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Translocation of the Eastern Bristlebird 2: applying principles to two case studies

Jack Baker

University of Wollongong, jbaker@uow.edu.au

David Bain

University of Wollongong, dwb01@uow.edu.au

Jean Clarke

University of Wollongong, jclarke@uow.edu.au

Kris French

University of Wollongong, kris@uow.edu.au

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Translocation of the Eastern Bristlebird 2: applying principles to two case studies

Abstract

The Eastern Bristlebird (*Dasyornis brachypterus*) is an endangered endemic passerine of south-eastern Australia. The re-establishment of extirpated populations through translocation was identified as a key action in New South Wales to address the threats to this species associated with habitat fragmentation and widespread and frequent fire. At Jervis Bay during 2003-2005, 50 birds were translocated from Bherwerre Peninsula to Beecroft Peninsula. In the Illawarra in 2008, 50 birds were translocated from Barren Grounds Nature Reserve to Cataract. At Jervis Bay, monitoring indicated that after 7 years, (i) there was no detectable impact on the source population from the removal of birds and (ii) the count at Beecroft Peninsula was 94 birds, with dispersal up to 6.3 km from the release point. In the Illawarra, (i) the source population was recovering 3 years post-removal and (ii) the maximum count at Cataract was 15 birds after 3.5 years, including evidence of breeding, and after 3 years, the maximum dispersal was 7 km from the release point. Both translocations adhered to five key principles as follows. (i) Feasibility analysis prior to each project was favourable. (ii) For 17 pre-stated criteria for success, 14 and 10, respectively, were met for Jervis Bay and Illawarra. (iii) Financial accountability was achieved with detailed statements showing budgets of \$201k and \$92k, respectively, for Jervis Bay and Illawarra. (iv) Ecological research was incorporated into both projects. (v) The results of each project are progressively being published. The re-introduction at Jervis Bay has succeeded, and we are optimistic about the Illawarra re-introduction.

Keywords

2, bristlebird, studies, eastern, case, translocation, two, principles, applying

Disciplines

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Translocation of the Eastern Bristlebird 2: applying principles to two case studies

Jack Baker, David Bain, Jean Clarke and Kris French

Jack Baker, David Bain, Jean Clarke and Kris French are members of the Institute for Conservation Biology and Environmental Management (University of Wollongong, NSW 2522, Tel: +61 2 4221 3655, Email: jbaker@uow.edu.au). This work was an integral part of the NSW Recovery Plan for the Eastern Bristlebird. The Jervis Bay project was part of David Bain's PhD and the Illawarra project was a culmination of two decades of successful recovery actions for the species.

Summary

The Eastern Bristlebird (*Dasyornis brachypterus*) is an endangered endemic passerine of south-eastern Australia. The re-establishment of extirpated populations through translocation was identified as a key action in New South Wales to address the threats to this species associated with habitat fragmentation and widespread and frequent fire. At Jervis Bay during 2003-2005, 50 birds were translocated from Bherwerre Peninsula to Beecroft Peninsula. In the Illawarra in 2008, 50 birds were translocated from Barren Grounds Nature Reserve to Cataract. At Jervis Bay, monitoring indicated that after 7 years, (i) there was no detectable impact on the source population from the removal of birds and (ii) the count at Beecroft Peninsula was 94 birds, with dispersal up to 6.3 km from the release point. In the Illawarra, (i) the source population was recovering 3 years post-removal and (ii) the maximum count at Cataract was 15 birds after 3.5 years, including evidence of breeding, and after 3 years the maximum dispersal was 7 km from the release point. Both translocations adhered to five key principles as follows. (i) Feasibility analysis prior to each project was favourable. (ii) For 17 pre-stated criteria for success, 14 and 10 respectively were met for Jervis Bay and Illawarra. (iii) Financial accountability was achieved with detailed statements showing budgets of \$201k and \$92k respectively for Jervis Bay and Illawarra. (iv) Ecological research was incorporated into both projects. (v) The results of each project are progressively being published. The re-introduction at Jervis Bay has succeeded and we are optimistic about the Illawarra re-introduction.

