Notornis, 2012, Vol. 59: 148-152
0029-4470

Habitat use by the critically endangered orange-fronted parakeet (*Cyanoramphus malherbi*) on Maud Island: its relevance for future translocations

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Abstract: Orange-fronted parakeets (*Cyanoramphus malherbi*) are New Zealand's rarest parakeet species with a global population of less than 500 individuals on remnant mainland populations and reintroduced populations on offshore islands. Since there is limited information about habitat preferences by this species on offshore islands I characterised habitat use on Maud Island, where captive-bred parakeets were introduced in 2007. I compared the vegetation characteristics of 29 plots (each 25 m^2) where parakeets were encountered and 23 plots randomly selected. Parakeets were observed foraging in 96.6% of the plots. Plots used by parakeets showed significantly higher density of stems under 20 cm dbh and a higher canopy than random plots. Used plots also tended to have greater canopy cover and lower understory and ground vegetation covers. These results indicate that orange-fronted parakeets use ecotones of broadleaf coastal forest-manuka scrub, and pine plantations-manuka scrub for foraging highlighting the potential value of islands with mixed patches of these vegetation types as future refuges for this critically endangered species.

Ortiz-Catedral, L. 2012. Habitat use by the critically endangered orange-fronted parakeet (*Cyanoramphus malherbi*) on Maud Island: its relevance for future translocations. *Notornis 59 (3&4):* 148-152.

Keywords bird conservation; reintroduction; endangered species; orange-fronted parakeet; habitat use

INTRODUCTION

The role of introduced predators as drivers of extinction among New Zealand forest birds is widely acknowledged (O'Donnell 1996; Wilson *et al*. 1998). The use of offshore islands that are free of introduced predators as translocation sites for the conservation of endangered species has led to the recovery of a number of species including saddleback (*Philesturnus carunculatus*) (Hooson & Jamieson 2003), kakapo (*Strigops habroptilus*) (Lloyd & Powlesland 1994), and New Zealand robins (*Petroica australis*) (Dimond & Armstrong 2007). In many cases, remnant natural populations have been used as source populations for translocations (Boessenkool *et al*. 2007; Leech *et al*. 2007; Ortiz-Catedral & Brunton 2010). However, species bred in captivity such as the orange-fronted parakeet (also known as "Malherbe's parakeet"; *Cyanoramphus malherbi*) have also been released onto managed islands for conservation purposes (Gaze & Cash 2008; Ortiz-Catedral *et al*. 2010a).

Currently, orange-fronted parakeets are thought to number less than 500 individuals in the wild (www.birdlife.org). Since 2005, captive-bred orange-fronted parakeets have been reintroduced to Chalky

Received 12 Aug 2011; accepted 16 Oct 2012
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and Maud Is (Hirschfeld 2008) and Tuhua I in the Bay of plenty (J. Kearvell, *pers. comm*.). Although successful breeding has been confirmed at these 3 sites, little information exists about the ecology of the species on small offshore islands. Information about the habitat use of managed species, coupled with demographic data are the basis to estimate carrying capacity of translocation sites (Baber & Craig 2003) and the long-term viability of managed populations (Armstrong & Ewen 2002). Lastly, such information is paramount to identify further release sites where captive-bred individuals could be transferred to expand the range of endangered species (Snyder *et al*. 1987).

The basic ecology of the orange-fronted parakeet remains largely unknown due in part to its rarity but also to the secretive habits of the species. One standing question is: to what degree do reintroduced orange-fronted parakeets make use of the available habitat on offshore islands? On mainland New Zealand, the species forages extensively on beech (*Nothofagus*) forests and nests in tree-cavities (Kearvell 2002; Kearvell *et al*. 2002). In contrast, research on Maud I has shown that captive-bred orange-fronted parakeets forage on native and introduced vegetation and nest in holes in the ground as well as in tree-hollows and the stems of *Cyathea* ferns, suggesting a high degree of behavioural flexibility of captive animals when released into a novel habitat (Ortiz-Catedral & Brunton 2009; Ortiz-Catedral *et al*. 2010b). During ongoing research on Maud I, I recorded observations on the characteristics of habitat used by orange-fronted parakeets and present the results here.

