total of 653 fledglings.

Since the outbreak of PCD (see above) the captive population has not suffered major disease outbreaks. Major causes of mortality in captivity have include accidents during handling; trauma due to birds flying into aviary hardware; stress during courtship; renal failure; intestinal worm impaction and aspergillosis (Philips and Holdsworth 2006). However, during the 2005/06 breeding season unusually high number of nestling deaths (43 individuals at three times the average rate) occurred at Taroona. Post mortems of nestlings failed to determine cause of death. Tests of some individuals indicated the presence of a herpes virus; however, tests of adult birds have failed to confirm the presence of herpes virus. The Taroona population has been quarantined and is subject to on-going investigations.

The need to avoid inbreeding depression in the OBP led to the development of methods to measure genetic diversity in the wild and captive populations. In 1992, the Department of Genetic and Human Variation at LaTrobe University (Drs N. Murray and H. Allen) began work on developing a probe to identify genetic markers in DNA from the blood of OBPs. The method detects specific alleles in the genotypes of individual birds from which estimates of genetic heterozygosity can be made. This information is used to assist with pair selection to maximise genetic heterozygosity in the captive population and to monitor genetic heterozygosity in the wild. In addition to the original founder stock, 16 wild birds have been added to the captive population to bolster genetic diversity (six in 1987, four in 1993, two in 1996 and four in 1997). A review of the fertility of the O'Donoghue (2005) has identified the need for new founder stock. Collection of these birds will be subject to State and Commonwealth approval processes.

The presence of PCD in the captive population delayed the release of captive-bred birds until 1991, when the disease was positively identified in wild OBPs (Brown *et al.* 1995). From 1991/92 to 1993/94, 38 captive-bred OBPs were successfully introduced into the wild at Melaleuca to establish release techniques and post-release survival. Coloured bands were applied to each individual to aid identification and they were held in a temporary aviary for up to a month (Brown *et al.* 1995). Observations indicated post-release survival was high and most birds remain in the area for the entire summer. Released birds were also observed to pair with other released birds or with wild birds, and many successfully raised young. Released birds tended to migrate later than wild-bred adults, behaving more like wild-bred juveniles (ie departing March—April). Subsequently, three individuals were observed in Victoria during winter and at least five back at Melaleuca. One individual returned to Melaleuca for three consecutive breeding seasons (Brown *et al.* 1995), thus confirming captive-bred birds can migrate successfully and breed for several years after release. However, some released birds were not seen again, either in the wintering range or at Melaleuca in subsequent years—their fate unknown.

The success of experimental releases at Melaleuca prompted the experimental release of birds at Birchs Inlet (Macquarie Harbour) in an attempt to re-establish the species at a historic breeding area. Fifteen birds were released in 1994 and 13 in 1996. The release method was similar to that used at Melaleuca (Brown *et al.* 1995). One of the 1994 birds was seen during the winter at Point Lillias (Vic) in 1995 (Starks 1997), and another at Birchs Inlet in 1997. Only one pair of the 1996 release is known to have bred, producing one fledgling. Since 1999, a concerted effort to re-establish the species at Birchs Inlet has been undertaken with the release of 236 individuals. A total of 264 captive-bred birds have been released at Birchs Inlet and a small population (c. 10) has now been established. Details of the Birchs Inlet release program are reported in Smales *et al.* (2000), Smales (2001) and unpublished reports to the OBPRT. Six captive-bred birds were also successfully released at Point Wilson Armaments Complex (Department of Defence) in August 1996. The objectives of this release were to:

a) Determine whether captive-bred birds could survive after release in mid-winter, adapt to local food plants, avoid predation and locate suitable roost sites,
b) determine whether birds released on the mainland are capable of migrating to and from their traditional breeding sites in Tasmania, and
c) whether birds have successfully migrated return to their release site or follow wild-bred birds to other wintering sites.

Survival of the 1996 released birds, three of which were fitted with radio transmitters, was encouraging, the last bird being seen over three weeks after release at the time when migration was expected to occur. The 1996 release demonstrated captive-bred birds released on the mainland can survive in saltmarsh environments and can adapt to local conditions and food sources (Menkhorst 1997). However, the fate of these birds beyond that year remains unknown. In August 2004, six captive-bred OBPs were released adjacent to the Point Wilson at the 29 Mile Road site to ascertain the attractiveness of dry saltmarsh habitat prior to experimental grazing trails. Two of these birds were observed as late as 3rd September, foraging within natural habitats. At least two (possibly a third) released bird were sighted briefly at Birchs Inlet several months later, While their long-term fate is unknown, this indicates mainland released birds are capable of undertaking migration.

A complete summary of captive-bred OBPs released at all sites, in all years is shown in Table 1.

Table1. Numbers of captive-bred birds released at Birchs Inlet, Melaleuca, Taroona and Point Wilson during the period 1991/92 —2005/06. (*) The bird released at Taroona was an escapee.

Year	Birchs Inlet	Melaleuca	Taroona	Point Wilson	Total
1991/92		11			11
1992/93		14			14
1993/94		13			13
1994/95	15				15
1996/97	13		1*	6	20
1999/00	33				33
2000/01	26				26
2001/02	51				51
2002/03	38				38
2003/04	26				26
2004/05	27			6	33
2005/06	35				35
Total	264	38	1	12	315

SPECIES INFORMATION AND GENERAL REQUIREMENTS

Conservation Status

The OBP is protected by State and Commonwealth legislation throughout its range. The OBP is listed nationally as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Under State legislation, the species is listed as Threatened under the *Flora and Fauna Guarantee Act 1988* (Vic), and as Endangered under the *Threatened Species Protection Act 1995* (Tas), *National Parks and Wildlife Act 1972* (SA) and *Threatened Species Conservation Act 1995* (NSW).

The International Union for Conservation of Nature and Natural Resources also lists the OBP as Critically Endangered (International Union for the Conservation of Nature 2002) as does the Action Plan for Australian Birds 2000 (Garnett and Crowley 2000) and the Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2003)

Species Details

Description and taxonomy
The Orange-bellied Parrot *Neophema chrysogaster* (Latham 1790) is one of six species of 'grass parrots' of the genus *Neophema*. It is a small parrot, about 21 cm long and a median weight of 45.2 ± 2.7g (range = 39.4-53.5g, n=202) with no weight difference between sexes (Holdsworth pers. comm.). The plumage is rich grassy-green above, with a narrow dark-blue edge to the wing, green on the breast, yellow abdomen and vent, with a bright orange patch on the belly. The species is similar to the Blue-winged Parrot *N. chrysostoma* and Elegant Parrot *N. elegans*, with which they sometimes associate (Eades 1998).

The orange patch is brightest in males, paler in females and small and/or diffuse in juveniles. On the forehead, males have a broad dark-blue frontal band bordered above and below by light blue, which is less distinct in females, and often absent in juveniles. The bill is dark grey in adults and yellowish-orange in juveniles. When flushed they produce a high-pitched metallic 'buzz' alarm call repeated rapidly up to ten times. The flight call is a high-pitched repeated 'tzeet…' given every second at the apex of the undulating flight (Wilson and Holdsworth 2005). For a more detailed description, see Higgins (1999). Three closely related 'grass parrots' also occur within the range of the OBP: Blue-winged Parrots in Victoria, Tasmania and South Australia; and Rock Parrots *N. petrophila* and Elegant Parrots in South Australia. These three species can be mistaken for OBPs, (ie some can have orange abdomens), but none has the grass-green upperparts, distinctive alarm call, and intense orange belly (in males) of the OBP (Eades 1998; Eades and Marsack 1998; Higgins 1999).

Life history and ecology
The life history and ecology of the OBP is well known (Brown and Wilson 1982, 1984; Loyn *et al.* 1986; Menkhorst *et al.* 1990; Starks *et al.* 1992; Brown *et al.* 1995, Holdsworth 2006).

The species breeds in coastal southwestern Tasmania then migrates to the coasts of Victoria and South Australia for the winter (Brown and Wilson 1982) (Figure 1). Both sexes breed in their first year and tend to be monogamous (Higgins 1999). Observation of banded individuals indicates pair bonding may occur on the wintering grounds prior to spring migration, but most pairing is believed to occur after arrival at breeding grounds.

Natural nest sites consist of a hollow in a limb or trunk of living Smithton Peppermint *Eucalyptus nitida* or occasionally Swamp Gum *E. ovata*[6]. The same hollow can be used for consecutive years

[6] The use of *E. ovata* and one dead tree for nesting has only been recorded at Birchs Inlet.

(Holdsworth 2006). Since 1992/93, specially built nest boxes have been erected at key sites (ie Melaleuca and Birchs Inlet). These boxes may offset any possible limitations of naturally available sites, but more importantly allows access to nests to inspect contents and band nestlings, which would otherwise be difficult or impossible to achieve in natural hollows due to cavity depth or structural soundness of trees.

Females occupy nests soon after returning to the breeding area (Oct-Nov) and nest scrapes are prepared by chewing and scratching rotten wood material within the nest cavity. Broody females spend increasingly more time within the nest chamber from mid-November. During this time, males feed the females at or near the nest site where copulation occurs. From long term studies conducted by Holdsworth (2006) the earliest laying date recorded is 29 November and the latest 19 January; however, most eggs (95%) are laid during December. Eggs are elliptical to broadly elliptical, glossy white and laid every second day. The mean dimensions of eggs are 22.9 ± 0.98 mm by 18.5 ± 0.67 mm (n = 99 eggs). Clutch size range is 2–6 with a median of five (mean = 4.7) (Holdsworth 2006). Only the female incubates the eggs and hatching occurs after 21–24 days. Females remain in the nest for approximately 10 days after hatching and are tended by the male. After 10 days, the female stops brooding during the day and both parents feed the young. From 14 days old, young increasingly clamber toward the nest entrance to be fed by both parents. Young usually fledge at 35 days from late January to mid-February. From 204 nests (natural and boxes) studied since 1993/1994, no secondary clutches were confirmed (Holdsworth 2006). Most parents depart the breeding area 2-3 weeks after fledging and juveniles form small flocks before leaving the breeding area in mid- to late March (Higgins 1999).

Orange-bellied Parrots eat seeds and fruits of grasses, chenopods, sedges and herbs by foraging on the ground or climbing on food plants (Higgins 1999). Diet varies according to season and habitat across the range (see Brown and Wilson 1984). The availability of food in the breeding range depends on maintaining, by fire management, a mosaic of moorlands of different ages (Brown and Wilson 1982, 1984). In the non-breeding range, OBPs forage predominantly on a suite of saltmarsh species, beach/dune plants and a variety of exotic weed species (Higgins 1999). In Victoria, there may be a shortage of seed in the available saltmarsh in most years during the critical mid-winter period and the parrots sometimes feed on weeds and introduced grasses in adjacent pastures and golf fairways (Loyn *et al.* 1986). In South Australia, strandline plants are as important as saltmarsh and pasture plants for OBPs (Gibbons 1984; Casperson 1995). Other species of parrots and introduced finches may compete with OBPs for food in key saltmarsh and beach habitats in the wintering range (Brown and Wilson 1982, 1984; Loyn *et al.* 1986; Hill 1995). Known food plants of the OBP are listed in Appendix 2.

DISTRIBUTION, IMPORTANT HABITATS AND POPULATIONS

Distribution

The Orange-bellied Parrot is endemic to southeastern Australia. Formerly, the species core range on the mainland extended from Adelaide, and possibly Yorke Peninsula, south-east through the Coorong, Robe, Beachport and Port MacDonnell in South Australia, east through southwestern coastal Victoria, Port Phillip Bay to South Gippsland, and north to near Sydney. In Tasmania it extended along the western and southern coast, east to Bruny Island (North 1912; McGill 1960; Jarman 1965; Loyn and Kinhill Planners 1980; Brown and Wilson 1982, 1984; Higgins 1999).

During the late 1800s, and in the 1920s, the species was reported widely as being common, or locally abundant (Jarman 1965). It was recorded near Sydney in 1907 (North 1912). The range and abundance of the Orange-bellied Parrot has declined steadily since the 1920s. It is now rarely recorded from west of the Murray River in South Australia or east of Jack Smith Lake in South Gippsland, Victoria (Higgins 1999). Recent records of single birds in NSW from Shoalhaven, in 1986 (Starks 1988), and at Shellharbour (G. Southwell pers. comm.) and Maroubra, in 2003 (B. Hensen pers. comm.) indicate a low, but unknown level of activity in that State. Small numbers of OBPs have recently (October 2006, C. Tzaros pers. comm.) been reported from the Adelaide area indicating the species can still utilise parts of its historic range. Figure 1 shows the present distribution of the Orange-bellied Parrot.