Key words: *Dasyornis*, re-introduction, recovery action, threatened species, post-translocation monitoring

Introduction

People have been moving organisms around the globe for millennia motivated by anthropocentrism (Heinsohn 2003) but in recent decades, translocation has been used increasingly as a conservation strategy for threatened species management (Griffith *et al.* 1989; Armstrong & McLean 1995; Fischer & Lindenmayer 2000). Generally, a translocation project aims to increase the number of populations and individuals as part of a recovery effort for a species. However, determining success is complex and rarely done effectively, and results of projects are rarely published. The popularity of translocations has stimulated a number of reviews (e. g. Fischer & Lindenmayer 2000; Seddon *et al.* 2007) that have examined principles for determining *a priori* the specific goals, the transparency of process and assessment of success of translocation projects. The important principles are: (i) a feasibility analysis prior to commencement of a project; (ii) evaluation of success against criteria stated prior to commencement of a project and that are adaptable to a range of projects; (iii) financial accountability for each project, which can inform future planning; (iv) the incorporation of ecological research, including experimentation, to further the understanding of the species and ecological processes; and (v) access to information through the publication of translocation projects, regardless of their level of success.

For the second principle, evaluation of the success of translocations, prior to the commencement of our projects we developed 17 criteria that were intended to be adaptable to many projects or species. Criteria were developed for the source and the translocated populations, including measures of survival and social behaviour. They were based on a timescale of short-, mid- and long-term periods that can be measured in generation time or time to first breeding. The use of generation time allows comparisons between very long-lived animals such as cockatoos and primates and short-lived animals such as finches and small mammals, particularly if investigating the potential genetic and demographic impacts to populations that may result from translocation. Ultimately, a translocation will be judged as successful if the source population recovers from the removal of individuals and the species persists at the host site.

The Eastern Bristlebird (*Dasyornis brachypterus*) is an endemic passerine of south-eastern Australia that is threatened by habitat fragmentation and widespread and frequent fire (Baker 1997; DEC 2004; OEH 2011). It is listed as endangered under Commonwealth and State legislation for the jurisdictions where it occurs. The species is currently restricted to a small number of populations between southern Queensland and northern Victoria (OEH 2011). Only two of these populations exceed 600 individuals; both are in central NSW: Bherwerre Peninsula at Jervis Bay and Barren Grounds Nature Reserve in the Illawarra (Baker 1997, OEH 2011). The species' habitat is low dense vegetation cover, which occurs in a wide range of communities. It is cover-dependent, poor at flying and dispersing; it is cryptic and detecting it depends on aural surveys (Baker 2000). Re-establishment of extinct populations was identified in a NSW state recovery plan (NPWS 2000) as an action to reduce the impact of potential threats to the species, particularly catastrophic wildfire. A re-introduction is a translocation defined as the movement of an organism into part of its native range from which it has disappeared or become extirpated in historic times as a result of human activities or natural catastrophe (IUCN 1987). In this paper, we describe two re-introductions of the Eastern

Bristlebird; one at Jervis Bay and one in the Illawarra. We evaluate these using the five principles outlined above.

Methods

Jervis Bay

Following a favourable feasibility analysis (see below), wild-caught Eastern Bristlebirds were moved over 3 years. Fifty-one birds were sourced from Bherwerre Peninsula (150°45', 35°04'): 16 in 2003, 20 in 2004 and 15 in 2005. The birds are sensitive to disturbance during breeding (August to February) and difficult to catch (Baker & Clarke 1999) so the translocations were planned to occur over several months after the breeding season. All birds caught were translocated. They were banded and, within 4 hours of capture, released at Beecroft Peninsula (150°48', 35°03'), approximately 12 km north of the source and a 45 minute drive. Birds were caught following the methods of Baker and Clarke (1999) at an average of one or two per day and transported individually in foam-padded cages (30 cm x 30 cm x 60 cm) lined with soft vegetation from the source environment. Birds were released individually and directly into the host environment. Two release points (1 km apart) were used as replicates in a study of the short-term movements of the birds after their release (see Bain *et al.* 2012).