METHODS

Between Oct 2008 and May 2010, I conducted observations of orange-fronted parakeets along the track network of Maud I as well as accessible coastal areas during low tide. Each time a parakeet was spotted, I recorded its activity such as perching, calling or foraging. I also identified the plant species on which the bird was perching. Further, I recorded the band combination as all individuals had unique combinations of colour and metal bands at the time of release (Ortiz-Catedral *et al*. 2010b), facilitating the identification of individuals. For unbanded parakeets, I recorded distinguishing features of the crown and whenever possible, took photographs for later identification. I use the size and shape of the crown routinely to identify nesting orange-fronted parakeets. Unbanded parakeets plots constituted 20 % of the data (i.e. 6 sightings). Further, two of these sightings were done simultaneously from a vantage point. After the parakeet(s) left the area, I tagged the tree with flagging tape and recorded its position using a GPS. Using the marked tree as the centre, a 25 m^2 plot was marked, and within each of these 'parakeet plots' (n = 29), I recorded the following habitat variables after Rayner *et al*. (2007): cover of the canopy, understory and ground in one of 4 categories (1: 0-25%; 2: 26-50%; 3: 51-75; 4: 76-100%); number of stems with a diameter at breast height (dbh) > 20 cm; number of stems with a diameter at breast height (dbh) < 20 cm; height in meters of the tallest tree/shrub within the plot and direction from the centre of the plot using a compass held at the centre of the plot. Sometimes, the parakeet(s) would return near the plot while I took measurements of vegetation. To avoid biases as a result of potentially resampling the same individuals, only the features of one plot per parakeet were recorded. To assess the features of the habitat selected by the parakeets, 'random plots' (n = 23) were selected and the same habitat characteristics measured. The randomly selected plots were chosen using a table of random numbers for a list of 250 accessible points established along the entire track system across all vegetation types. To avoid the effect of measuring characteristics of the edge of the tracks, the random plots were located 20 m away from the track. Whether the plot was uphill or downhill was selected by tossing a coin. I restricted the measuring of vegetation features to a 40 m band either side of tracks instead of using randomly generated coordinates. This was done because large sections of Maud I are core habitat for the critically endangered Maud Island frog (*Leiopelma pakeka*) and takahe (*Porphyrio mantelli*). However, restricting sampling to accessible sites along the tracks was deemed appropriate as this area includes all vegetation types found on the island. Only 3 parakeet plots were measured within coastal forest habitat (47 ha), which constitutes only 16% of the habitat present on Maud Island.

Statistical analyses

I used Fisher's exact test to determine the relationship between the presence of parakeets in a plot versus the predefined categories of canopy, understory and ground cover. Differences in mean number of stems under or above 20 cm, height of the tallest tree within the plot. Statistical analysis was performed in SAS Version 8© and StatView Version 5.01.

RESULTS

Within parakeet plots, in all (n = 29) but one instance parakeets were observed foraging (96.5%). The only exception was a parakeet calling but not foraging while perching. Parakeet plots had higher frequencies of the highest category of canopy cover (76-100%) than random plots (18 *vs* 4, respectively; Fisher's exact test $P = 0.005$, n = 52). In contrast, the lowest category of understorey cover (0-25%) was significantly more frequent in parakeet plots than in random plots (17 *vs* 12, respectively; Fisher's exact test $P = 0.001$, n = 52). Lastly, parakeet plots had 0-25% ground cover significantly more frequently than random plots (26 *vs* 12) (Fisher's exact test $P = 0.003$, n = 52).