The species' current breeding range is a narrow coastal strip of southwest Tasmania between Birchs Inlet, in Macquarie Harbour, and Louisa Bay on the southern coast. Most pairs breed within 20 km of Melaleuca Inlet, Bathurst Harbour and Port Davey in what is considered one breeding population (Brown and Wilson 1984) (see Figure 1).

Most adults depart the breeding range in February, leaving juveniles to follow in March and April. During migration, individuals forage on beaches, coastal dunes, heathland and pasture until reaching the saltmarshes of northwest Tasmania and King Island. The first birds arrive at Lavinia State Reserve, King Island, in mid-March and have usually left by June. Adults first reach Victoria in late March and disperse east as far as coastal South Gippsland, and as far west as Lake Alexandrina in South Australia. The majority of the known population over-winters in coastal habitats in southern central Victoria, western Victoria and southeast South Australia. In September, the first adults leave the Australian mainland for Tasmania, with the last birds departed by mid-November. Observations of banded birds indicate pre-breeding migration is more rapid than post-breeding migration. The location of migratory corridors and mode of passage is not well known; however, all observations suggest the species is more likely to 'island hop' across western Bass Strait rather than making long, direct sea passages. The timing of sea passages is probably influenced by prevailing winds with individuals taking advantage of tail winds. Observations of 699 colour-banded OBPs at Melaleuca (Holdsworth 2006) clearly show those individuals in their second year of life or older return before first-year birds arrive. Older birds begin to arrive late in September and increase to a peak arrival between 14—18 Oct. Conversely, first-year birds the earliest arrival of first-year birds is on the 11th October, and peak arrival is during the period 29 Oct — 2 Nov. (Holdsworth 2006).

In Victoria, up to 70% of the entire known population concentrates at three wintering sites around Port Phillip Bay and the Bellarine Peninsula. These are the Western Treatment Plant and Point Wilson (mainly within the Spit Nature Conservation Reserve), Lake Connewarre and Swan Bay, including Swan Island. Since 1999, up to 10% of the known population has been found at Yambuk Lake, Kellys Swamp and Rutledges Cutting near Port Fairy in western Victoria. In South Australia, most recent sightings have occurred between the Victorian border and Port MacDonnell, around Canunda National Park and in the southern part of the Coorong National Park (eg. Brown and Wilson 1984, Hewish and Starks 1988, Starks *et al.* 1992, Starks 1999, J. Starks pers. comm.)

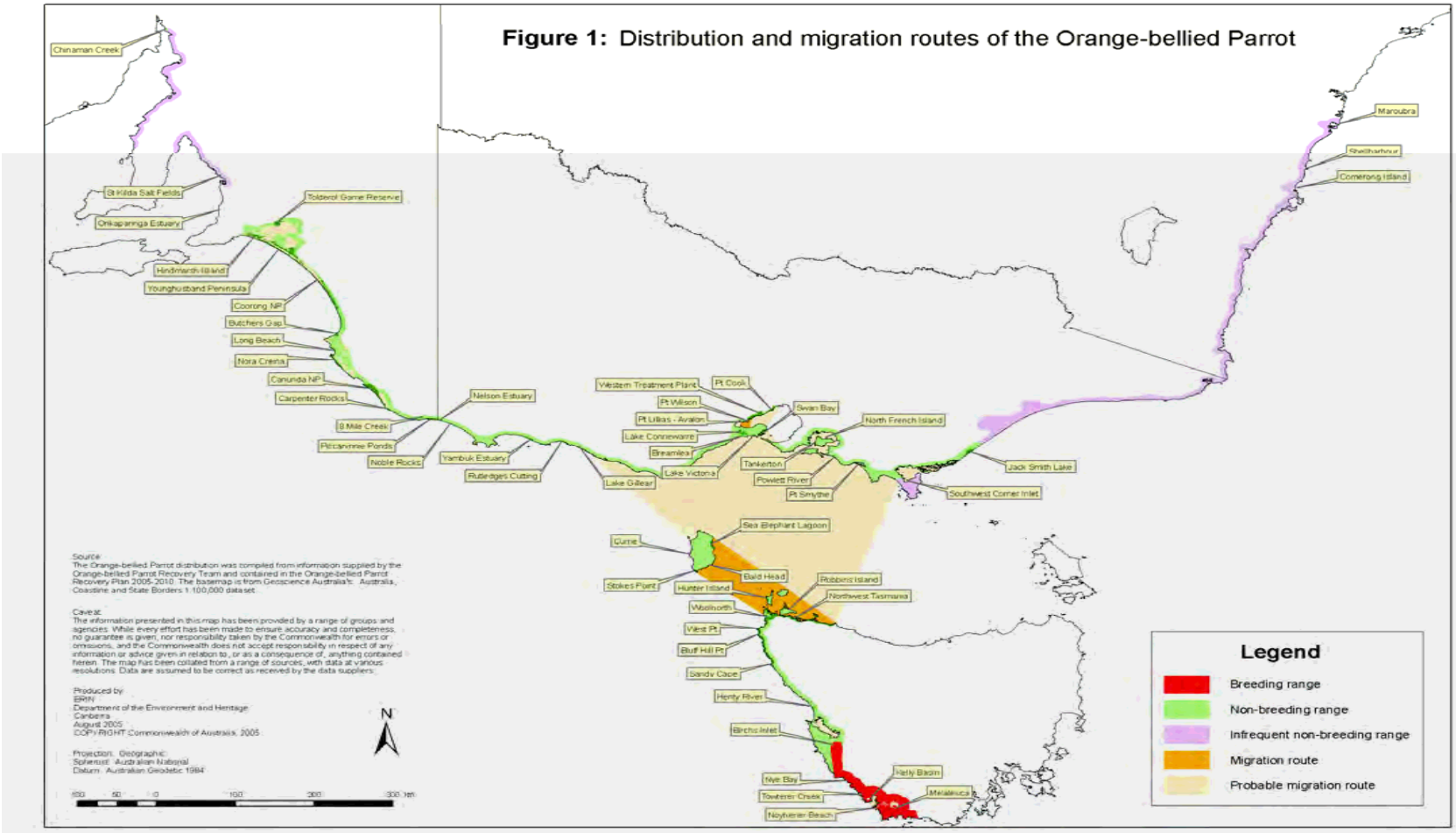

Figure 1. Distribution and migration routes of the Orange-bellied Parrot.

Important habitats

Eucalypt forest (breeding habitat), saltmarshes, coastal dunes, pastures, shrublands, estuaries, islands, beaches and moorlands, usually within ten kilometres of the coast, make up the diverse habitats used by OBPs.

Breeding habitat is a mosaic of eucalypt forest, rainforest, and extensive moorland and sedgeland plains dominated by Buttongrass *Gymnoschoenus sphaerocephalus*, and intersected by wooded creeks, rivers and estuaries within the Tasmanian Wilderness World Heritage Area (Brown and Wilson 1982, 1984; Stephenson 1991). During breeding, OBPs feed on the seeds and fruits of a range of sedgeland and moorland plants, such as Paper Daisy *Helichrysum pumilum*, Flat Cord-rush *Eurychorda complanata* and Lemon-scented Boronia *Boronia citriodora*, and roost in copses of tea-tree *Leptospermum spp.* and paperbark *Melaleuca spp.*. Nesting occurs predominantly in the hollows of live Smithton Peppermint *Eucalyptus nitida* (Brown and Wilson 1984; Higgins 1999). At Melaleuca and Birchs Inlet, the species favours small forest patches close to feeding areas for nesting, but probably nests within extensive forest at Towterer Creek north of Port Davey (M. Holdsworth pers. comm.). Fire-dependent moorlands are an important feature of the breeding habitat. Vegetation structure, plant species diversity and seeding response to fire influence the distribution and abundance of the plant species within these habitats (Brown and Wilson 1982, 1984).

On passage in western and northwestern Tasmania the species occurs in dunes, heathland, coastal grasslands, saltmarshes and pasture. On King Island, they mostly occur in saltmarsh dominated by Beaded Glasswort *Sarcocornia quinqueflora*, flanked by dense Swamp Paperbark *Melaleuca ericafolia*.

In Victoria, the species uses saltmarshes dominated by Beaded Glasswort, Southern Sea-heath *Frankenia pauciflora* and Shrubby Glasswort *Sclerostegia arbuscula*, as well as associated grassy or weedy pastures. In South Australia, and on migration in western Victoria, they also use beaches, dune frontages and adjacent dune systems, and sheltered areas along rocky foreshores where they feed on the seeds of strandline plants such as Sea Rocket *Cakile maritima*.

In Victoria, critical winter habitat for the species is saltmarsh along the western shore of Port Phillip Bay, particularly the Spit Nature Conservation Reserve, and on the Bellarine Peninsula at Lake Connewarre Wildlife Reserve and Swan Bay, including Swan Island. Other suitable habitat is located at Jack Smith's Lake, Corner Inlet, Western Port, French Island, Port Fairy, Yambuk and Discovery Bay Coastal Park. In South Australia, important saltmarsh areas occur at Canunda National Park, Lake Bonney, Nora Creina, Robe, Butchers Gap, Blackford Drain, Woods Well, Magrath Flat and Lake Alexandrina. At these sites birds tend to spend less time and occur in smaller flocks than in the key sites in Port Phillip Bay and the Bellarine Peninsula.

Food availability in saltmarshes in mid-winter was thought to be a key factor affecting population dispersion (Loyn et al. 1986). The study of Lee (2000) confirmed there are significant fluctuations in availability of seed during the non-breeding period, and *Frankenia pauciflora* was found to be the most important indigenous saltmarsh species carrying seed during mid-winter before the onset of seeding in *Sclerostegia.* At The Spit Nature Conservation Reserve, Orange-bellied Parrots were strongly associated with saltmarsh communities dominated by *F. pauciflora* and *Suaeda australis.* Lee (2000) and Lee and Burgman (undated) also concluded the distribution of important saltmarsh food plant species depends more critically on edaphic and microtopographic features associated with inundation and exposure than on the details of soil nutrient status.

Since research into the ecology of the OBP began in 1979, winter habitat and their plant communities has been mapped and described in detail in Victoria (Carr and Kinhill Planners 1979; Yugovic 1984; McMahon *et al*. 1994) and in South Australia (Gibbons 1984; Casperson 1995). A method of remote sensing to identify saltmarsh communities suitable for OBPs was developed by

the Royal Melbourne Institute of Technology (Race 1994a, 1994b); however, this yet to be broadly applied to guide conservation management. In Tasmania, a comprehensive map of all vegetation communities is available (TASVEG). All OBP habitats, including grasslands, heathlands, scrub, wetlands and saltmarshes as well as woodlands and forest are mapped to 1:25000 scale.

Population and reproduction

Important populations

Currently, only one wild breeding population is known; however, there is some evidence of partioning at the extremes of the breeding range. Persistent resighting of some released birds and their progeny at Birchs Inlet, but not at Melaleuca (c. 80km south), for brief periods during the spring and autumn migrations, and no Melaleuca birds being sighted at Birchs Inlet during the breeding season suggests the existence of another sub-population between the two localities. Further research is required to better understand the breeding population distribution and dynamics. The species forms a single but widely distributed population within the wintering range. Population monitoring throughout the range has been an important component of the recovery program.

Monitoring and banding the population in summer

The first observations of the breeding population at Melaleuca began in 1979, and every year since 1992, monitoring has been conducted. Observation of the species is centred on the vegetable gardens of the King and Willson families, which have attracted OBPs for over 50 years. Since 1988, OBPs have been provided with supplementary food to aid observation of colour-bands. From 1986/87 to 2004/05, 806 wild OBPs (760 at Melaleuca and 46 at Birchs Inlet) have carried Australian Bird and Bat Banding Scheme metal bands (Holdsworth 2006), most indicating by colour the year of banding on one leg, and coloured plastic bands identifying individual birds on the other. Colour-bands have also been attached to all captive-bred released birds (see above). In 2000, coloured plastic bands were replaced by coloured anodised aluminium lettered bands, improving the observability of the bands, particularly on the mainland. Banding of birds at Melaleuca prior to 1993 was conducted entirely by mist netting at feed tables. Since 1993, on average 47 (range 11-72) nestlings have been banded annually from nest boxes and wild nests. Colour-banding of nestlings allows the recognition of individuals and age cohorts in the wild population, and enables monitoring of demographic trends. The continued provision of nest boxes is crucial for the success of the banding and monitoring programs. The daily observation of colour-banded birds in the breeding range forms the basis of estimating the annual breeding population of the OBP, determining population trends and measuring individual survival and longevity.