At Beecroft Peninsula, monitoring was conducted each spring (2003-2010). Aural surveys were conducted (*sensu* Baker 1997) in the vicinity of the release points, along three transects measuring 2600 m, 1590 m and 4270 m. Each transect was surveyed twice, once in each direction. The survey with the maximum number of detections was used for the population count. Throughout the remainder of Beecroft Peninsula, which extends approximately 7 km, 2 km, 2 km and 3 km to north, east, south and west respectively from the release points, incidental detections were made with and without the use of call replay. This provided additional records to add to the population count as well as an estimate of the annual dispersal maximums for 2003-2010. With all detections, an attempt was made to observe whether the birds were banded, although attempts often failed due to the species' cryptic nature and dense habitat.

At Bherwerre Peninsula, monitoring was undertaken before, during and after the removal of the 51 birds to assess short-term impacts on the source population (Bain *et al.* 2008, Bain & French 2009). In addition, monitoring using aural survey and direct observation occurred along a 4.6 km transect within an area of the source population where 44 of the 51 birds were removed. Birds were counted (*sensu* Baker 1997) in spring 2002-2009. In some instances, this transect was surveyed twice in a year, in which case the maximum count was used.

Illawarra

By 2007, with the apparent medium-term success of the translocation of Eastern Bristlebirds at Jervis Bay and following a favourable feasibility analysis (see below), a second translocation was planned for the Illawarra. To minimize the cost, it was

undertaken in a single stage and with considerably less monitoring. Fifty wild-caught birds were sourced from Barren Grounds Nature Reserve (150°43', 34°42') during March-April 2008. All birds were released 1-2.5 hours after capture at the one point in their new host environment at Cataract (150°48', 34°17') within the Sydney Catchment Authority Special Areas, approximately 40 km north of the source site and a 60 minute drive. Birds were caught at an average of one per day and transported as per the Jervis Bay project. The release point was at the confluence of the two arms of a reservoir and thus, the translocated population was initially confined to disperse between these arms, which spread at approximately 60° for 7 km.

Monitoring used call replay at both the host site and source site. At Cataract, the host environment was monitored at 1, 1.5, 3 and 3.5 years after the translocation. Call replay was usually broadcast at 400 m intervals for 2 minutes, followed by 13 minutes of listening and area searching (radius 200 m). Some points were closer than 400 m and at some points replay was used on more than one occasion. Monitoring transects were along the limited extent of roads, tracks and the edge of Cataract Reservoir and also through the undergrowth, which was dense and difficult to traverse. At Barren Grounds, birds from the source population were trapped opportunistically along a transect of 6.4 km of tracks known to have a high density of Eastern Bristlebirds. Birds were monitored along the transect by aural survey and direct observation during the removal of birds for translocation and again after 3 years to give the total detections and the minimum count.

Results

Jervis Bay

The capture effort was 51 birds in 37 days with 93 person.days of work. Of 51 Eastern Bristlebirds captured, one bird died, presumably from stress, during processing and therefore represents a capture but not a translocation. Five birds died soon after release (see Bain *et al.* 2012). Hence, the effective translocated population was based on 45 birds. Another bird was found dead on the road, 3.8 years after its release.

At Beecroft Peninsula, Eastern Bristlebirds were duetting (presumably a sign of social interaction) within 6 months of the first release and, 6 months after the second release, 2 birds were observed without bands and these were presumed to be progeny of the translocated birds. The population counts have been variable but with a trend of increasing numbers with time since the translocations commenced (Table 1). The count for spring 2009 was the first indication that the population exceeded the number of birds released at the host site. The birds had dispersed widely throughout habitat on Beecroft Peninsula, with birds detected 4.6 km from the nearest release point after 1.5 years and the maximum dispersal of 6.3 km after 6.5 years (Table 1).

At Bherwerre Peninsula, in the area where 44 birds were removed from the source population, the count appears to have stayed stable during the 7 years from 0.5 years before the removals to 4.5 years after the last removal (Table 2). Approximately half of the birds were detected by their duetting calls.

