Biological Conservation 147 (2012) 79–86

Contents lists available at SciVerse ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Factors affecting post-release dispersal, mortality, and territory settlement of endangered kokako translocated from two distinct song neighborhoods

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ARTICLE INFO

Article history:
Received 24 June 2011
Received in revised form 13 November 2011
Accepted 27 November 2011
Available online 20 January 2012

Keywords:
Callaeas wilsoni
Dispersal
Habitat
Mortality
North Island kokako
Song
Translocation

ABSTRACT

Animal translocation success rate is generally low, with the causes of failure poorly understood without comprehensive and protracted monitoring. Here we examine the outcome of a translocation of endangered North Island kokako (*Callaeas wilsoni*) from two adjacent song neighborhoods in New Zealand, each with individual vocal traditions (c. 75% of phrases unshared) to a single release site. We conducted detailed radio-telemetry to monitor post-release dispersal over 50 days during four serial releases of 20 birds while we broadcast neighborhood-specific song around the release site. The birds moved substantial distances after release, however overall short-term release site dispersal was not as great as predicted by a random walk model, suggesting an attraction to playback and/or a reluctance to explore areas away from the release site. This apparent attraction was not specific to a given song neighborhood, however. Although the post-release mortality rate (22% over 31 days) was relatively high in this translocation, we did not detect an effect of sex, age, source origin, or duration of captivity on mortality. We show that habitat use during this acclimation period was disproportionate to availability – the birds' preferred habitat was similar to that at the capture site. At least four pairs formed, with two and three confirmed breeding in the first and second seasons post-release respectively. Mate choice was non-assortative with respect to song neighborhood, revealing that reduced phrase sharing rates found in adjoining neighborhoods are not a barrier to pair formation. We compare this example with other kokako translocations and make recommendations for future translocations.

1. Introduction

Animal translocations, defined as the "deliberate and mediated movements of wild individuals or populations from one part of their range to another" (IUCN, 1996), are an important wildlife management tool frequently used for biological conservation (Fischer and Lindenmayer, 2000; Griffith et al., 1989). Although some translocations, particularly in New Zealand, have met with spectacular success (e.g. Butler and Merton, 1992; Ortiz-Catedral and Brunton, 2010) it is generally acknowledged that translocation success rate is often low (Dodd et al., 1991; Griffith et al., 1989; Letty et al., 2007; but see Parker, 2008). While the causes of past translocation failures are at times poorly understood (Fischer and Lindenmayer, 2000), current research is enhancing our understanding of translocation science by detailed and prolonged monitoring of translocated animals, with the aim of improving future success rates (Devineau et al., 2011; Hamilton et al., 2010).

While the ultimate goal of an animal translocation is to establish a self-sustaining population, it is vital to examine behavioral responses immediately following release into an unfamiliar environment as these affect longer-term population processes such as breeding success and survival (Armstrong et al., 1999; Armstrong and Seddon, 2008; Dickens et al., 2010; Tweed et al., 2003). Tracking post-release movement (hereafter referred to as 'dispersal') is particularly crucial because knowing where animals go, which habitats they use or avoid, which conspecifics they settle near, and with whom they ultimately form social bonds will allow us to improve the success of future translocations (Sutherland et al., 2010; Tweed et al., 2003). Managers also need information on which individuals survive and which die, when they die, the potential causes of mortality, and ultimately which animals contribute most to establishing a successful population.

Animals are subjected to numerous physical and behavioral challenges during translocation (Letty et al., 2007). For example, there is a risk of injury during capture and handling, both in enclosures at the source and release sites, and in containers during

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doi:10.1016/j.biocon.2011.11.019

transportation. Individuals are sometimes held in captivity at the source site while others are captured, and held again at the release site to acclimatize them before release, all of which may compound stress (Dickens et al., 2010). Once released, animals are faced with an unfamiliar environment with potentially unfamiliar conspecifics, and in which they must find food and avoid predation. Examining how animals cope with these overlapping challenges is important for optimizing future translocation protocols (Dickens et al., 2010; Teixeira et al., 2007).

This study concerns the translocation of endangered North Island kokako (*Callaeas wilsoni*), a large (230 g) songbird endemic to New Zealand (Heather and Robertson, 1997; IUCN, 2010). Due to their conservation status, several re-introductions of kokako have been attempted (reviewed in Molles et al., 2008), either to create 'insurance' populations and thereby preserve genotypic heritage (e.g. Brown et al., 2004), increase genetic diversity in small, inbred populations (Hazel Speed, Department of Conservation, personal communication), or return kokako to their former range (e.g. Molles et al., 2008). In cases where kokako have been successfully translocated to islands, or isolated forest blocks embedded within farmland, post-release dispersal opportunities were restricted, essentially confining the birds to the intended area. However, where kokako have been translocated to mainland sites within a matrix of suitable habitat, some birds have wandered widely, resulting in the loss of potential founders. To mitigate this problem, playback of conspecific vocalizations to "acoustically anchor" kokako has been attempted with some promising preliminary results (Molles et al., 2008). When kokako have been sourced from multiple sites, assortative pair-formation with respect to source site has been documented (Brown et al., 2004; Rowe and Bell, 2007), suggesting that vocal variation resulted in social discrimination. How song variants affect where birds disperse to, with whom they form partnerships, or where birds establish territories are important questions, the answers to which will inform and improve future translocations.