These studies (Holdsworth 2006) show a mean survivorship of 55% (± 3.2 s.e) for juveniles and 63.6% (± 2.0 s.e) for adults. There was a decreasing trend in survival rates across all cohorts from 1999 onward with average annual survival declining markedly thereafter. The reason for this decline is unclear. There was no difference in survival rate of each sex. The mean lifespan recorded for 693 banded individuals is 2.7 years. Maximum recorded longevity for a male in the wild is 11.7 years and for a female 10.4 years (Holdsworth 2006). Historically, Orange-bellied Parrots are reported to live to 13 years in captivity (Lewitska 1980). The longest lived bird in the current captive population was a 12.7 year old male and the oldest successful breeding bird is an 11 year old female (Holdsworth 2006).

Analysis of sightings of banded birds and known production of fledglings at Melaleuca for the period 1994-2004 shows an average minimum population of 92 birds (range 71 –116). The population trend is slightly upward which has been influenced by successful juvenile production in recent years (Figure 2). Overall, the data indicate the efforts of the OBPRT have resulted in at minimum, a stable population.

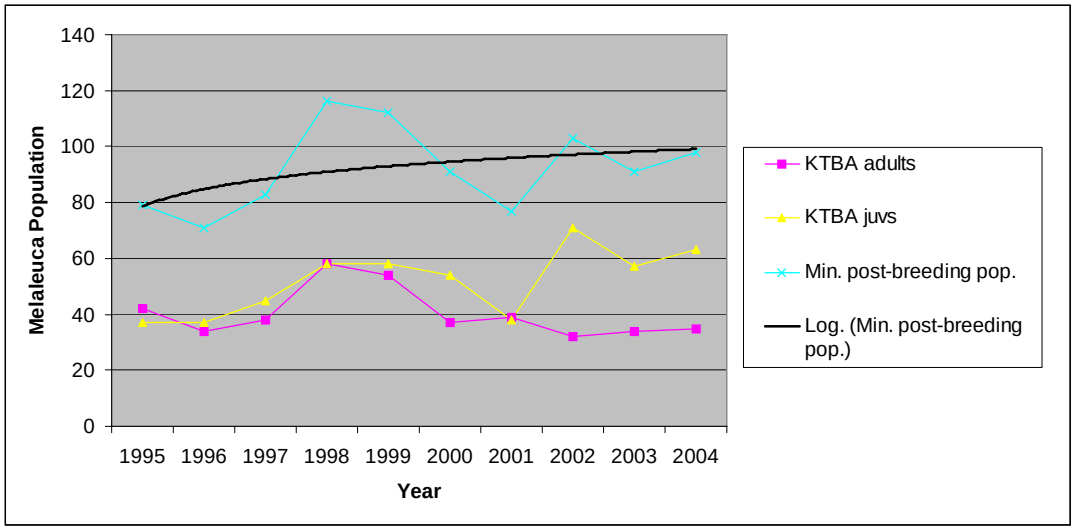

Figure 2 The chart shows the number of OBPs known to be alive (KTBA) at Melaleuca since the 1994/95 breeding season

Reproductive success

Since 1991/92, 74 custom-made nest boxes have been erected at Melaleuca to encourage breeding in accessible sites. Nest boxes have been increasingly used by OBPs and have become an important component of the monitoring program. During the period 1992/93 – 2005/06 192 breeding attempts occurred in nest boxes at Melaleuca with a mean occupancy rate of 14.8/year (range = 8 –18). Observations of these nest boxes and some natural nests formed the basis of a long term study of the reproductive success of the species (Holdsworth 2006). Since 1993/94 (when significant nest observations commenced), a total 874 eggs were laid of which 695 hatched at 80% hatching success. Six hundred and six nestlings fledged at a success rate of 87%. Overall breeding success (ie proportion of eggs laid that result in a fledgling) was 69% at an output of 3.3 fledglings per nest with eggs (Holdsworth 2006). This study also showed some indication the breeding success of the OBP is influenced by fire frequency.

In 1994, nest boxes were installed at Birchs Inlet and Towterer Creek, and in 2001 at Noyhener Beach to encourage local and released birds to use them for breeding. One nest box had been used at Towterer Creek in 2003 (unknown production) and up to nine boxes are used by released birds and progeny at Birchs Inlet each year with a total of 46 juveniles being produced.

Censusing the population during winter

Surveys of the winter population are conducted annually to count the numbers of birds using traditional sites and new sites. A coordinated national count, which covers known and potential habitat in Victoria, South Australia and northwest Tasmania/King Island, has been conducted on a weekend in late July in various guises since 1979. Birds Australia has coordinated and conducted winter counts of the OBP since 1984. A key component of the winter surveys is the involvement of volunteers. Over 150 volunteers regularly participate in the annual national count weekend. Recently, some of the tasks of organising the winter surveys have been delegated to regional groups. Regional groups are better placed to observe birds at short notice and more able to tap into local resources and implement actions of the recovery plan. The expansion of such groups throughout the range has great potential to increase coverage and capacity within the volunteer force.

Birds Australia promotes the counts and publicises the results through the production of a summary report, website, quarterly magazine *Wingspan*, regional bird organisations, local naturalist groups and through the Threatened Bird Network newsletter *Volunteer*. Details of these counts and

volunteer assistance have been published regularly (Menkhorst 1984, Jessop and Reid 1986; Starks 1988, 1992, 1993, 1994, 1995, 1996, 1997, 1999; Starks *et al.* 1992).

State conservation agencies provide staff and logistical support to assist BA volunteers. Although winter surveys are extensive, often covering most of the winter range, including all known wintering sites and many other areas of potential winter habitat, results have been variable. Figure 3 shows the maximum number of OBPs recorded during the wintering period each year between 1979 and 2006 In recent years, the winter surveys have counted far fewer birds than the summer population at Melaleuca (see Figure 2). The reasons for this discrepancy are not entirely known, but it probably indicates the species is using different habitat, is dispersing into smaller flocks, or is moving beyond its former range during winter, coupled with the fact that the winter range is so geographically extensive that it is challenging to survey all known or suspected sites. Many suspected sites are physically difficult to access, either by foot or by boat. Orange-bellied Parrots are occasionally observed feeding with flocks of Blue-winged Parrots, Elegant Parrots and other seed eating birds, particularly in areas outside of western Port Phillip Bay (Starks *et al.* 1992; Klau and Langdon 1994; J. Starks pers. comm.). Sightings of banded birds during the winter counts provide information on survival, longevity, site fidelity and movements, and have shown captive-bred/released birds are capable of normal migration.

Initially, winter counts were used as an annual index of the wild population, but the consistently higher summer counts at Melaleuca (Figure 2) have become more valuable as a population index. Winter surveys will be used primarily to locate banded birds, assess the annual use and condition of favoured feeding and roosting sites, locate new habitats, and encourage public involvement and awareness of the species.

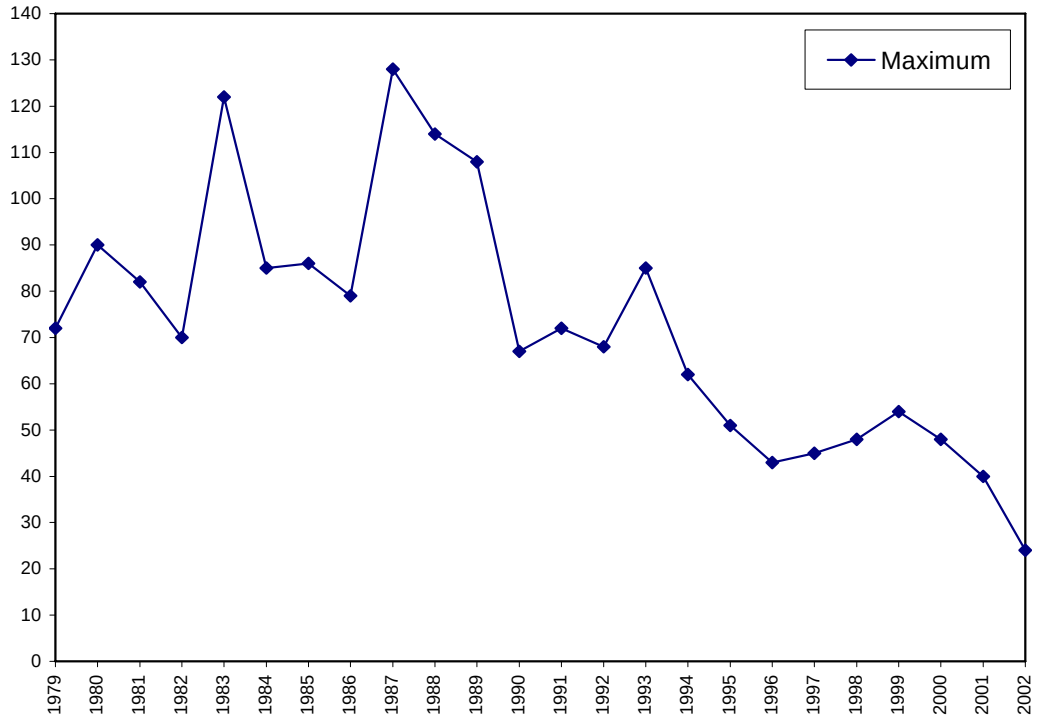

Figure 3. Maximum number of OBPs recorded during the wintering period each year.

Population viability analysis

Population viability analysis (PVA) uses a computer model to synthesise information about the population dynamics of a species to produce estimates of the risk of extinction. The model is reliant on detailed biological information such as reproductive rates, population estimates, and

survival. The results of OBP PVA are used by the OBPRT to guide the recovery strategy and refine actions.

The first PVA, prepared in 1993 (McCarthy 1995), showed high juvenile mortality was the greatest limitation to population increase, and emphasised the value of the captive-breeding program. It predicted the most effective use of the captive-breeding program was to release 40–60% of captive-bred birds annually. Captive breeding and the supply of artificial nests are important in reducing the risk of extinction, but winter survival was considered the critical limiting factor. The management of winter food resources and the control of sources of mortality for wintering birds were considered most important.

A PVA based on a stochastic simulation model (e.g. Burgman *et al.* 1993) to estimate parameters for the wild population has since been developed (Drechsler 1998; Drechsler *et al*. 1998). Because of uncertainty in some of the parameters of the OBP population dynamics, an authoritative estimate of the extinction risk of the population is not available, but survivorship, particularly in winter, is likely to be more limiting than reproduction, regardless of the uncertainties (Drechsler *et al.* 1998). The PVA also identified the qualitative features of habitat, such as the composition of vegetation, were more important than quantitative features such as habitat size (Drechsler *et al*. 1998). The PVA model was further developed in 1999 as a component of a Development Plan and Environmental Management Plan for a proposed wind farm at Woolnorth in northwest Tasmania (Drechsler and Meredith 2000).

The postgraduate work undertaken at University of Melbourne on traditional saltmarsh habitat and its use by OBPs at the Murtcaim Wildlife Area (Lee 2000, Lee and Burgman undated) will further enhance a PVA model, and predictions may assist the order of priority for developing winter habitat areas.

KNOWN AND POTENTIAL THREATS

Biology and ecology relevant to threatening processes
The Orange-bellied Parrot survives as a small, single population. The majority of the population breeds around Melaleuca in southwest Tasmania, though recent efforts may have succeeded in re-establishing a second breeding group at Birchs Inlet. The entire population migrates along the westcoast of Tasmania and crosses western Bass Strait to coastal Victoria. Stochastic factors such as disease, loss of genetic variation, storms during migration, and destruction of nest sites, eggs and chicks by fire are important influences on the species' long-term survival.

Degradation and loss of habitat
On the mainland, Orange-bellied Parrots traditionally occurred in coastal saltmarsh and beach dune habitats (Jarman 1965; Brown and Wilson 1984). The reasons for the species' decline are not clear; however, it is likely fragmentation and loss of the wintering habitat over the last 100 years is the primary cause (Ashby 1924; Carr and Kinhill Planners 1979; Brown and Wilson 1980; Loyn 1982; Yugovic 1984; Menkhorst *et al.* 1990; Edgar and Menkhorst 1993; Casperson 1995; Heathcote and Maroske 1996). Orange-bellied Parrot habitat has been degraded and lost throughout its range; however, the majority of this impact has occurred within the non-breeding range (ie migratory corridors and wintering areas). The major contributing factors are:

- drainage of wetlands for grazing;
- alteration and destruction of saltmarsh for industrial and urban development;
- grazing of native vegetation;
- vegetation clearance for agricultural purposes and;
- recreational activities

Species recovery is limited by the capacity to ameliorate these impacts and incompatible land use practices continuing unabated in some areas. For example, grazing still occurs on some coastal grasslands and saltmarsh habitats in Tasmania and Victoria.

Grazing has been shown to have both deleterious and beneficial effects on saltmarsh plant communities (Carr et al. 2002). Negative impacts include physical damage to saltmarsh plants and creation of tracks through the vegetation, improving access to pests including rabbits, hares and foxes, and grazing stock consume seeding heads, which would otherwise be available to Orange-bellied Parrots. Positive impacts have been observed in situations where salt-tolerant introduced grasses are invading a saltmarsh. In some situations grazing by sheep appears to slow the rate of spread of these weeds where its intensity prevents seeding from taking place.