Illawarra

The capture effort was 50 birds in 52 days with 182 person.days of work. All 50 Eastern Bristlebirds were captured, processed, moved and released without incident. At Cataract, birds were detected duetting during each of the survey periods and, 3.5 year after the release, 15 birds were counted (Table 3) and three of these were unbanded. Dispersal after 1 year was indicated by birds detected at two locations approximately 2 km from the release point. After 1.5 years, one bird had dispersed 5 km and after 3 years, 5 birds had dispersed 5 km and one bird, 7 km (Table 3).

At Barren Grounds, the translocated birds were captured along 6.4 km of transect during 52 days and during this period we estimated that 43 birds remained uncaptured. Three years after the removal, a survey along the transect during 6 days counted an estimated minimum of 59 birds from 81 detections. Approximately half of the detections involved birds duetting. Call replay was used on 2 or 3 different days at 16 points; at 11 of these, the maximum number of birds was not detected on each occasion, indicating that our method was not consistent in detecting all birds present at a point.

Discussion

Jervis Bay

The bristlebirds (*Dasyornis* spp) are known to be sensitive to disturbance and handling, and individual Eastern and Western Bristlebirds have died in previous radio-tracking projects (Baker & Clarke 1999). In this study, there was one death directly attributable to handling and a further five deaths after release that were probably attributable to the translocation and radio-tagging (Bain *et al.* 2012). The discovery of the road-killed Eastern Bristlebird prompted the placement of traffic advisory signs along the main road at Beecroft Peninsula. Fortunately, these fatalities and any other disturbance caused to the translocated individuals did not prevent the successful establishment of a new population at Beecroft Peninsula.

After 7 years, the translocation of the Eastern Bristlebird to Beecroft Peninsula has shown many indications of success. The detections of duetting birds and unbanded birds are taken as evidence of social interactions and breeding. For Barren Grounds Nature Reserve post-fire, Baker (1997) calculated that the species had an annual population growth rate of 14%, at which a population could double in 5 years. Hence, the latest results for Beecroft Peninsula indicate that the species is breeding and surviving well and it has dispersed widely on the Peninsula.

The removal of 15 bristlebirds per year was estimated to represent less than 2.5% of the source population on Bherwerre Peninsula (Baker 1997; Whelan & MacKay 2002) and it was considered that this was sustainable. Short-term monitoring (Bain & French 2009) showed no significant difference in bird numbers between a removal site (500 ha) and a non-removal (control) site (400 ha), although this result was confounded by the effects of

an unplanned fire that affected approximately 50% of the habitat (4300 ha) at Bherwerre Peninsula. Similarly, in the medium-term, along a 4.6 km transect where most of the translocated birds were removed, we detected similar numbers of birds pre-removal and 6-7 years thereafter and took this to indicate that there was no apparent impact on the source population.

Illawarra

After 3.5 years, the translocation of the Eastern Bristlebird to Cataract has shown some indications of success (see (ii) *Criteria for success* and Table 4 below). The detections of duetting birds and unbanded birds are taken as evidence of social interactions and breeding. While the latest monitoring count of 15 was modest, it needs to be understood in context. First, the high rate of false negatives for detections at Barren Grounds suggests that we would not have detected all of the birds present in the area we monitored at Cataract. Secondly, dispersal has been detected to 7 km from the release point and, considering the geography of the site, this suggests that dispersal is likely to be across an area of approximately 3000 ha. Given the difficulty of access at Cataract and the number of call replay locations, the effective monitoring area was <750 ha. Thus, the results to date indicate that the population is likely to establish in the long-term and that the translocation will be a success.

The removal of 50 birds was estimated to represent 5% of the source population at Barren Grounds (Pellow & Clarke 2008). We expected that the source population could sustain this proportion being removed considering that the only estimate of the species recovering from a perturbation was 14% annual growth estimated for this population in the 1990s when it was recovering from fire (Baker 1997). A minimal monitoring effort 3 years after the removal counted a minimum of 59 birds in the removal area, with our results suggesting a high level of false negatives for detections. This indicates a minimum annual growth rate of 11% in the proximity of the removals and, although it cannot distinguish population flux across the whole population, is taken as evidence that the number of birds is building and that the Barren Grounds population will recover from the effect of the removal.

