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Survival and habitat use in translocated and resident greater prairie-chickens

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ABSTRACT

Translocation, or the purposeful movement of organisms from one location to another for conservation, is currently being used to bolster populations of the endangered greater prairie-chicken (*Tympanuchus cupido*). We used radiotelemetry to compare survival between 58 resident birds and 54 newly translocated greater prairie-chickens that were sourced from a location more than 325 km away. Model averaged survival estimates were lower in translocated birds (0.42; 95% CI: 0.17–0.66) than in resident prairie-chickens (0.65; 95% CI: 0.46–0.79) through the breeding season. Habitat, sex and year were each included in at least 1 of the top 4 models, but the model averaged confidence intervals for each parameter encompassed zero. Survival of both resident and translocated prairie-chickens increased throughout the breeding season. Both translocated and resident prairie-chickens selected for core prairie habitat over agriculture, and birds tended to avoid surrounding private grasslands and wooded areas. We suggest that future translocation projects account for reduced survival of translocated birds when determining the appropriate release cohort sizes and sex ratios. We also recommend that future management for greater prairie-chicken habitat focus on the expansion of core protected patches of prairie to promote elevated survival and better chances of conservation success.

Introduction

Translocation, or the movement of individuals from one area to another with the intent of bolstering or establishing wild populations, has served as a conservation tool for more than 100 years (International Union for Conservation of Nature [IUCN] 1987; Kleiman 1989). However, many early translocation projects were poorly documented, and thus few provided information for future programs (Seddon et al. 2007). A growing body of literature about translocation is emerging (Ewen et al. 2012) but many studies consist of qualitative and retrospective analyses (Seddon et al. 2007). As a result, few examples of science-based frameworks are available to facilitate the effective use of translocation as a conservation tool (Kaler et al. 2010; Terhune et al. 2010; Stephenson et al. 2011; Kesler et al. 2012). Without research-based guidelines, future translocations will likely gamble valuable resources and endangered and declining species.

The greater prairie-chicken (*Tympanuchus cupido*) is a grouse native to mid-continent grassland habitats in North America, and populations have declined precipitously from historical numbers (Svedarsky et al. 2000). Translocation has been used to supplement populations in areas with severe declines, and the history of greater prairie-chicken translocation projects reflects the difficulties that many conservation programs have faced due to a limited base of knowledge in translocation biology. In the United States, at least 26 attempts have been made to translocate greater prairie-chickens since 1950 (Toepfer et al. 1990; Mechlin et al. 1999; Snyder et al. 1999). Similar to translocations of other taxa (Griffith et al. 1989; Wolf et al. 1996), few greater prairie-chicken projects were successful at establishing self-sustaining populations (Kruse 1973; Toepfer et al. 1990) and few left documentation about why failures occurred (Snyder et al. 1999). Consequently, basic data are missing about project duration, release methods, release site selection, season of release, and numbers of birds released. These data are needed to identify successful methodologies to improve future translocation projects (Snyder et al. 1999).

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Many translocation projects involving grouse (Kurzejeski and Root 1988; Toepfer 1988; Musil et al. 1993; Kaler et al. 2010) and other taxa (Wilson et al. 1992; McKinstry and Anderson 2002) have documented periods of reduced survival immediately following release. Unfamiliarity with the landscape (Farina and Belgrano 2004), high levels of predation, and poor habitat quality have been proposed as causes of reduced survival in translocated individuals (Van Zant and Wooten 2003; Siano et al. 2006; Moorhouse et al. 2009; Tavecchia et al. 2009). Female survival is sometimes lower than male survival during grouse translocations (Kurzejeski and Root 1988; Toepfer 1988), a pattern that has been attributed to elevated reproductive costs (Svedarsky 1988; Thomson et al. 1998) and more frequent and longer female movements (Maxson 1977; Svedarsky 1988).

The greater prairie-chicken's decline in Missouri has been primarily due to the loss and fragmentation of >99% of the native tallgrass prairie habitat, and fragmentation of remnant prairie patches (Missouri Department of Conservation 1999). Habitat degradation, and the associated forces of habitat loss and fragmentation are primary factors driving the loss of biodiversity (Wilcox and Murphy 1985; Fahrig 1997; Battisti 2003; Lindenmayer and Fisher 2006). The degradation of grassland habitat has occurred rapidly during the last two centuries in North America and impacts were wide-spread throughout the mid-continent. Native grassland habitats (i.e., prairie) suitable for the prairie-chickens and other grassland obligate species once occurred on >6 million ha in Missouri (Christisen 1985), but today <36,437 ha of these grasslands remains and only 8907 ha are in public ownership (Missouri Department of Conservation 1999).