Invasive weeds
Since the early 1990s, there has been a gradual but steady decline in the number of OBPs found on traditional habitats during winter (see Figure 3). Searches for OBPs in adjacent, largely agricultural areas have found small numbers of OBPs, mostly foraging on a suite of weed species. These weed species include at least one known to be highly toxic to some species of birds and mammals - Common Heliotrope *Heliotropium europaeum* (Starks *et al*. 2003). The potential threat from foraging on weed species, and the added risk of exposure to any herbicides used to control weeds, has not been assessed. In addition, the impact of pastoral and agricultural practices on OBP population levels throughout the OBPs range is unknown. Species of concern include:

- Tall Wheat Grass *Lophopyron ponticum*
- Rice Grass *Spartina anglica*
- Coast Barb-grass *Parapholis incurva*
- Sea Barley-grass *Critesion marinum*
- Marram Grass *Ammophila arena*ria
- Sea Spurge *Euphorbia paralias*
- Boxthorn *Lycium ferocissimum*

Weed invasion of native vegetation has the potential to degrade potentially suitable OBP foraging habitat. The loss of large areas of saltmarsh to pasture has resulted in the spread of agricultural weeds, in places seriously degrading remnant saltmarsh communities (McMahon *et al*. 1994; Carr *et*

al. 2002). The introduced salt-tolerant Rice Grass *Spartina anglica* invades and out competes saltmarsh vegetation such as Beaded Glasswort, potentially reducing available foraging habitat. Invasion by *Spartina* is a particularly severe problem in Anderson's Inlet (Vic). It is a major threat to saltmarsh communities there and is likely to impact on OBPs (McMahon *et al*. 1994; Department of Natural Resources and Environment 1998). *Spartina* has also been found at other saltmarsh areas such as Lake Connewarre (Vic) and Robbins Passage (Tas).

In the Spit Nature Conservation Reserve, altered hydrology and declining salinity have resulted in invasion of saltmarsh by exotic salt-tolerant annual grasses, such as Coast Barb-grass *Parapholis incurva* and Sea Barley-grass *Critesion marinum* (Carr *et al*. 1991, 2002). Eradication of Marram grass *Ammophila arena*ria and Sea Spurge *Euphorbia paralias* is being conducted within the Southwest World Heritage Area (Tas). Both species are vigorous colonisers and out compete a range of native OBP food plants. The spread of Sea Spurge is also exacerbated by dune erosion caused by cattle grazing along coastal areas of the northwest and Bass Strait islands. Other weeds such as Boxthorn *Lycium ferocissimum* can invade areas of Shrubby Glasswort (McMahon *et al*. 1994); however, in some highly modified areas (e.g. Kellys Swamp, Vic) Boxthorn adjacent to saltmarshes is used by OBPs as a roost site in the absence of suitable native vegetation.

Introduced predators and competitors

Although there is a lack of clear evidence predation of OBPs by foxes and cats is a serious threat, anecdotal observations suggest there is the potential. A fox has been observed stalking OBPs (L. Robinson pers. comm.) and evidence of cat predation of a Blue-winged Parrot at a site where OBPs were seen with the Blue-winged Parrots (J. Starks pers. comm.). Intuitively, the presence and high abundance of these introduced predators at OBP sites must increase the level of mortality and thus limit recovery potential.

The introduced European Rabbit grazes on saltmarsh and beach-dune vegetation and on weed species, though the impact this has on food availability for OBPs has not been assessed. In the breeding grounds, Common Starlings *Sturnus vulgaris* have aggressively prevented OBPs from entering known nest-hollows (Higgins 1999). Feral Honeybees *Apis mellifera* are known to invade and occupy tree hollows and nest boxes to the exclusion of hollow-nesting birds and mammals, including parrots, and invasions have resulted in the abandonment of clutches and the death of broods (Trainor 1995). Feral Honeybees have occupied OBP nest sites to the exclusion of OBPs at Melaleuca and Birchs Inlet (OBPRT unpubl. data). Common Starlings, Honeybees and Sugar Glider *Petaurus breviceps* aggressively compete with OBPs for nest hollows at Birchs Inlet starlings and gliders killing incubating females at nest (Holdsworth 2006),.

In each State, the ongoing control of feral predators (ie foxes and cats) and competitors (ie rabbits, Common Starlings and Honeybees) in OBP habitat are significant tasks being undertaken at some level by volunteers, local councils, the Department of Defence, Melbourne Water, and State conservation agencies.

The impact of introduced competitors, such as European Goldfinch *Carduelis carduelis*, European Greenfinch *C. chloris* and House Mouse *Mus domesticus*, for winter food resources (e.g. Gibbons 1984; Loyn *et al*. 1986) has not been assessed. Control of introduced competitors has been proposed to improve the quality and quantity of critical winter habitat (OBPRT 1999).

Wind farms

The presences of wind farms, and increasing level of development proposals throughout most of the Orange-bellied Parrot migratory and winter range, has the potential to impact on the species. The species' migration (during the night and day) through a narrow coastal band on which wind farms have been established or are planned, presents the potential for collision. The entire Orange-bellied Parrot

population could pass through most of the wind farm sites in western Tasmania whilst on migration. On the mainland, those Orange-bellied Parrots that winter west of Cape Otway or in South Gippsland could pass through wind farm sites in those areas. Wind farms sited in and adjacent to important wintering sites (e.g. Yambuk Lake) pose a risk to Orange-bellied Parrots commuting between foraging sites, roosting and drinking sites. In addition, direct habitat loss or effective habitat loss (through abandonment of sites due to the presence of turbines) may add to the impact on the species at key sites. Generally, wind farm developers within the Orange-bellied Parrot range have been required to undertake pre-development bird utilisation studies to determine potential impacts. Where possible turbine layout is adjusted to avoid key migratory or feeding zones to reduce collision risk. At some sites a range of mitigating measures have been implemented to further reduce collision potential. This has included on site weed control, habitat restoration and provision of supplementary food crops away from windfarm sites. The collective impact of wind farms on birds (including the OBP) is uncertain. A study commissioned by the Australian Government Department of the Environment and Water Resources, to provide information on the cumulative risk of bird strike from windfarms (including the cumulative risk to OBPs) was finalised in February 2006. The purpose of the study is to better inform the environmental regulatory process.

Disease

A significant cause of death among captive Orange-bellied Parrots during the breeding program up to 1991 was Psittacine Circoviral Disease (PCD) (Brown 1988). The disease was detected in wild birds in 1993, however, while a significant number of individuals are antibody positive to PCD, there has not been any detected outbreak of the disease. Sub-clinical effects are unknown. Since 1991, mortality due to PCD has been practically eliminated in captive-bred stock through the relocation of the Hobart facility to a warmer, more sheltered site. Management of this disease will be consistent with the Threat Abatement Plan (Australian Government Department of the Environment and Heritage, 2005) and associated hygiene protocols (Australian Government Department of the Environment and Heritage 2006) which have been made under the provisions of the EPBC Act 1999.

Other causes of mortality in captive birds include renal failure, intestinal worm impaction and aspergillosis (Philips and Holdsworth 2006) all of which are controllable to some degree. However, during the 2005/06 breeding season an unusually high rate of nestling mortality of 43 individuals at three times the average rate occurred at the Taroona breeding facility. Post mortems could not determine the cause of death, but subsequent tests of material from these nestlings indicated the presence of a herpes virus. Further tests have failed to detect herpes virus in adult birds in the Taroona or Healesville populations and investigations are continuing to determine if a novel virus is active in the captive and wild populations. The results of these investigations will be used to develop a comprehensive disease action plan. This event has indicated that there may be a need to improve the standard of aviaries, quarantine facilities and management of the captive population. Irrespective of the cause or causes of death, this event has highlighted the potential risk to the captive population as insurance against extinction in the wild. In addition, any embargo on releases may reduce the wild population and limit the establishment of sub-populations. These will therefore reduce the species long-term viability. A contingency plan is required to make provision for the establishment of a new isolated captive colony, using 'clean' founder stock from the wild to deal with a virulent diseases found to be active in the captive population, but absent from the wild population.

The illegal import of exotic psittacine birds presents a risk of introducing and establishing new virulent diseases to Australian wild and captive populations. This risk is of particular significance to threatened species such as the OBP. The control of transfer of disease from introduced species, has been identified as a high priority by DEH for preventative action, and has been addressed through the establishment of draft quarantine protocols for the housing of seized exotic psittacine birds

Illuminated boats and structures

Anecdotal evidence suggests the bright lights used at night by squid boats operating in Bass Strait and the Southern Ocean occasionally attract migrating birds, including parrots. This could potentially

seriously disrupt OBPs migrating to the mainland and could be affecting their survival. Other lit structures such as lighthouses and ships could also pose a similar threat to migrating OBPs. An OBP was reported striking the Cape Wickham Lighthouse at night in April 1905 (Anon. 1906). Further investigation is required to determine the influence of these potential impacts on the species' survival.

Trapping

Orange-bellied Parrots were regularly trapped for aviculture up to the 1960s, particularly in South Australia (Jarman 1965; Brown and Wilson 1980). Several pairs are known to have reached Europe in the 1970s (Low 1980). Currently, there are no OBPs in captivity outside the captive-breeding program described here. Significant powers under State and Commonwealth legislation, combined with the difficultly in laundering a species not represented in aviculture collections have probably eliminated trapping of this species. However, the potential risk still exists and State and Commonwealth authorities must remain vigilant.

DETAILS OF SPECIFIC OBJECTIVES AND RECOVERY ACTION

This section provides detailed information on the specific objectives and associated recovery actions contained within the Recovery Plan.

Specific Objective 1 - To monitor the population size, productivity, survival and life history of the Orange-bellied Parrot

In order to measure population trends, impact of threats, success (or otherwise) of actions and recovery criteria, it is essential to undertake population monitoring throughout the species' range.

Action 1.1 Observations of banded birds within the breeding range.

The observation of colour-banded birds throughout the breeding season (Oct.–Mar.) provides the basis to estimating the annual breeding population, survival and longevity of the species. The breeding population estimates are used as an index of the total population and for comparison against winter survey results. A review of the methodology and statistical robustness of this action is required to confirm data collected under this action is collected and analysed in the most cost-effective manner. The provision of supplementary seed at Melaleuca will be reviewed annually by the OBPRT and, if deemed appropriate, phased out over the life of this plan. This action will be coordinated by a Breeding Season Project Officer (BSPO), and observations will be conducted by volunteers under the supervision of Site Coordinators.

Action 1.2 Monitor breeding productivity

Understanding the reproductive success is fundamental to predicting the species' survival and the effectiveness of the recovery program. The monitoring program consists of several visits to all nest boxes and natural nests occupied by OBPs throughout the breeding period. A trained team of 4–6 professionals and volunteers undertake the following tasks during these visits:

- monitor nest box usage by parrots and other species,
- search for natural nests,
- determine clutch size, hatching success and fledging success of all nests,
- record physical attributes of all nest sites,
- attach ABBBS approved colour leg-bands to all nestlings within nest boxes and from natural sites when accessible,
- identify parentage (by observing presence of colour-banded adults) at all nest sites,
- collect blood samples from all banded nestlings for DNA and, when required, PCD analysis,
- collect other samples (ie parasites, feather samples, crop samples) as required to support other research projects.

The colour-banding undertaken under this action forms the basis of mark-recapture studies undertaken under Action 1.1 and monitoring movements of individuals under Action 1.3.

Action 1.3 Coordinate surveys of population in the winter range

This action will involve an annual count of the winter population in late July, monitoring of the main wintering habitats in May and September, searching for colour-banded birds and searching for additional wintering sites. Search efforts will be intensified in all areas, particularly those that have been poorly searched in the past and especially those that contain large expanses of potentially suitable habitat. Greater emphasis will be placed on collecting sightings of banded and unbanded birds to improve the robustness of mark-recapture population modelling in the winter range. More frequent observations of colour-banded birds in the winter range will also assist in understanding survival, migration behaviour, foraging requirements and population dynamics. It will be important to encourage the regional groups to be actively involved in organising and participating in the winter surveys, requiring special effort in regions where volunteer networks have been recently established. Nevertheless, a Winter Season Project Officer (WSPO) is required to undertake training, survey coordination and data analysis of winter surveys. The WSPO will provide regular feedback on the progress and results of the surveys to regional groups, volunteers and OBPRT.

Action 1.4 Investigate the relationship between climatic variation, migration and breeding success across years

There is evidence migration (particularly southern) and breeding success is influenced by climatic variation between years. Consistent climatic data have been collected at a range of sites throughout the species' range. This combined with the substantial body of resighting and breeding productivity data since 1991 may be sufficient to allow statistical analysis of the correlation between these variables.