Evaluation of the translocations

(i) Feasibility analysis

Establishing the feasibility of translocating Eastern Bristlebirds began with research into the ecology of the species, which commenced in 1985 and intensified in the 1990s. It was part of an iterative planning process guided by a recovery team active since 1992 and a recovery plan first drafted in 1997. In New South Wales, undertaking a feasibility analysis became mandatory under a Translocation Policy (NPWS 2001), which requires a rigorous peer-reviewed Translocation Proposal (TP) to be approved and all necessary research licences to be approved. The TPs for the Jervis Bay (Whelan & MacKay 2002) and Illawarra (Pellow & Clarke 2008) projects were both approved under this policy. Each was deemed to be feasible because of the following considerations. (i) There was

evidence that the host sites were part of the species' former range and supported similar vegetation and invertebrate food resources. (ii) Vertebrate pest control programs and fire management strategies were sympathetic to the species' requirements. (iii) The source populations were large enough to support the removal of individuals for translocation. (iv) Techniques for capturing, monitoring and tracking birds had been developed and tested.

(ii) *Criteria for success*

We used 17 criteria to assess the success of our translocations (Table 4). The Jervis Bay project meets 14/17 criteria after 7 years and cannot yet be assessed on the remaining 3 criteria, which require data 10–50 years post-translocation. For Jervis Bay, the source site appears to be unaffected by the removal of 51 individuals and the numbers at the host site indicate that the newly established population is flourishing and the translocation is a success. The Illawarra project has met 10/17 criteria after 3 years and cannot yet be assessed for the other 7 criteria. For the Illawarra, the source population appears to be recovering quickly and the results at the host site are evidence that the newly established population is widely dispersed and surviving, which indicates that the translocation has been successful in the short- to mid-term.

(iii) *Financial accountability*

Both projects were collaborative with numerous partners and supporters. The budgets were forecast in the TPs and administered by the proponents: the University of Wollongong managed the Jervis Bay project and the former NSW Department of Environment and Climate Change (DECC), the Illawarra project. The actual budgets for the projects (Jervis Bay adjusted to 2008 values using annual CPI increase of 13.5% from 2004 to 2008 (<http://www.rba.gov.au/calculator/annualDecimal.html>) are given in Table 5. The cash component for the Jervis Bay project accounted for a staged approach over 3 years and considerable additional ecological research. The cash component for the Illawarra project was much less because it was done without a PhD student and supplementary research, although a major in-kind cost was for project management (85 days @ \$83kpa +30% on costs) undertaken by one of the authors (JB) while he was on extended leave from his position in DECC. The total cost (cash plus in-kind) for the Jervis Bay project (\$201 100) was approximately double that for the Illawarra project (\$92 000). These amounts under-estimate the in-kind contributions because they omit the hours and out-of-pocket expenses for the many volunteers involved: 53 person.days provided by 8 volunteers at Jervis Bay and 75 person.days provided by 23 volunteers at Illawarra.

(iv) *Incorporation of ecological research*

Monitoring to assess the success of the translocations is reported in the present paper. From DNA samples and morphometric data collected during the Jervis Bay project, two techniques were established for sexing Eastern Bristlebirds (Bain 2007). A particular concern during the Jervis Bay project was the response of the source population to the

removal of 51 birds. However, monitoring before, during and after the removals showed that there was no significant impact on bird numbers in the source population (Bain & French 2009). The measurement of movements and home ranges of newly translocated Eastern Bristlebirds is reported in Bain *et al.* (2012). During both projects, pin feather samples were collected from which DNA was extracted and used for phylogenetic/geographic and population analyses for the species (Roberts *et al.* 2011).

(v) *Access to information*

For both projects, data and preliminary analyses were made available in the short-term through annual reports to all stakeholders, particularly the recovery team, and by presentations to scientific, management and lay communities. The Jervis Bay project was reported in a thesis (Bain 2006) and progressively through four published papers. The present publication analyses both projects for their success.