Current landscape management for greater prairie-chickens in Missouri emphasizes a core protected area model for Missouri's remaining grassland bird populations, which includes a core of high quality habitat surrounded by a buffer zone matrix of neutral and non-hostile habitats. Core protected area models and buffer zones are used for a range of conservation applications and they emphasize a large high quality core with surrounding areas of lower quality (e.g. UNESCO Man and Biosphere Reserves; Wells and Brandon 1993; UNESCO 1996; Ebregt and Greve 2000; Oliver and Giovanna 2008). In Missouri, the Partners in Flight Grassland Bird Conservation Area Model includes a core protected area and surrounding buffer zone, and it is used to guide prairie management (PIF model; Fitzgerald et al. 2000; Missouri Department of Conservation 2006). The design includes a landscape for greater prairie-chickens with a large block (≥800 ha) of high quality prairie habitat centered upon one or more leks. Matrix habitats (≥3200 ha) surrounding the core reserve are a mix of quality grassland (≥800 ha) and neutral habitats (e.g., agriculture). Additionally, the PIF model recommends that no more than 5% of the matrix be comprised of woody vegetation, which is considered hostile (Fitzgerald et al. 2000). Core protected area models are applied to prairies based on the rationale that the protected core areas, should promote higher survival and reproduction in prairie-chickens (e.g. Missouri Department of Conservation 2006). Further, the non-hostile surrounding matrix should ameliorate the negative effects of patch-size sensitivity (Fitzgerald et al. 2000; Johnson and Winter 2005) and provide additional land for lekking and mating display, predator escape, roosting, and forage (e.g., ecological patterning; Hamerstrom et al. 1957).

Although core protected area models provide a potentially useful guide for management planning, their utility and appropriateness for the grassland landscape remains unclear (Winter et al. 2001; Johnson and Winter 2005). Much of the research regarding patch size and edge effects, upon which the PIF model was based, was conducted in forested landscapes (Donavan et al. 1995). Results from studies on patch size and edge effects conducted in grassland landscapes vary widely, and suggest that overarching generalizations may be elusive because of interacting landscape characteristics, species, and habitats (Winter and Faaborg 1999; Winter et al. 2000, 2001; Johnson 2001; Johnson and Igl 2001).

When applied to greater prairie-chickens, core protected area models incorporate the concept that large patches of prairie habitat are critical (Christisen 1981; Burger 1988; Ryan et al. 1998; Fitzgerald et al. 2000), but uncertainty remains about the relationship between survival and the birds' use of matrix, or buffer zone habitats surrounding core areas. Whereas prairie-chickens have been recorded to use the patches of buffer agricultural and non-native grassland habitats for feeding, nesting, and brood rearing activities (Horak 1985; Ryan et al. 1998; Svedarsky et al. 2003; Matthews et al. 2011; McNew et al. 2012), the dangers of the fragmented nature of these habitats might be outweighing benefits. Fence lines and shelterbelts that serve as transit lanes for terrestrial predators (Winter et al. 2000) and provide hunting perches for avian predators are common in fragmented habitats (Bohall and Collopy 1984; Svedarsky and Van Amburg 1996; Wolff et al. 1999; Applegate et al. 2004). Further, predation by avian and mammalian predators, such as raptors and coyotes (*Canis latrans*), is often a leading cause of mortality for greater prairie-chickens in fragmented habitats (Burger 1988; Toepfer 1988; McNew et al. 2012).

Conservation managers are challenged by the lack of empirical information about survival of resident and translocated greater prairie-chickens and how habitats in a landscape with a core protected area and surrounding non-hostile matrix habitats affect the birds. To address these information gaps, we conducted a study of translocated and resident greater prairie-chickens in landscapes with large central reserves and surrounding matrices of hostile and non-hostile habitats in buffer zones. We tested for differences in survival between translocated and resident greater prairie-chickens, males and females, for differences in survival between core area habitats and buffer zone matrix habitats, and for differences in habitat selection. We anticipated that translocated birds would initially have lower survival than residents, because of the stress of release or unfamiliarity with the area of release (Kurzejeski and Root 1988; Toepfer 1988; Musil et al. 1993; Kaler et al. 2010; McKinstry and Anderson 2002). Further, we predicted that females would have lower survival than males because of greater reproductive costs or greater movement (Svedarsky 1988; Thomson et al. 1998; Kemink and Kesler 2013). Finally, we predicted that birds that entered buffer matrix areas (agriculture and primarily non-native grassland habitat patches) outside the protected core areas would exhibit reduced survival.

Study area

We conducted research between March and August in 2010 and 2011 in a core protected area landscape similar to that prescribed by the PIF model. Research was centered around Taberville Prairie (38°3′ N, 93°58′ E) and Wah'Kon-Tah Prairie (37°54′ N, 93°59′ E) within the Taberville and El Dorado prairie-chicken focus areas (Fig. 1). Both areas contained protected core prairie habitat that was managed and owned by the Missouri Department of Conservation and The Nature Conservancy (Taberville: 578 ha, El Dorado: 1213 ha). Management consisted of a spatio-temporal combination of herbicide treatments for invasive and exotic plants, prairie restoration (with locally collected seed), burning, grazing, and high mowing (L. Gilmore, Missouri Department of Conservation, personal communication). Habitat within the buffer matrix and broader landscape surrounding the core prairie habitats consisted of urban areas (5%), water (3%), agriculture (12%), grassland (50%), and woodland (30%). Matrix habitat was under a variety of management prescriptions that included row and forage crops, idle

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