Specific Objective 2 - To identify all sites used by Orange-bellied Parrots and better understand migrations

A lack of understanding about the geographic spread of the species, particularly in winter, limits the capacity of the Recovery Plan to be successfully implemented. Migration routes, changed food resources, location of roost sites, habitat usage and threats within the non-breeding range are not clearly understood and require attention under this plan. In addition, it is not certain whether the breeding range has contracted as there is little information on use of sites away from Melaleuca.

In 2000, progress was made towards establishing a Site Register for OBP locations in Victoria. After consultation with DSE it was decided the Biosites database could function as an OBP Site Register. Examination of Biosites shows that not all sites where OBPs have been found were included and more detail of habitat, threats and management issues for each site are needed. Similar databases in Tasmania and South Australia are used as a site register for OBP locations in those states; however, there is no central database. The winter habitat project (see below) will consolidate this information.

In late 2005, the DSE, through a bid from the OBPRT, was awarded a cross-regional Australian Government Natural Heritage Trust grant, for a three-year project to be carried-out by Birds Australia. This project seeks to examine the habitat and site use by OBPs throughout their mainland winter range, which has been identified as a priority action under this Recovery Plan. One of the primary outputs of the project is to generate habitat models at a range of spatial scales, from broad-scale regional to fine-scale site, that correlate the location of OBPs with selected habitat and landscape attributes, derived from an analysis of GIS layers such as vegetation and topography, and a detailed field assessment at OBP sites. The models may also be used to predict the occurrence of OBPs elsewhere within their potential winter range, and be useful in guiding future surveys (see Action 2.2). The project will result in an improved understanding of OBP movement and dispersal patterns. This will in-turn result in an improved and prioritised OBP site management regime, and guide the implementation of a number of recovery actions (e.g. Actions 3.1 and 3.5)

Action 2.1 Develop an integrated GIS site register of known and potential habitat

In conjunction with conservation agencies, develop a GIS site register of all historic and current OBP habitats. For each site, the register will contain details of location (including map coordinates and boundary), vegetation description, land tenure and land management regimes (ie grazing, disturbance factors and fire history). Some initial development has been done in Victoria and this will be extended through existing wildlife databases in Tasmania and South Australia. The spatial information will be combined with species information layers including search effort, OBP records, other Neophema records and introduced competitor/predator distribution. The GIS data will be analysed to determine if causes of population decline or spatial change can be attributed to particular management regimes or threats.

As part of the NHT mainland habitat project, a comprehensive database of all mainland OBP records will be improved and maintained. This database contains details of location, site name and tenure, other Neophema parrots records, banding data etc. Historic records will be assessed for accuracy and positional data corrected to align with the current mapping datum. Additional new data, such as that on floristics, vegetation structure and microtopography collected during OBP habitat assessments, will be entered as linked fields within this database. The spatial component of the database is being improved by linking the existing database to up-to-date geospatial datasets, obtained through state authorities, to allow us to vet data and conduct detailed spatial habitat analyses (such as habitat models).

Action 2.2 Surveys of non-breeding habitat

Winter population surveys (see Action 1.3) include monitoring of the main migratory and wintering habitats and searches of potential sites. They provide valuable information on the daily and seasonal use of habitats, identify known and potential food plants, proximity of potential roost sites, identify potential threats and stimulate management of OBP resources on private and public lands. This action will use the maps generated by Action 2.1 and be implemented as a component of the activities described in Action 1.3. These focused search efforts also result in the sighting of OBPs that are subsequently followed-up for detailed habitat assessment – the data from which is then used to generate site-scale habitat models.

Action 2.3 Survey of entire breeding range

The concentration of observation effort at Melaleuca and Birchs Inlet has provided a significant body of information about population trends and productivity; however, little is known about the breeding outside these locations. Observations of significant numbers of unbanded birds in the winter range suggest the presence of breeding groups elsewhere in southwest Tasmania. An intensive and extensive survey during the breeding season is required to determine the presence of other breeding concentrations. This level of survey will be conducted in the first and last year of the plan to measure change of breeding range and distribution. Targeted searches of key potential habitats at Noyhener Beach, Nye Bay, Solly River, Davey River and Towterer Beach will be conducted during intervening years. In addition, potential habitat within the Southwest Conservation Area, where mining and forestry development pressures exist, will be targeted during these surveys. Skilled ornithologists will be required to undertake this action.

Action 2.4 Develop search methods and innovative techniques to identify key sites and measure migration behaviour

While the broad migration pathways are relatively well known, little detail is available on the specifics of migration behaviour. Details of flight heights, flight corridors, air speed and non-stop *versus* staged movements are required to better inform decision-makers particularly in relation to coastal developments. Search methods will be developed to measure variables during surveys within the non-breeding range (see actions 1.3 and 2.2).

The ability to track individuals over large distances would add significantly to our knowledge of the OBPs behaviour and assist in targeting conservation management activities. The small size of the species has limited the capacity to use telemetry equipment (ie VHF radio, satellite transmitters, GPS loggers); however, various technologies have improved significantly in recent years and may soon be useable on OBPs. A review of existing technologies and their application to tracking OBPs is required and, where possible, develop tracking projects to aid recovery actions.

OBPs can be difficult to locate (particularly during migration) due to limited numbers, dispersed population, high mobility and accessibility of sites. Significant effort is required to search areas using conventional survey techniques and relies on highly skilled individuals to discriminate between closely related species. The development of call recording devices has the potential to provide an alternative to existing search techniques to gather more accurate information about the species' spatial distributions throughout its range, in particular the poorly understood migration corridors. Essentially, these devices use digital audio recorders combined with relatively inexpensive, large-capacity computer hard disk drives, to record ambient sound including bird calls. The recovered recordings are then analysed using a variety of digital signal processing techniques for signature signals indicative of the specific species under consideration. Special microphone configurations can be used to obtain spatial data such as vertical distributions and velocity. Field trials of prototype equipment undertaken by DPIW at Melaleuca during 2004 have proven the potential for further development (Wilson and Holdsworth 2005). While the prototype was cumbersome, the recordings collected during these trials clearly identify OBPs against other sounds including other bird calls, frogs, aircraft and wind. Further refinement of the equipment and field testing in wintering sites in areas of other Neophema activity is required to improve the robustness of the equipment. If proved successful call recording devices can be used at strategic OBP sites to measure presence/absence at feeding and roosting sites, migration flights and possibly used as a means to measure population levels. This action has application

throughout the species range and may overcome the current technical difficulties of tracking OBPs over long distances using radio telemetry. Ultimately, these devices may be automated using data loggers, further enhancing the field application.

Specific Objective 3 - To increase the carrying capacity of habitat by actively managing sites throughout the species' range

An increase in habitat carrying capacity can be provided through enhancement of existing habitat or the creation of new habitat. This can be achieved through habitat protection measures at existing sites, revegetation of natural foraging and roosting habitat or through the provision of supplementary habitat, including roost sites, food crops and nest boxes.

Action 3.1 Review implementation and effectiveness of management plans

A number of known OBP sites, both within the summer and winter (including migration) range, are on public lands. Infrastructure developments proposed on or near OBP habitats may have management implications for OBPs. Management plans for these sites are either written or reviewed periodically, and it is crucial the requirements of OBPs are incorporated into these plans. Agencies responsible for developing and implementing these plans will be informed of the locations of known and potential OBP habitats through the site register (Action 2.1). Detailed maps of OBP habitat can also be produced, and we can also provide specific regional habitat models to NRM bodies within the winter range of the OBP, significantly increasing the capacity for sites to be more strategically and effectively managed at the regional level. Where OBPs are known to use exotic plants for food or roosting, it may be necessary to suspend or modify weed control measures.

An audit of the implementation of conservation measures for OBP values in all existing management plans is required to guide future management decisions.

Action 3.2 Maintenance of foraging habitat at breeding sites through appropriate fire management

Habitat management burning is planned, but infrequently conducted, between April and September (when OBPs are absent) every year within the breeding range. However, competing priorities (ie asset protection) combined with limited fire crew resourcing, limits the ability for PWS to conduct burns in accord with fire management plans. Funding is required to ensure habitat management burns designed to improve OBP habitat can compete with other PWS burning program priorities.

Limited information is available on usage of different age classes of OBP foraging habitat, though observations indicates recently burnt areas are favoured by the species and breeding productivity is increased following burning. A detailed study of the usage of vegetation age classes is required to better inform the fire management decision-making process. This study will be undertaken as a component of a higher degree research to investigate fire ecology of buttongrass moorlands in the World Heritage Area. The Site Coordinators and volunteers undertaking observational work under Actions 1.1 and 5.1 will assist this study.

Action 3.3 Provide, maintain and monitor nest boxes

The provision of nest boxes is primarily conducted to allow ease of colour-banding and monitoring of productivity. However, nest boxes have provided an opportunity to monitor and control competitors, thus increasing nesting success of some individuals. Nest boxes have been installed at Melaleuca, Birchs Inlet, Noyhener and Towterer Creek since 1992. Common Starlings, Honeybees and Sugar Gliders (Birchs Inlet only) aggressively compete with OBPs for nest boxes, particularly at Birchs Inlet. Common Starling and Honeybee populations will be controlled where this occurs. Further work is required to determine the level of impact from Sugar Gliders. Teams of 2–4 experienced volunteers assist this program with nest box erection, maintenance and monitoring throughout the breeding season. The provision of nest boxes will be reviewed annually by the OBPRT and, if deemed appropriate, phased out over the life of this plan.

Action 3.4 Manage migratory habitat in Tasmania (including King Island)

Large areas of heathland, coastal scrub and saltmarsh in along the west and northwest of Tasmania are used for the grazing of livestock (predominantly cattle). While quantitative data of the effect of grazing are not yet available, empirical observations at sensitive habitats and limited seed resources

during low productive years clearly indicate a negative impact on OBP resources. Direct impacts include removal or reduction of seed resources, alteration of microhabitats through compaction, degradation of roost sites and disturbance of feeding birds. Indirect impacts include changed fire regimes, weed invasion and increased human access/occupation. The effects of grazing and associated land management practices throughout the species' range requires closer attention to better inform the decision making process within PWS. Leaseholders and PWS must reach agreed standards of management outcomes to balance the value of grazing with the conservation requirements of the OBP. Foraging sites within the Arthur-Pieman Conservation Area (APCA), Hunter Island, West Kangaroo Island and Perkins Island require immediate attention. Other sites within the region, including freehold tenures on King Island, require further investigation. A comprehensive review of grazing practices on coastal lands will be conducted to guide management of Crown Lands.

Action 3.5 Provide additional habitat at sites throughout the winter range

Additional habitat is fundamentally important if the species is to recover and increase in number. OBPs are clearly resourceful and quite capable of finding new winter habitats, including weed species and seed crops. Winter count results for the last few years suggest traditional saltmarsh sites are being less heavily relied-upon and there has been an increased use of other coastal and near-coastal habitats, or saltmarsh habitats outside the known usual haunts. The OBPRT will need to be more active and innovative in pursuing the creation of new winter habitats, both foraging and roosting. This should include providing additional habitat through a range of trials to establish what attracts or retains OBPs, then to implement results at targeted key sites. The success of experimental management could also be tested through the release of captive-bred birds at these sites and measuring their use by the released birds. The results of previous habitat enhancement and creation programs will be collated. The results of habitat creation experiments will be conducted using AEMA and incorporated into existing and new management plans under Action 3.1.

Where OBP sites exist on private land, landowners will be consulted with the aim of producing and then implementing management agreements for these sites. Landowners will be encouraged and, where necessary, assisted in applying for funds to undertake OBP conservation on their land.

The use of supplementary seed crops to provide interim food resources or modify flight behaviour has potential to increase the winter survival of the OBP. The nutritional suitability of different food crops, including sunflower, millet, rape, oats, linseed and poppy will be tested. Selection of single or mixed crop plantings for trial habitat creation will be based on the results of the nutritional test. Food crops will be planted and maintained adjacent to key wintering sites. This may include the Spit Nature Conservation Reserve (on Melbourne Water land), Lake Connewarre State Game Reserve (on private land), Yambuk Lake (on private land) and Piccaninnie Ponds Conservation Park (on private land). A monitoring program will be implemented to measure any use of the crops by OBPs, BWPs or other seed-eating birds.

Funds and support will be sought to undertake winter habitat revegetation programs. These will include revegetation of saltmarsh foraging habitat and enhancement or establishment of roosting habitats at unused or little-used wintering sites supporting adequate foraging habitat. A saltmarsh revegetation plan for the Werribee River mouth was developed in 2001 (Murphy 2001) and implementation of this plan will be encouraged for this site. The methodology developed will be applied to other sites, particularly in western Port Phillip Bay and the Bellarine Peninsula, as opportunities are identified. The planned decommissioning of parts of the Melbourne Water Western Treatment Plant creates potential for recreating additional saltmarsh habitat there.