Conclusion

Building on the success of the translocations reported here, the current federal recovery plan (OEH 2011) recommends translocation as a key recovery action for Eastern Bristlebird populations in Victoria and northern NSW.

Fire is a threat to the Eastern Bristlebird and so, although fire is inevitable in its habitat (Baker 2000; Bain *et al.* 2008) the current fire management practices at Beecroft and Cataract aim to restrict unsuitable fire regimes in the areas of the translocated populations (Whelan & MacKay 2002; Pellow & Clarke 2008). Nevertheless, the fire at Bherwerre Peninsula in December 2003 was a timely reminder of the good sense of having a population established on Beecroft Peninsula as an insurance against the local population being severely reduced or extirpated by an extensive fire.

The popularity and importance of translocation as a conservation technique carries with it a responsibility to undertake properly planned, comprehensive programmes that are effectively assessed and reported. In the present case, we have discharged that responsibility by adhering to the five key principles that we espoused and we commend these principles to be used in future translocation projects. The re-introduction at Jervis Bay has succeeded and we are optimistic that in the long-term the re-introduction at Illawarra will also be successful. Capacity building, communication and collaboration have been recognized as critical elements of adaptive management for biodiversity conservation (Burbidge *et al.* 2011, Baker *et al.* 2009, Seddon *et al.* 2007) and reporting and evaluation of our efforts enables confirmation of the benefits of recovery planning (*sensu* Bottrill *et al.* 2011). We believe that the success of the translocations reported here attests to the value of planning by the Eastern Bristlebird Recovery Team, which has ensured that those critical elements have been provided.

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Table 1 Eastern Bristlebird count and dispersal at Beecroft Peninsula, Jervis Bay

Year	Years since first translocation	Minimum population count	Maximum distance from nearest release point
2003	0.5	6	960
2004	1.5	16	4580
2005	2.5	30	3000
2006	3.5	15*	_*
2007	4.5	15*	_*
2008	5.5	37	5900
2009	6.5	74	6250
2010	7.5	94	5200

*reduced survey effort

Table 2 Eastern Bristlebird count at Bherwerre Peninsula, Jervis Bay

Year & season	n(ebbs) surveyed
2002 spring	25*
2003 autumn	(16 removed)
2003 spring	27
2004 summer	34**
2004 autumn	(20 removed)
2004 spring	20
2005 summer	23
2005 autumn	(8 removed)
2005 spring	28
2006 spring	6***
2007 spring	8***
2008 spring	25
2009 spring	27

*pre-translocation

**immediately post-fire in adjacent habitat

***data collected by inexperienced surveyors

Table 3 Survey effort and Eastern Bristlebird count and dispersal at Cataract, Illawarra

Time	1 year (autumn)	1.5 year (spring)	3 year (autumn)	3.5 year (spring)
Survey transect	25 km	39 km	35 km	37 km
Replay points (distance from release point)	39 (0-5 km)	66 (0-7 km)	62 (0-7 km)	72 (0-7 km)
Call replays	58	117	107	98
Detections	17	24	16	33
Locations	4	6	4	6
Birds	7	12	8	15
Dispersal	0-2 km	2-5 km	2-7 km	2-6 km

1 **Table 4 Assessing the success criteria** (T_B = breeding/generation time = one year for the Eastern Bristlebird)
2