From August to October 2009, kokako from distinct song neighborhoods in Te Urewera National Park were translocated to Whirinaki Forest, 53 km to the southwest, to establish a new population. This time period was chosen primarily as it coincides with high food availability and yet is sufficiently prior to breeding. We used the opportunity of this translocation to examine post-translocation movements of 20 kokako (10 from each neighborhood) while we broadcast songs representative of each group from multiple speakers near the release location. With the aim of improving the success of future translocations, we examined: (1) dispersal and mortality immediately following translocation in relation to sex, age, and holding time in captivity; (2) movements in relation to conspecific song playback representative of the two neighborhoods (based on the hypothesis that birds will be attracted to conspecific songs, we predicted that dispersal movements away from the release site would be lower than expected by a random dispersal model; further, if birds are attracted specifically to local songs, we predicted that birds would tend to associate with speakers broadcasting songs recorded from their own neighborhood); (3) habitat associations relative to source site habitat both during dispersal and once final territories were established (if kokako exhibit a rigid preference for their natal habitat type, we predicted that they would occupy those habitats with the greatest similarity to their catch site); and (4) pairing success with respect to the origin of the birds, timing of release, and dispersal parameters. As assortative mating with regard to natal song dialect has been shown to occur in this species (Rowe and Bell, 2007), we also predicted that adults would pair assortatively with respect to song neighborhood. We use our findings to develop recommendations that will aid managers in improving the success of future translocations.

2. Methods

2.1. Capture and release sites

The New Zealand Department of Conservation (DOC) captured for translocation 20 kokako from within contiguous native forest (permit number DOCDM-185320). Birds were captured from two adjacent areas in the vicinity of the Otamatuna Hut (eight males, two females) and Te Mapou Hut (three males, seven females), Te Urewera National Park, New Zealand (lat. 38°20′S, long. 177°9′E; Table 1) using local song playback. The two capture areas are separated by a wide, deep valley and individual capture sites were generally on ridges within those areas (Fig. 1a). All birds were weighed, measured, banded, and fitted with radio transmitters (model: PD-2, Holohil Systems Ltd., Carp, ON, Canada) attached using a modified Rappole Harness (Rappole and Tipton, 1991). At capture, feather samples were taken from all birds for sexing, and blood, fecal, and cloacal samples from six birds in each neighborhood were collected for disease screening. Birds were held in individual aviaries close to the catch site for a maximum of 10 days ($\bar{X} = 4.25$, SE = 0.55, $N = 20$; for husbandry details, see King, 2010). In two cases, a male and a female, presumably members of the same pair, were caught at the same net site and were therefore held in the same aviary. Once either the maximum holding period was reached or the aviary contained eight individuals, the birds were transported by helicopter, and then by car, to the release site; there the birds were housed in an aviary overnight, provided with water and food, and released passively at dawn the following morning. As introduced mammalian predators such as brushtail possums (*Trichosurus vulpecula*) and ship rats (*Rattus rattus*) have been identified as the leading cause of nesting failure in kokako (Innes and Flux, 1999; Innes and Hay, 1995; Innes et al., 1999), a release site was chosen within a 1000 ha core area in Whirinaki Forest Park (lat. 38°65′S, long. 176°41′E; Fig. 1b) where predator numbers were controlled with trapping and/or ground-based poison prior to, and following release.

Table 1
Kokako translocated to Whirinaki Forest Park, New Zealand, days in 657 captivity, and the expected and observed probabilities of within neighborhood pair formation following release. P-values are 1-tailed and determined by Fisher's exact tests.

Capture-site neighborhood	Sex	Age	No. of birds released	No. of birds available to pair	Days held in captivity		Assortative pairing		
					Range	Average	P(exp.)	P(obs.)	P
Otamatuna	Male	Adult	5	5	2–7	4.20	0.29	0.33	0.71
		Sub adult	3	0	3–10	7.00	–	–	–
	Female	Adult	2	2	2–7	4.50	0.83	0.67	0.86
		Sub adult	0	0	–	–	–	–	–
Te Mapou	Male	Adult	3	1	1–5	2.67	0.71	1.00	0.75
		Sub adult	0	0	–	–	–	–	–
	Female	Adult	7	5	1–8	3.71	0.17	0.00	0.58
		Sub adult	0	0	–	–	–	–	–