The health and extent of saltmarshes will be monitored using fixed photopoints and habitat description transects throughout the life of this plan. This information will be incorporated into the site register database (see action 2.1). Results from the habitat modelling, as part of the mainland habitat project, will be useful in terms of identifying sites to be targeted for improved management and restoration. This information will be provided to appropriate land management agencies within each of the NRM regions within the winter range of the OBP.

Action 3.6 Test suitability of unoccupied winter habitat by release of captive birds

The success of experimental management of unoccupied winter habitats could be tested through the release of captive-bred birds. The release of six OBPs at Point Wilson in 1996 and 2004 demonstrated captive-bred and released OBPs could survive at a wintering site. The experience gained from releases in Tasmania and at Point Wilson will be used to develop a release protocol for experimental releases on the mainland. Consideration will be given to the use of radio telemetry to monitor the progress and survival of released birds. A release will take place at one or more sites where habitat enhancement work has been undertaken and at one or more sites where trial food crops have been planted.

Action 3.7 Conduct trial of impact of grazing by sheep on the upper saltmarsh, Spit Nature Conservation Reserve

Up to the late 1970s flocks of OBPs were regularly recorded in the upper saltmarsh, even though sheep grazed the saltmarsh. Grazing was ceased as a conservation measure to protect native vegetation in early 1979; however, numbers of parrots using the site declined during the 1980s. The last sighting of an OBP at the site was in 1994. It is not clear what caused this decline. However, it is speculated grazing of the saltmarsh by sheep replicated the browsing of macropods (which are now absent from the area), and affected the supply of seed on key OBP food plant species, including Southern Sea-heath and Grey Glasswort *Halosarcia halocnomoides*. In order to determine the effect of sheep grazing on seed production, and the potential to use controlled grazing as a management tool, experimental grazing trials will be conducted.

Before allowing sheep into the saltmarsh, it is desirable to know whether the upper saltmarsh is capable of supporting OBPs in its present state. An experimental release of captive-bred birds was conducted during 2004 and the results will be factored into the grazing trial methodology. Funding for this study is provided from the OBP Trust Fund established by Hydro Tasmania to contribute to conservation of the species to offset potential impacts of the Woolnorth wind farm (northwest Tas.).

Specific Objective 4 - To identify, measure and ameliorate threats, particularly in migratory and winter habitats

Action 4.1 Monitor and control of human disturbance at The Spit Nature Conservation Reserve and Swan Island

Promoting awareness and interest in the OBP recovery effort creates a demand by the birdwatching community to see OBPs in the wild. There is some potential to increase opportunities to observe OBPs in winter at the SNCR, Western Treatment Plant and Swan Island. However, it is known OBPs are disturbed by human interference and an increased presence of birdwatchers may result in birds shifting from critical food resources or increasing energy expenditure beyond sustainable levels. Increased patronage of the Swan Island golf course may have already resulted in declining use by OBPs and requires further investigation.

A system of volunteer guides could be established to take visitors to see OBPs and be educated in identification, the recovery effort and potentially assist winter surveys. This could be one of the tasks of a Bellarine Peninsula Regional Group.

Action 4.2 Wind farm proposals

Since 1999, the OBPRT have been actively involved in the planning process for wind farm development proposals to ensure proponents undertake comprehensive environmental impact assessments so OBP habitat is not degraded and wind farm infrastructure is sited in a manner which minimises the risk of collision. The OBPRT will continue to ensure proponents are fully aware of the issues relating to collision risk and OBP conservation values, and develop adequate assessment and management guidelines for impact risk assessment. Siting of wind farms within the species' migratory corridors and winter sites continues to be a problem.

Action 4.3 Determine the impact of the squid fishery and other light sources during migration

Anecdotal evidence suggests the bright lights used at night by squid boats operating in Bass Strait and the Southern Ocean occasionally attract migrating birds, including parrots. This could potentially disrupt OBPs migrating to the mainland and could be affecting their survival. Other lit structures such as lighthouses and ships could also pose a similar threat. A questionnaire will be circulated to operators and crew of squid boats asking whether they can recall any birds being attracted to the boats at night. Operators will also be asked if they would like to participate in a survey to identify and record, where possible, data on any birds attracted to the boats. Expert assistance will be needed to develop mitigation measures, in consultation with squid boat operators and Australian Fisheries Management Authority (AFMA). An assessment of the potential for other lit structures to impact on OBP behaviour is also required.

Action 4.4 Control of introduced predators at migratory and wintering sites

Currently there is no quantifiable data to support whether cats and/or foxes are threatening process for the OBP. This is partly due to the problems associated with monitoring such a small population over a vast area, but also because research associated with broad control programs has generally not been well targeted or monitored in a scientifically rigorous manner in relation to the OBP. However, based on a few sightings of potential predation events and the high abundance of these introduced predators at some key OBP sites, it is reasonable to assume there is some elevated level of predation. With such a small population, any reduction in the predator pressure will be beneficial to the species' recovery. Current fox/cat control measures are generally ad hoc and ineffective in significantly reducing population across the OBPs range. In New Zealand, intensive baiting has reduced predator levels at selected sites (Clout and Saunders 1995). Intensive predator control at key OBP sites could be a way of identifying and measuring threats through management. While it is necessary to ensure management authorities in each state continue introduced predator control programs, these must be reviewed to ascertain appropriate target areas and structured using AEMA. This will ensure the effectiveness of a range of control measures, such as poison programs, trapping, shooting, fence exclusions and pet control can be measured and the results applied for greatest benefit. Given the problems of detecting predation events on OBPs, research at key OBP sites should focus on the abundance of analogue prey species populations and the relative composition of these species in prey remains and scats. Such studies could be undertaken as a project through a tertiary institution (see Action 9.2).

Currently low intensity cat control is conducted by the Parks and Wildlife Service at Sea Elephant River (King Island) and nearby Short-tailed Shearwater colonies as a means to reduce the potential impact cats may have on OBPs. While this effort should continue as part of the management regime of the Lavinia State Reserve, it is recommended the program be restructured to have a more rigorous experimental design in order to measure the effectiveness of control measures as described above. Unlike all other areas the OBP frequents, King Island has the potential to apply broader cat control measures to deal with not only the feral cat population, but also the domestic source. With a relatively small human population, King Island lends itself well to applying methods such as responsible cat ownership educational material, de-sexing incentives, community participation and ultimately legislative controls to reduce the source population. A strategic approach to the cat populations on King Island could result in significant reductions of predator pressure on the OBP.

Action 4.5 Impact of introduced bird competitors

Introduced birds such as finches compete with OBPs for food resources, but the extent of this competition and whether it is having a deleterious impact is unknown. Control of introduced finches at sites within government reserves is a management issue for state governments and should be made part of on going site management by the relevant government authority. The extent of competition by introduced finches should be investigated and could form a post-graduate project. (see Action 9.2).

Action 4.6 Control of invasive weeds in native vegetation areas used by OBPs

The introduced grass Spartina invades saltmarsh vegetation, potentially reducing available foraging habitat. Spartina is a particularly severe problem in Anderson's Inlet (Vic.), and it has been found at other saltmarsh areas such as the Barwon River estuary (Vic.) and Robbins Passage (Tas.). Other invasive weeds can impact on OBP resources include Boxthorn *Lycium ferocissimum*, Coast Barb-grass *Parapholis incurva*, Sea Barley-grass *Critesion marinum*, Marram grass *Ammophila arena*ria and Sea Spurge *Euphorbia paralias.* The spread of many of these species is exacerbated by dune erosion caused by cattle grazing, fire and human activities. Control of these invasive weeds has been undertaken by land management authorities on reserved lands and should continue to be encouraged as a management priority in affected saltmarsh areas.

Action 4.7 Population Viability Analysis (PVA)

The OBPRT should retain the ability to undertake its own PVA and not rely on modelling by consultants contracted by wind farm proponents. Consideration should be given to using alternative models such as RAMAS Metapop. The cumulative effects of the risk of collisions for all wind farms should be modelled. A thorough review of the assumptions of Drechsler model is required in the light of additional data collected over the last few years.

Action 4.8 Management of aircraft and other human activities at Melaleuca

A study of aircraft and human activity at Melaleuca concluded OBPs react differently to the presence of helicopters than to fixed wing aircraft and helicopter use should be carefully controlled. Prescriptions are required to regulate the number, type and activity of aircraft in the region to ensure visitor activity and site usage does not impact on OBP values. Monitoring programs designed to measure use of the site and impact on the species is required.

Specific Objective 5 - To increase the number of breeding sub-populations /groups

The successful management of the captive-breeding population provides an opportunity to use captive-bred birds to increase wild populations and reintroduce the species. The establishment or bolstering of sub-populations in the winter and breeding range reduces the potential for stochastic events, such as bushfires and disease outbreak, to impact on all of the population. The establishment and long-term maintenance of sub-populations will improve the species' long-term survival. The release of captive-bred birds at Birchs Inlet between 1999 and 2004 has shown some signs of re-establishing a small breeding population. However, the level of success has been significantly reduced the influence of introduced nest competitors (ie Common Starling, Honeybee and Sugar Glider). Further releases, combined with intensive habitat management are required to ensure for this population is maintained and becomes self-sustaining.

Action 5.1 Maintain breeding population at Birchs Inlet

Each year, for the life of the plan, excess birds from the captive-breeding program will be made available for release at Birchs Inlet. The timing and method of releases will be determined by the OBPRT and the Captive Management Group will oversee the release program. This action relies heavily on the involvement of volunteers to assist with husbandry of birds and monitoring studies. This action is conducted in an isolated area and requires the establishment and maintenance of a field hut and facilities from October to April each year. A Site Coordinator is required to guide the daily activities of volunteer assistants. The success of this action is reliant on the continued management of the breeding habitat, in particular, fire management, Common Starling and Honeybee control. Further work is required to determine the influence of Sugar Gliders on the reproductive success on the OBP at this and other sites.

Action 5.2 Identify other potential release sites within breeding range

There exists the potential to establish or bolster other sub-populations within the breeding range. Areas such as Nye Bay, Noyhener Beach, Towterer Beach and Southport Lagoon have potential for release of captive-bred birds; however, an assessment of the suitability of these sites is required. An assessment will be undertaken to determine habitat quality, and the practicality and cost of releasing birds at alternative locations.

Specific Objective 6 - Maintain a viable captive population

Given the precarious situation of the wild population, a captive population is considered essential insurance against the species' demise. A captive population is also a valuable research tool to inform the implementation of other actions in the plan.

A captive population of at least 150 birds is considered adequate to provide the insurance function as well as to generate a reliable supply of birds for release into unoccupied habitat and for winter habitat experimental management (Actions 3.6, 3.7). The supply of captive-bred birds for release in the wild will be subject to review during this life of this plan.

Healesville Sanctuary, DPIW, Adelaide Zoo and Melbourne Zoo will, subject to annual review and approval, provide captive-breeding facilities, technical support and program management for the life of this plan.

Action 6.1 Management of captive management program

A Captive Management Coordinator (CMC) is required to coordinate activities of the CMG and guide operational matters, in particular pair selection, transfers and release management. To ensure the long-term viability of the captive population, it is necessary to develop a Captive Management Strategy. This strategy will include an assessment of the role of other institutions and private aviculturists, interpretive requirements, population management, the merits of releasing the species into private aviculture and contingency plans for expansion and closure of the program. A husbandry manual, detailing housing, feeding and health care is required. In addition, contingency plans for emergency evacuation or control of disease outbreaks (e.g. PCD) at each facility need to be produced. Volunteers who undertake daily care of captive birds conduct a significant component of the captive-breeding program. Resources are required to feed birds, operate and maintain aviaries, supply nest boxes, maintain security and provide veterinary care.

This action will ensure for sufficient birds are produced to supply the requirements of the reintroduction program and winter habitat experimental management whilst maintaining a captive population of at least 150 individuals. This can be achieved by increasing productivity levels through a range of husbandry techniques.

Action 6.2 Manage genetic diversity

A method for monitoring genetic diversity is needed to ensure the captive population is representative of the wild genotype. If a decline in the heterozygosity of the wild population is detected, the potential exists for selective release of captive birds to redress this imbalance.
Founder stock may need to be collected occasionally in order to maintain genetic diversity within the captive population. It is also important, particularly for managing the captive-stock and the release

program, to determine actual sex of individuals at an early stage. This will be done using DNA-based sexing techniques.
Research under this action could be done through a stipend for a post-graduate study (see Action 9.2).

SUPPORTING ACTIONS
A number of actions within this plan do not directly contribute to the recovery of the species; however, they are nevertheless fundamental to the successful implementation recovery actions because they provide vital support.