<i>Criteria</i>	<i>Jervis Bay</i>		<i>Illawarra</i>	
	<i>Achieved</i>	<i>Comments</i>	<i>Achieved</i>	<i>Comments</i>
A. Initial				
1. Feasibility analysis favourable	Yes	Completed prior to commencement (Whelan & MacKay 2002)	Yes	Completed prior to commencement (Pellow & Clarke 2008)
B. Released individuals				
<i>Short-term</i>				
2. Animals moved successfully	Yes	One death during processing	Yes	All birds released alive
3. Animals survived settlement period	Yes	Five deaths during first two days, no other recorded fatalities with birds	Unknown	Obviously some birds survived because they were detected after one year
4. Animals survived first T_B	Yes	11 birds detected after first year	Yes	7 birds detected after first year and 12 after 1.5 years
5. Evidence of any social behaviour	Yes	Birds heard duetting within days of release	Yes	3 unbanded individuals indicating that breeding had occurred after 18 months
<i>Mid-term</i>				
6. Population survived 3 T_B	Yes	30 birds detected after third year	Yes	15 birds detected after third year
7. Evidence of social behaviour, possibly breeding	Yes	Duetting heard between birds, 2 birds observed without bands	Yes	Duetting heard between birds, 3 birds observed without bands after 3.5 years
<i>Long-term</i>				
8. Evidence of breeding	Yes	Two birds observed without bands and population increasing	Yes	Three birds observed without bands
9. Population exceeds translocated number	Yes	45 released and alive after settlement, 94 at 7 T_B	Unknown	-
10. Population survival for 10 T_B	Unknown	Project going for only 7 years	Unknown	Project going for only 3.5 years
11. Population survival for 20 T_B	Unknown	Project going for only 7 years	Unknown	Project going for only 3.5 years
12. Population survival for 50 T_B	Unknown	Project going for only 7 years	Unknown	Project going for only 3.5 years
C. Source population (wild)				
<i>Short-term</i>				
13. Some sites of removal reoccupied within first T_B	Yes	All sites reoccupied	Yes	All sites reoccupied

<i>Mid-term</i>				
14. Continued reoccupation of removal sites during next 3 T _B	Yes	No change in numbers surveyed in source population across all three years	Yes	Numbers in the vicinity of the removals are recovering at 11% pa
15. Evidence of social interaction/breeding within 3 T _B	Yes	Duetting regularly heard between birds and some groups of 3 birds detected indicating the presence of juveniles with parents	Yes	Duetting regularly heard between birds and some groups of 3 birds detected indicating the presence of juveniles with parents
<i>Long-term</i>				
16. Evidence of breeding in removal sites within 5 T _B	Yes	Duetting regularly heard between birds and some groups of three birds detected indicating the presence of juveniles with parents.	Unknown	Duetting regularly heard and replacement of removals, although unknown origin of replacements
17. Complete recovery within 10 T _B	Yes	No change observed in bristlebird numbers before and after removals, although origin of replacements unknown	Unknown	Project going for only 3.5 years
Success?	Yes (at 7 years)	14/17 Yes 3/17 Unknown	Yes (at 3.5 years)	10/17 Yes 7/17 Unknown

Table 5 Project budgets adjusted to 2008 values.

The in-kind components are under-estimated because they omit volunteers' time and expenses. UoW = University of Wollongong. NPWS/DECC = NSW National Parks and Wildlife Service, which became part of Department of Environment and Climate Change, now Office of Environment and Heritage. ARC = Australian Research Council. SCA = Sydney Catchment Authority. HNCMA & SRCMA = Hawkesbury Nepean & Southern Rivers Catchment Management Authorities.

	<i>Jervis Bay 2003-2005</i>		<i>Illawarra 2008</i>	
	Cash	In-kind	Cash	In-kind
<u>Expenses - UoW</u>				
PhD student stipend	89 400			
Salaries project officer	31 200		23 500	
Salaries project supervision	25 000			
Vehicle	10 800		7 900	
Administration and equipment	18 700		6 400	
<u>Expenses – NPWS/DECC</u>				
Salaries	22 100		8 000	39 700
Vehicle		1 100		1 900
Administration and equipment		2 800		4 600
Total expenses	\$197 200	\$3 900	\$45 800	\$46 200
<u>Income</u>				
ARC stipend	89 400			
UoW	25 000			
NPWS/DECC	82 800	3 900	8 000	46 200
SCA			27 800	
HNCMA			5 000	
SRCMA			5 000	
Total income	\$197 200	\$3 900	\$45 800	\$46 200
<i>Total cost</i>	<i>Jervis Bay 2003-2005</i>		<i>Illawarra 2008</i>	
	<i>\$201 100</i>		<i>\$92 000</i>	