Parakeet plots showed no significant difference in density of stems with a dbh > 20 cm (mean random plots = 0.13; mean parakeet plots = 0.31; *t-test* -1.18, $P = 0.24$). However, the mean density of stems with dbh < 20 cm was significantly higher in parakeet plots than in random plots (mean random plots = 19.0; mean parakeet = 34.5; *t-test* -2.84, $P = 0.006$). The mean height of the highest tree within parakeet plots was significantly higher than that of random plots (mean random plots = 3.6 m; mean parakeet plots = 6.2 m; *t-test* -2.55, $P = 0.01$). Most parakeet plots ($n = 22$) were located in regenerating scrub of manuka (*Leptospermum scoparium*) and manuka (*Kunzea ericoides*). Four in radiata pine (*Pinus radiata*) plantations and 3 in coastal forest dominated by Nikau (*Rhopalostilis sapida*), kohekohe (*Disoxylum spectabile),* titoki (*Alectryon excelsus),* kawakawa (*Macropiper excelsum)* and mahoe (*Melycitus ramiflorus*). Of random plots, 19 were found in regenerating scrub, 2 in radiata pine plantations and 2 in coastal forest.

DISCUSSION

Captive breeding has been identified as one successful tool to halt the extinction of bird species around the world (Butchart *et al*. 2006). A number of studies overseas have documented the biology of captive-bred birds following translocation to island environments, mostly in Hawaii (Collazo *et al*. 2003; Tweed *et al*. 2006; Reynolds *et al*. 2008). In New Zealand, there is a solid body of theoretical and practical knowledge about the biology of translocated wild-bred birds to islands (Armstrong *et al*. 1999; Armstrong *et al*. 2002; Taylor *et al*. 2005; Leech *et al*. 2007; Taylor & Jamieson 2007). However, the study of captive-bred birds following translocation for conservation around the country is less extensive (Berry 1998; VanHeezik *et al*. 2009; Ortiz-Catedral *et al*. 2010a; Ortiz-Catedral *et al*. 2010b). Parallel to the growing list of captive management plans for New Zealand endemics (Dilks 1993; West *et al*. 1995; Pullar 1996; Reed 1998; Dumbell 2000; Blanchard 2002), field-based research on already established populations of captive-bred species is necessary as it can provide valuable data to inform and maximise the conservation outcomes of such plans.

In my study, parakeets were recorded in areas of forest with a greater frequency of high canopy cover, low understory and low ground cover, suggesting an active use of ecotones of the habitat types on Maud I. Although the random plots showed significant structural differences from plots used by parakeets (i.e., lower frequency of high canopy cover, low understory and low ground cover), and no parakeets were recorded at the time of sampling, it is possible that these would become used as the density of parakeet increases. Future studies should focus on the potential progressive use of areas as the numbers of parakeets on the island increase. Although further observations would be valuable, the findings of this study highlight the value of regenerating vegetation as potential habitat for captive-bred and re-introduced orange-fronted parakeets. Coupled with previous information on the diversity of nesting sites used by the species at the same site (Ortiz-Catedral *et al*. 2010a) and opportunistic observations on its diet (Ortiz-Catedral & Brunton 2009), this study indicates that Maud I has a greater potential as a stronghold for orange-fronted parakeets than previously thought. During the initial releases of the species, it was assumed that the remnants of mature coastal forest on the island would be the core habitat used by parakeets (J. Kearvell, *pers. comm.*). While the extent of use of mature forest was not determined during this study owing to concerns about disturbance to other critically endangered species (see methods) it is clear that orange-fronted parakeets were not restricted to this habitat. To date, only captive-bred orange-fronted parakeets have been used for reintroductions to Chalky, Maud and Tuhua Is. Future studies should ideally assess the potential of these sites as sources for future translocations to extend the geographic distribution of the species and its global population size.

ACKNOWLEDGEMENTS

Thanks to Andy Grant, Peter Gaze, Mike Aviss, Simon Elkington, Jackie van Hal, Carol Knight and Jonathan Kearvell from the Department of Conservation for supporting this research and for facilitating the permitting process. I am also thankful to the numerous volunteers who helped in the field. This project was funded by: J. S. Watson Conservation Trust of the Royal Forest and Bird Protection Society of New Zealand, Department of Conservation New Zealand, Massey University and the Mohamed bin Zayed Species Conservation Fund. All field research was conducted entirely under full ethical and methodological approval (DOC Permit NM 20767-RES). Part of this research was conducted during my PhD studies and was financed by the National Council of Science and Technology of Mexico (CONACYT) and Massey University Vice-Chancellor's Scholarship.

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