7. Foster community support and involvement in the conservation and recovery of the species and its habitat
The South Australian, Western Victorian and Tasmanian regional groups have proved very successful in undertaking aspects of the recovery program. Regional groups are needed in other key areas within the migratory and wintering range of the OBP. These are: South Gippsland (Vic.), Adelaide-Port Augusta (SA) and South coast (NSW).

The website is an important avenue of communication about the recovery effort. The success of the nest box webcam could attract corporate sponsors for further similar initiatives. A description of the mainland habitat project features on the Birds Australia web site, and it also houses useful information for people taking part in OBP surveys (e.g. audio files of OBP and Neophema calls, notes in identification, official survey forms etc.). On-going advertising will be important for encouraging continued involvement in the recovery effort.

Implementation of the recovery program has, and will continue to, involve significant support from volunteers. Volunteers play a key role in the identification and monitoring of breeding and foraging sites, in habitat monitoring and habitat protection, surveying for OBPs on the mainland during winter and rehabilitation work. It is estimated that at least 450 volunteer days will be contributed to implementation of actions each year. While most of this effort is directed to observation tasks, there remains the potential for a broader range of volunteer opportunities within other actions (eg. TUC editing, website management, data entry and vetting, public education, planning etc).

Action 7.1 Develop and maintain communication pathways to meet the needs of stakeholders and the broader community
Efficient and effective communication is critical for the successful implementation of many Recovery Plan actions. This can be achieved through a variety of means and may vary according to the needs of a particular community group or stakeholder. An analysis of the needs of stakeholders needs to be conducted. There is a demand for information about the OBP from a broad range of groups and individuals. The brochure currently used to disseminate information, while useful, is outdated and limited in its effectiveness. A multi-media interpretive package is required to more effectively disseminate appropriate information to all stakeholders and the general community. The platforms for this package will be CD-ROM and through a website. This will include biological information, conservation significance, recovery actions and identification tools. Where a specific need is identified hard copy information may also be produced.
In order to stimulate interest in the OBP and advocacy of the recovery effort, it is important opportunities are made available for all stakeholders and the general public to see the OBP and the recovery effort. This may include observation of birds throughout the range during organised field days, assistance with banding program or release of captive-bred birds.

Action 7.2 Support existing and establish new OBP regional groups
The establishment of working groups in South Australia, South-western Victoria, Bellarine Peninsula, Westernport-Bass Coast and North-west Tasmania-King Island has proved to be a very successful model in undertaking and promoting the recovery effort at the local level. Regional groups in other key areas will be established. A small level of funding is required to facilitate coordination and operation of each group. Natural Resource Management groups throughout the species' range will play an important role in facilitating, supporting and, in some cases, resourcing the regional groups. A core task of regional groups is to hold field days to provide information to local landowners and

managers as well as provide a forum for training volunteers in observation techniques and encouraging them to report sightings immediately.

Action 7.3 Produce a recovery program newsletter

The recovery program newsletter TUC, needs to be published and circulated more frequently than was achieved under the previous plan. Production of TUC in the past was constrained by lack of resources and overwhelming demands on the Winter and Summer Coordinators. This will be resolved by the creation of a volunteer editor on an annual basis. Resources for design, publication and circulation will be secured from sponsorship sources and all regional groups will be requested to provide articles through sub-editors in those groups. The circulation of TUC will be increased through publication of a PDF version on the OBP website.

Action 7.4 Coordinate volunteer involvement in the recovery program

It is important to maintain the provision of advice and support to volunteers and extension officers who carry out OBP surveys and who are involved in habitat protection and restoration programs. To effectively manage volunteer activities, an activities program is required. This will be used to communicate volunteer opportunities through volunteer organisation networks. Project officers and regional groups will play a key role in coordinating these efforts and raising community awareness.

The success of volunteer involvement is dependent on providing a safe working environment and rewarding experience. Volunteer selection, training, supervision, provisioning and feedback are all-important aspects of volunteer coordination and require attention.

8. Secure adequate funding and support to successfully implement the Recovery Plan

The successful implementation of the Recovery Plan is dependent on securing adequate resources to support recovery actions. Less than half the funds required to undertake recovery actions were secured during phase 3 of the plan, and resulted in delays to the recovery process. To ensure this does not occur again, it is critical significant funds be secured for the life of this plan.

Action 8.1 Develop and implement a Recovery Fund Plan

A Recovery Plan Fund (Recovery Plan Fund) will be produced with the aim to secure actual funds on a partnership basis from Commonwealth threatened species programs, the Natural Heritage Trust process, State conservation programs, private donors and corporate sponsors.

A key component of the RPF will be identification of sponsorship marketing opportunities. The RPF will identify all tasks within this plan, which are not capable of being funded through government sources. These will be incorporated into sponsorship marketing 'packages', tailored to appeal to a range of sponsorship levels. This will range from the existing nest-box sponsor program to a major partnership donor/sponsor.

The sponsorship component of the RPF will identify corporate neighbours who could contribute to recovery program tasks. This is particularly relevant to a number of industries in the Port Phillip Bay region. A range of other sponsorship opportunities will also appeal to regional-based companies where there is a conceivable relationship between the OBP and the business (ie airline companies). The RPF will also identify Ecological Trusts and other funding bodies for support of finite projects within this plan.

A fundraising person is required to assist the OBPRT to develop the RPF within the first year of this plan. This may involve the costs of employing a professional fundraising adviser or the provision of corporation staff to develop the RPF.

Action 8.2 Develop a program to foster collaborative research activities at tertiary institutions

The implementation of previous phases of the recovery plan involved the collaboration of several tertiary institutions in research projects. These have included LaTrobe University (genetic research), Melbourne University (PVA, botany), University of Sydney (PCD) and University of Tasmania (population ecology). Successful implementation of this plan will rely on the continued involvement and establishment of partnerships with these and other institutions. Based on the actions within this

plan, a research program will be developed to identify a range of research opportunities and these will be communicated widely to tertiary institutions.

9. Manage, review and report on the recovery process

The OBP Recovery Program is a complex, multi-disciplinary operation covering a wide range of organisational, biological, and technical, conservation management and social issues. While a number of organisations are individually responsible for implementation of recovery actions, there is a necessity to coordinate recovery program activities.

Action 9.1 Maintain an effective Recovery Team to organise, implement, review and report on the recovery effort

Progress towards meeting the Recovery Plan objectives and implementation of actions is achieved with high levels of community, institution and Government stakeholder support and involvement. The Orange-bellied Parrot Recovery Team (OBPRT) is the principle forum for coordination of the recovery program and consists of members from Government and non-government organisations with an interest in, and responsibility for, OBP conservation (see Appendix 1). The OBPRT evaluates and reports annually to relevant organisations on progress of the recovery effort and provides advice to government on conservation issues affecting the species.

The OBPRT meets annually at the completion of breeding season and summer activities (circa May). The meeting is held in one of the three range states on a rotational basis and the host conservation agency in each State provides the Chair.

Action 9.2 Maintain Recovery Program Coordination

During implementation of the last plan (1998–2002), the financial resources available restricted the capacity of the program to employ a single coordinator. It was therefore necessary to amalgamate part of the coordinator's responsibilities with other recovery program actions. This resulted in the establishment of Summer and Winter Coordinator positions. The tasks of Summer Coordinator included breeding season research, surveys, conservation management and Natural Heritage Trust grant administration as a full-time position within the Department of Primary Industries, Water and Environment (Tas.). The tasks of the Winter Coordinator were integrated with coordination of winter surveys and monitoring as a part-time position within Birds Australia. The splitting of the coordination responsibilities across the range reduced the capacity of the Winter and Summer Coordinator's to concentrate on on-ground actions and limited their ability to achieve overall recovery program coordination.

A Recovery Program Coordinator (RPC) is fundamental to the implementation of this Recovery Plan. The RPC will report directly to the OBPRT through its Chair and ensure OBPRT members fulfil their agreed responsibilities. The position includes liaison with appropriate government agencies, non-government organisations, regional groups, Natural Resource Management regional groups and other stakeholders as is necessary. The framework for implementation of the Natural Heritage Trust objectives and the Recovery Plan will guide this. The tasks of the RPC include:

- Identify management and conservation issues and communicate these to relevant people.
- Coordinate the submission of grant applications and cooperative proposals to support the recovery process.
- Facilitate the collation and analysis of data and its publication.
- Facilitate implementation of high priority actions in each range State.
- Develop and review timelines for the completion of actions.
- Report regularly to the OBPRT.

The RPC needs to have the flexibility to allow strategic thinking, address issues across all States, and integrate field tasks done by core staff in state government departments. It is also important to develop effective contact and communication between regional groups. There exists the potential to appoint a RPC, possibly a retired person, on a nominal retainer to undertake coordination of the recovery program (independent of the summer and winter implementation roles). Implementation of summer

and winter recovery program actions can then be consolidated in two Project Manger positions (see Action 1.1 and 2.1).

Action 9.3 Review and upgrade listings throughout the range

The OBP is currently listed as Critically Endangered under the EPBC Act. This should also be reflected in state legislation where applicable. Similarly, all State authorities should identify and make management provisions for habitat critical to the survival of the species under their respective jurisdictions.

MANAGEMENT PRACTICES

Fire management

In the Tasmanian Wilderness World Heritage Area, appropriate fire regimes are essential to maintain an adequate diversity and abundance of food plants in the breeding habitat. Bushfires in the breeding grounds could potentially devastate large areas of foraging habitat and destroy nesting sites. To manage this threat, control burning is conducted, and carried out in accordance with the PWS regional fire management plans and in consultation with Threatened Species Section (DPIW). Fire management prescriptions for Melaleuca and Birchs Inlet (Marsden-Smedley 1993; PWS 1997), and long-term monitoring of food plant abundance at Birchs Inlet (Askey-Doran 1995) will guide future habitat management in the breeding range. All habitat burning is designed to minimise the chance of escape and natural boundaries are used where possible. Good progress in developing ecological burning regimes has been made in recent years with improved understanding of fire behaviour and fire control in buttongrass plains. Adaptive management principles are being used to guide a program of experimental burns to learn more about fire behaviour.

Wind farms

The Federal Government was committed through the *Renewable Energy (Electricity) Act 2000* and the Mandatory Renewal Energy Target (MRET) to reducing greenhouse gas emissions through the development of renewable energy. The incentives under MRET are linked to total energy production and therefore have tended to direct greatest development interest to the high wind energy sites throughout the southeast coastal region. This has resulted in a proliferation of wind farm development proposals and speculative investigations in northern Tasmania, southern Victoria and southeastern South Australia. Unfortunately, much of this development interest coincides with the migratory and winter range of the OBP. Several wind farm proposals for sites where OBPs are known to occur have been referable actions under the EPBC Act.

Since 1999, the OBPRT has been actively involved in the planning process to ensure proponents undertake comprehensive environmental impact assessments to ensure OBP habitat is not degraded and wind farm infrastructure is sited in a manner, which minimises the risk of collision. In general, wind farms within10km of the coast has the potential to involve OBPs. However, the majority of OBP values occur within 3km of the coast throughout its range. Where developments are proposed in winter habitats or migratory corridors, the OBPRT has encouraged proponents to develop a range of management tools to minimise impacts. These include on-site mitigation (eg. turbine siting, vegetation management) designed to reduce collision risk, off-site habitat improvements (eg. habitat restoration, supplementary food crops) designed to attract OBPs away from the wind farm, and compensation packages (eg. funding of Recovery Plan actions) to offset actual and immeasurable collisions. Successful implementation of these impact management tools should result in a 'no net loss' outcome.

It is critical all levels of the planning and development process in each state is cognisant of the issues relating to collision risk, OBP conservation values, mitigation mechanisms and compensation measures. All wind farm proposals must ensure no net loss of OBPs or their habitat and make provision for adequate management of resources associated with the species.

River mouth management

Orange-bellied Parrots are known to use the margins coastal wetlands, including the mouths of creeks and rivers, such as Yambuk Lake at the mouth of the Eumeralla River in Victoria. Creek and river mouths often become blocked by movement of sand along the foreshore, causing upstream flooding, and often inundating surrounding farmland. Although this is a natural process, the sandbars blocking the mouths of many of these wetlands are often artificially opened. The mouth of the Eumeralla River has been opened regularly and favourable conditions exist in farmland round Lake Yambuk for the growth of *Sarcocornia* saltmarsh and a range of salt tolerant weeds. Up to 18 OBPs have been found round the lake. In years where the mouth has not been opened, the saltmarsh and weed margins have remained inundated, and OBPs have not been found there.

The artificial opening of river mouths has many management implications, including agricultural, social and environmental. It is important the authorities responsible for management of river mouths are aware of OBP habitat issues so potential adverse impacts on the OBP can be taken into consideration when decisions are made.

