

Population increase of critically endangered Malherbe's parakeet *Cyanoramphus malherbi* introduced to Maud Island, New Zealand

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SUMMARY

We present the first population estimate for the little known and critically endangered Malherbe's parakeet *Cyanoramphus malherbi* inhabiting Maud Island, New Zealand. From March 2007 to May 2009 we conducted surveys for the species at this site to document the status of this translocated population and to determine the relative value of Maud Island for the conservation of this species. Using a modified version of the mark-resighting method, we estimated that the Maud Island population of Malherbe's parakeets has gone from an initial founder group of 11 captive-bred parakeets released on site, to a maximum of 97 during our survey period (assuming a 72% survival rate between trimesters). Out of a total of 221 sightings, 22% corresponded to un-marked individuals hatched on site. Our estimate of population size, coupled with the high reproductive potential of the species, suggests that translocation of captive-bred individuals to sanctuaries free of invasive predators is an effective management method for increasing the global population size of the species and eventually downgrade its IUCN threat category.

BACKGROUND

The Malherbe's parakeet *Cyanoramphus malherbi* is 23 cm long with predominantly green plumage except for a narrow band of orange-feathers above the culmen, a yellow crown, orange patches on the rump and blue flashes on their wings (Forshaw 2006). It is a critically endangered species endemic to New Zealand and currently restricted to three remnant populations in Canterbury, a captive breeding population and three island populations established via translocation of captive-bred individuals (Boon, Kearvell et al. 2000; Grant and Kearvell 2000; Gaze and Cash 2008; Hirschfeld 2008). With a global population of around 300-500 individuals (Kearvell, Grant et al. 2003; Hirschfeld 2008), Malherbe's parakeets represent one of New Zealand's rarest forest-dwelling bird species. The human-induced modification of large tracts of habitat, combined with predation pressure from introduced mammals have been identified as the chief drivers of population

decline for Malherbe's parakeets (O'Donnell 1996; Higgins 1999). Key actions for the conservation of the species include predator control in locations where remnant wild populations occur and captive breeding for translocation, the latter action being a joint venture between the New Zealand Department of Conservation and the Isaac Wildlife Trust. Although populations of Malherbe's parakeets and other parakeet species have been established throughout New Zealand using captive-bred individuals, no study has aimed to determine demographic changes beyond the initial phase of establishment at a new site.

Translocation to habitats free of introduced predators is a widespread conservation technique used in New Zealand (Hooson and Jamieson 2003; Dimond and Armstrong 2007; Leech, Craig et al. 2007; Ortiz-Catedral and Brunton 2010) and a central element of the management of critically endangered species (Flack 1977; Lloyd and Powlesland 1994). To increase the number of populations,

geographic range and numbers of Malherbe's parakeets, captive-bred individuals have been translocated to three island sanctuaries free of introduced predators: Chalky Island, Maud Island and Tuhua Island. Since March 2007, we have studied the Maud Island population to document aspects of the diet (Ortiz-Catedral and Brunton 2009), breeding biology (Ortiz-Catedral, Kearvell et al. 2010) and behaviour (Ortiz-Catedral 2009) of Malherbe's parakeets on an insular environment. Also, with the aim of assessing the relative value of Maud Island for the conservation of Malherbe's parakeets, we have conducted surveys to estimate the current population size of the species at this site.

Maud Island (41° 1' 28" S, 173° 53' 19" E) is a hilly 296 ha offshore island in the Marlborough Sounds, in the South Island of New Zealand. It is classified as a Scientific Reserve and managed by the New Zealand Department of Conservation. The island has four major habitats: regenerating scrub (74%), broadleaf mature coastal forest (16%), *Pinus radiata* plantations (6%) and grasslands (4%). A track network 16 km long crosses all habitat types and facilitates access to most sites on the island.

ACTION

The New Zealand Department of Conservation released captive-bred Malherbe's parakeets onto Maud Island on eight occasions, each comprising flocks ranging in size from three to fourteen individuals. From March 2007 up to May 2009, 68 individuals were released, each of known sex and age, and with a unique ring combination consisting of one metal and two colour plastic rings (Table 1). Further to these releases, we have evidence of three individuals fledging within the first trimester of our study (Ortiz-Catedral, Kearvell et al. 2010).