Western Treatment Plant decommissioning
Melbourne Water has plans to decommission some settlement ponds at the Western Treatment Plant by 2005 (Lane *et al*. 1999). Many of the settlement ponds were originally built on reclaimed saltmarsh adjacent to what is now the Spit Nature Conservation Reserve. The decommissioning of these ponds creates potential for creating additional saltmarsh habitat there. Any redevelopment plans Melbourne Water has for these settlement ponds are likely to have management implications for OBP recovery.

Grazing
Large areas of heathland, coastal scrub and saltmarsh in northwest Tasmania are used for grazing purposes. The Arthur-Pieman Conservation Area Management Plan (Parks and Wildlife Service 2001) allows for continued grazing of coastal heathland and various grazing leases and licences are provided on other Crown lands within the region. While quantitative data of the effect of grazing are not yet available, empirical observations at sensitive habitats and limited seed resources during low productive years clearly indicate a negative impact on OBP habitat resources. The responsibility for management of grazing within coastal regions rests with PWS and provision for protection of OBP resources is required. Closing or modifying leases and licences, excluding stock from sensitive areas, altering the timing of agistment or reducing stocking rates will improve the resources available to migrating parrots.

Feral pest control
In NZ, intensive baiting can reduce predator levels at selective sites (Clout and Saunders 1995). Intensive predator control at key OBP sites could be a way of identifying and measuring threats through management. This should be carried out by relevant state authorities/ landowners. It is necessary to ensure management authorities in each state include active and on-going feral predator control programs as part of their management plans for parks/reserves under their control.

Starlings and feral honeybees can occupy nest boxes, particularly at Birchs Inlet, to the exclusion of OBPs. Common Starling and feral honeybee populations need to be controlled where this occurs.

Collection of founder stock
To maintain genetic diversity in the captive population and to ensure the captive population closely represents the genetic diversity of the wild population, it may be necessary on occasions to collect additional birds from the wild. The impact of any removal from the wild will be determined through a PVA.

Weed control and herbicide use
Orange-bellied Parrots are known to forage on a suite of weed species (see Appendix 2) and their use of weed species as a food source appears to be increasing. Control of weed species at certain localities may impact on OBPs, both through a loss of food sources and through the potentially harmful effects of herbicides. Authorities conducting weed control need to be informed of this potential impact and be encouraged to consult with the OBPRT on areas to be controlled and to use of non-toxic (to birds) herbicides.

Visitor disturbance
A report on aircraft and human activity at Melaleuca (Bezuijen *et al*. 2000) concluded OBPs at Melaleuca appear to be relatively tolerant to most current fixed wing aircraft and visitor activity, though there is individual variation in sensitivity to these activities. However, this should not necessarily be interpreted as meaning the current activity levels have no impact, and it is not known

to what degree current levels of activity could be increased before OBP tolerance is exceeded and impacts become apparent. A second study was conducted to determine the impacts of helicopter operations on the species (Quin and McMahon 2001). This study concluded OBPs reacted differently to the presence of helicopters than fixed wing aircraft and helicopter use should be carefully controlled. Under the World Heritage Area Management Plan, PWS have primary responsibility to ensure aircraft and visitor activity, and site usage does not reduce habitat quality for OBPs.

Promoting awareness and interest in the OBP recovery effort creates a demand by the birdwatching community to see OBPs in the wild. There is some potential to increase opportunities to observe OBPs in winter at the Spit Nature Conservation Reserve, Western Treatment Plant and Swan Island. However, OBPs are disturbed by human interference and an increased presence of birdwatchers may result in birds shifting from critical food resources or increasing energy expenditure beyond sustainable levels. Access to these sites is strictly controlled by a permit system administered by Melbourne Water (Western Treatment Plant), Parks Victoria (Spit Nature Conservation Reserve) and DSE, Geelong (Swan Island).

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APPENDICIES

Appendix 1 Orange-bellied Parrot Recovery Team Membership (2006)

Organisation name
Government Agencies
Department of Environment and Heritage (SA)
Department of Primary Industries and Water (Tas) -Threatened Species Section, Biodiversity Conservation Branch
Department of Sustainability and Environment (Vic) – Threatened Species and Communities Section, Biodiversity and Natural Resources Division
Department of Sustainability and Environment (Vic) – Arthur Rylah Institute
Department Environment and Water Resources (AG)
Healesville Sanctuary (Zoological Board of Victoria)
Non-Government Organisations
Birds Australia
Threatened Species Network (World Wide Fund for Nature)
LaTrobe University (School of Genetics and Human Variation)
Regional Working Groups
South-west Victorian Working Group (Chair)
South Australia Working Group (Chair)
Murray Lakes-Coorong Working Group (Chair)
Bellarine Peninsula Working Group (Chair)
Westernport-Bass Coast Working Group (Chair)
North-west Tasmania-King Island Working Group (Convenor)

Appendix 2 Orange-bellied Parrot food plants

Below is a list of plant species eaten by the Orange-bellied Parrot, the state distribution, months of year flowering/fruiting and the frequency they are observed being utilised. Introduced species are denoted (*).

Family	Botanical name	Common name	Distribution	Period	Frequency
Monocotyledons					
Cyperaceae					
	Gymnoschoenus sphaerocephalus	Button-grass	Tas., Vic.	Dec.–Mar.	occasional
	Isolepis nodosa	Knobby Club-rush	Vic.	June–Sept.	occasional
Iridaceae					
	* Romulea rosea	Onion-grass	Vic.	Aug.	occasional
Juncaginaceae					
	Triglochin mucronatum	Prickly Arrowgrass	Vic., SA	Apr.–June	rare
	Triglochin striatum	Streaked Arrowgrass	Tas., Vic., SA	Apr.–June	occasional
Poaceae					
	*Holcus lanatus	Yorkeshire Fog Grass	Tas., Vic., SA		rare
	*Pennisetum clandestinum	Kikuyu	Tas., Vic., SA	July–Sept.	rare
	*Poa annua	Winter Grass	Tas., Vic., SA	July–Sept.	regular
	Poa poiformis	Blue Tossock-grass	Tas., Vic., SA		rare
	Polypogon monspieliensis	Annual Beard-grass	Vic.		rare
Restionaceae					
	Eurychorda complanata	Flat Chord-rush	Tas.., Vic.	Oct.–Dec.	regular
	Lepyrodia tasmanica	Branching Scale-rush	Tas., Vic.	Oct.–Dec.	regular
Dicotyledons					
Aizoaceae					
	*Galenia pubescens		Vic.	June–July	rare
	Tetragonia sp.	Native Spinach	Vic.	July	rare
Apiaceae					
	Actinotus bellidioides	Tiny Flannel-flower	Tas.	Dec.–Mar.	regular
	Apium prostratum prostratum	Sea Celery	Tas., Vic., SA	Mar. –July	rare
Asteraceae					
	*Aster subulatus	Aster-weed	Tas., Vic., SA	Apr. –Sept	rare

APPENDIX 2. Cont.

	*Arctotheca calendula	Capeweed	Tas., Vic., SA	Sept.–Nov.	occasional
	*Helianthus annuus	Sunflower	Vic., SA	May–Sept.	occasional
	Helichrysum pumilum	Paper Daisy	Tas.	Oct-Dec	frequently
	Leontodon leysseri		Tas.		
	*Onopordum acanthium	Heraldic Thistle	Tas., Vic., SA	any time	rare
	Senecio pinnatifolius	Variable Groundsel	Tas., Vic., SA	any time	occasional
	*Sonchus asper	Rough Sow Thistle	Tas., Vic., SA	any time	occasional
Boraginaceae					
	*Heliotropium europaeum	Common Heliotrope, Potato Weed	Vic., SA	Apr.–Aug.	occasional
Brassicaceae					
	*Brassica fruticulosa	Twiggy Turnip, Wild Mustard	Vic.	July–Aug.	occasional
	*Cakile maritima	Sea Rocket	Tas., Vic., SA	Mar.–Sept.	often
	*Diplotaxis tenuifolia	Sand Rocket, Lincoln Weed	Tas., Vic., SA	Feb.–Sept.	occasional
	*Rapistrum rugosum	Giant Mustard, Turnip Weed	Tas., Vic., SA	Oct.	rare
Caryophillaceae					
	Sagina maritima	Sea Pearlwort	Vic.	May–July	rare
	*Cerastium glomeratum	Sticky Mouse-ear Chickweed	Vic.	July–Oct.	rare
Chenopodaceae					
	Atriplex cinerea	Coast Saltbush	Vic.	May–July	rare
	*Atriplex prostrata	Orache	Tas., Vic., SA	May–July	occasional
	*Chenopodium glaucum	Glaucus Goosefoot	Vic.	Mar.–Aug.	regular
	Halosarcia halocnemoides	Grey Glasswort	Vic.	winter	rare
	Sarcocornia quinqueflora	Beaded Glasswort	Tas., King I., Vic., SA	Mar.–July	regular
	Sclerostegia arbuscula	Shrubby Glasswort	Tas., Vic., SA	June, Nov.	regular
	Suaeda australis	Austral Sea-blite	Tas., Vic., SA	Mar.–June	regular
Cunoniaceae					
	Bauera rubioides	Wiry Bauera	Tas.	Dec.–Mar.	rare
Epacridaceae					
	Leucopogon parviflorus	Coast Beard-heath	Tas.,Vic., SA	any time	rare

APPENDIX 2. Cont.

Frankeniaceae					
	Frankenia pauciflora	Southern Sea-heath	Tas., Vic., SA	May–Aug.	often
Geraniaceae					
	*Erodium botrys	Herons–bill	Vic., SA	Aug.–Jan.	rare
Lythraceae					
	Lythrum hyssopifolia	Lesser Loosestrife	Tas.,Vic., SA	May	rare
Oxalidaceae					
	*Oxalis corniculata	Yellow Wood Sorrel	Tas., Vic., SA	Mar.–Sept.	occasional
Plantaginaceae					
	*Plantago coronopus	Buck's–horn Plantain	Tas., King I., Vic., SA	Apr.–Aug.	rare
	*Plantago lanceolata	Ribwort	Tas., Vic., SA	May–July	rare
Plumbaginaceae					
	*Limonium sp.	Sea–lavender	SA	July	occasional
Polygonaceae					
	*Polygonum arenastrum	Hogweed	Tas., Vic., SA	Mar.–July	regular
	*Rumex crispus	Curled Dock	Tas., Vic., SA	July–Aug.	rare
Primulaceae					
	Samolus repens	Creeping Brookweed	Tas., Vic., SA	May–July	rare
Rosaceae					
	Acaena novae–zelandiae	Bidgee–widgee	Tas., Vic., SA	Nov.–Sept.	regular
Rutaceae					
	Boronia parviflora	Swamp Boronia	Tas., Vic., SA	Oct.–Dec.	regular
	Boronia citriodora	Lemon –scented Boronia	Tas.	Oct.–Dec.	regular
	Boronia pilosa	Hairy Boronia	Tas.	Oct.–Dec.	regular
Stylidiaceae					
	Stylidium graminifolium	Grass Triggerplant	Tas.	Dec.–Mar.	rare
Thymelaeaceae					
	Pimelea serpyllifolia serpyllifolia	Thyme Rice–flower	Tas., Vic., SA	Dec.–Mar.	rare

Appendix 3 Abbreviations used in this document

AEMA	Adaptive experimental management approach
AFMA	Australian Fisheries Management Authority
AGDEW	Department of Environment and Water Resources (Commonwealth)
AZ	Adelaide Zoo
BSPO	Breeding Season Project Officer
CMA	Catchment Management Authority
CMA	Catchment Management Authority
CMC	Captive Management Co–ordinator
CMG	Captive Management Group
DEH	Department of Environment and Heritage (South Australia)
DPIW	Department of Primary Industries and Water (Tasmania)
DSE	Department of Sustainability and Environment (Victoria)
EA	Environment Australia
HMEO	Habitat Management Extension Officer
HS	Healesville Sanctuary
INRM	Interim Natural Resource Management region
LU	LaTrobe University
NRM	Natural Resource Management
NSW	New South Wales
NSW NPWS	New South Wales National Parks and Wildlife Service
NZ	New Zealand
OBP	Orange–bellied Parrot
OBPRT	Orange–bellied Parrot Recovery team
PWS	Parks and Wildlife Service (Tasmania)
RPC	Recovery Plan Co–ordinator
RPF	Recovery Plan Fund
SA	South Australia
SAWG	South Australian Working Group
SNCR	Spit Nature Conservation Reserve
TAS	Tasmania
TUC	Trumped–up Corella
VIC	Victoria
WSPO	Winter Season Project Officer
WTP	Western Treatment Plant (Melbourne Water)
WVWG	Western Victoria Working Group
WWF	World Wide Fund for Nature