Monitoring: Two teams (two observers each) walked the entire track network on Maud Island once every three months. Surveys were restricted to one day every trimester, priority being given to locating nesting sites for Malherbe's parakeets from the onset of our study (Ortiz-Catedral, Kearvell et al. 2010). Each team covered a different path to avoid overlapping of records. Whenever a parakeet was seen or heard, attempts were made to clearly determine whether it was a ringed individual. The unique ring combinations were then registered. On Maud Island, Malherbe's parakeets are inquisitive and frequently

Table 1. Summary of releases of Malherbe's parakeets on Maud Island, New Zealand

Date	Individuals released	Age (months)*	Sex male/female)
7/03/07	11	3.91	3/8
25/05/07	3	14.76	4/0
25/10/07	4	3.82	2/2
19/12/07	11	3.2	5/6
21/02/07	14	2.49	7/7
14/01/09	10	1.8	5/5
31/03/09	9	3.63	3/6
14/05/09	6	9.29	5/1
Total	68	5.36	33/35

*Average for release flock

approached observers. In two instances, they even attempted to land on the observer while the observers were taking notes (Ortiz-Catedral 2009). Such behaviour facilitated registering of ring combinations.

For our population estimate, we only considered records of individuals clearly identified as ringed or un-ringed within 20 m of observers. We therefore excluded all records of parakeets flying overhead, the occasional flock seen at a distance, or the occasional parakeet seen perching in the canopy of coastal forest, as these records consisted of only 3.6% of all sightings (total sightings of ringed + un-ringed parakeets $n = 221$; sightings of flocks + unidentified $n = 8$). Taking into account the behaviour of parakeets, we used a modified method of the capture-mark-resighting method developed by Hoeck and Biebach (Hoeck 2010) and currently used to estimate population size of the Floreana Mockingbird (*Mimus trifasciatus*) a species that, like Malherbe's parakeets often approaches observers in the field. In this method, the population size of a species in a given area (N) is calculated as $N = (M * C) / R$ where M is the known number of ringed individuals alive; C is the total number of all ringed plus un-ringed individuals registered during a given sampling session and R is the number of resighted ringed individuals (Hoeck 2010). We assumed that during our survey period a survival rate of 72% between trimesters applied. Our estimate is based on a three-month survival rate study

of 20 Malherbe's parakeets fitted with radio-transmitters (unpublished). A study of translocated captive-bred Puaihoi (*Myadestes palmeri*) reports an estimate of 75% survival to 80 days post-release in Hawaii (Tweed, Foster et al. 2006), thus we consider our estimate as a good reflection of demographic dynamics of captive-bred, reintroduced birds into insular systems. For Red-fronted parakeets (*Cyanoramphus novaezelandiae*), a post-translocation survival estimate of 55% and 42% at 30 and 60 days post-release has been reported (Ortiz-Catedral and Brunton 2010). We included these lower survival values as a conservative estimate of lower vs. maximum population size of Malherbe's parakeets on Maud Island.

CONSEQUENCES

Population increase: During our survey period (March 2007-May 2009) we recorded 221 sightings of Malherbe's parakeets on Maud Island: 164 re-sightings of ringed birds and 49 of un-ringed individuals plus 8 unidentified. Taking into account these figures, our survey data indicates that during our study period, Malherbe's parakeets on Maud Island have gone from 11 individuals alive in the first trimester after release to a maximum of 97 individuals by the end of our study assuming 28% mortality between trimesters. When we calculated population size using a higher mortality rate of 45 and 58 respectively, we obtained an estimated 126 and 96 individuals respectively, by the end of our field study.

Discussion and conclusions: Our study on Maud Island represents the first documented attempt to estimate the population size of an insular population of Malherbe's parakeets. Our population estimate suggests that Maud Island has become a significant stronghold for this critically endangered species as it represents between 19.2–42% of the 300-500 extant Malherbe's parakeets globally, considering the lowest and highest survival estimates in the field. Clearly, estimates of population sizes on the other two island populations established via translocation (Chalky and Tuhua Islands) would be necessary to adjust these figures. Also, an updated population estimate of the remnant population in the wild is necessary.

Malherbe's parakeets are known to reach sexual maturity within months of fledging, use various nesting sites (Ortiz-Catedral, Kearvell et al. 2010) and raise more than one brood

apparently in synchrony with masting events of seeding plants (Forshaw 1989; Higgins 1999). These characteristics are shared with the closely related Red-fronted parakeet (Boon, Kearvell et al. 2000) which, on offshore islands lacking introduced predators, exhibits high productivity (Ortiz-Catedral and Brunton 2008 & 2009). Our finding of population increase and an increase in the proportion of un-ringed records of Malherbe's parakeets on Maud Island, together with the above cited aspects of its reproductive biology, suggest that captive-bred translocation is an effective conservation method for increasing the global population size of this species. Our survey for Malherbe's parakeets on Maud Island represents a starting point to implement monitoring programs for New Zealand parakeets managed via translocation. Attempts to determine population sizes for the other populations of Malherbe's parakeets need to be conducted in the foreseeable future to assess the present status of the species and review its IUCN threat-category classification.

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