SPACE USE, MOVEMENTS, AND HABITAT SELECTION OF TRANSLOCATED EASTERN WILD TURKEYS IN NORTHWESTERN LOUISIANA

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Abstract: Translocations have successfully restored wild turkey (*Meleagris gallopavo*) populations across the United States, but some translocations have failed to establish sustainable, local populations. Understanding how translocated wild turkeys move across a landscape and select habitat immediately after translocation should enable biologists to refine restoration methods. Therefore, we assessed movements and habitat selection for the first 90 days following translocation for 12 eastern wild turkeys (*M. g. silvestris*; hereafter, turkeys) in northwestern Louisiana, based on 3 daily GPS locations for each turkey. We found that translocated turkeys behaved differently than would be expected of resident turkeys. Turkeys exhibited greater movements and range size, but similar habitat selection and distances between roost sites, when compared to resident turkeys from comparable regions. Turkeys also tended to move away from their release site throughout our study, and were 5,769 ± 1,047 m (mean ± standard error) from their release site by day 90. Large range size and movements within suitable habitat, coupled with moving away from release sites, suggests translocated turkeys may not have behaved optimally as they familiarized to their new environment, forcing them to maintain larger areas and increase movements. Because successful restocking events rely on quick establishment around release sites to minimize risky behaviors, a closer examination of behavior and factors affecting temporal periods needed for site-familiarity, particularly of female turkeys, seems warranted.

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To expedite expansion of wildlife populations, biologists have often relied on translocations. In hard-release translocations (hereafter, translocations), animals are moved and released into a novel environment without prior experience or acclimation. Although simplicity of these translocations is attractive, they are often unsuccessful as a conservation technique (Dodd and Seigel 1991, Armstrong and Seddon 2008, Fontúrbel and Simonetti 2011). Translocated animals may experience greater mortality than resident animals due to an exploratory phase after translocation, in which larger activity ranges and extensive movements can result in greater predation and anthropogenic-induced deaths (Jones and Witham 1990, Reinert and Rupert 1999, Sullivan et al. 2004, Roe et al. 2010). Concurrent with lesser survival, animals often exhibit reduced fidelity to release sites, meaning they expend energy exploring areas with unknown levels of resources and risks of predation (Lewis 1995, Roe et al. 2010). Thus, effectiveness of translocations relies largely on animals maintaining small activity centers and movements around a predetermined suitable release site.

Wild turkey (*Meleagris gallopavo*) populations declined drastically between the late 1800s and into the early 1900s because of habitat loss and overhunting (Dickson 2001). Restoration efforts throughout the United States relied on translocation efforts from remnant wild turkey populations to hasten population recovery (Dickson 2001). Now successfully reintroduced into much of its native range, turkeys are found and hunted in every state except Alaska (Eriksen et al. 2015). Despite success in restoring turkey populations, some local populations have recently declined and some areas within the historical range are still unoccupied (Eriksen et al. 2015). For example, in some areas of eastern Texas and western Louisiana, populations of eastern wild turkeys (*M. g. silvestris*; hereafter turkey) are too small to be detected or turkeys are completely absent and translocations to reestablish turkeys in these areas still occur (Byrne et al. 2015*a*, Eriksen et al. 2015, Isabelle et al. 2015).

Although overall translocation success for turkeys is undeniable, some of these efforts continually fail to establish local populations (Kelly 2001, Feuerbacher et al. 2005, Isabelle et al. 2015). The reasons underlying these failures are unclear. Kelly (2001) suggested poor poult survival and nest success were primary drivers in east Texas, whereas Feuerbacher et al. (2005) suggested that great adult mortality coupled with lesser brood survival hindered successful population establishment (Boyd and Oglesby 1975, Swank et al. 1985, Whiting et al. 2005). However, relatively few studies to date have examined postrelease dispersal and exploratory behaviors of translocated turkeys (Little 1980, Little and Varland 1981, Hopkins et al. 1982, Miller et al. 1985, Isabelle 2010, Marable et al. 2012, Isabelle et al. 2015). Understanding how translocated turkeys move across a landscape and select habitat immediately after translocation should enable biologists to refine restoration efforts and may help identify why certain translocation efforts continue to be unsuccessful. Thus, our objective was to describe space use, movement patterns, fidelity to release site, and habitat selection of translocated turkeys in northwestern Louisiana.

STUDY AREA

Staff with the Louisiana Department of Wildlife and Fisheries captured turkeys in Jackson, Morehouse, Union, and Vernon parishes, Louisiana. Turkeys were released and monitored on and around 2 sites in Caddo Parish, located in northwestern Louisiana (Fig. 1). This study area (within 15 km of release sites) consisted of pine (*Pinus* spp.) forests (40%), developed areas (16%), bottomland hardwood drainages (11%), upland hardwoods (9%), and open areas such as pastures, cultivated fields, and oil and gas openings (8%) per the National Land Cover Dataset 2011 (NLCD; Jin et al. 2013). All of the study area was in private ownership. Prior to our study, 106 turkeys (69 females and 37 males) had been released on sites in Caddo Parish over the course of 6 translocations between 1978 and 1996, but those releases failed to produce a sustained turkey population.

METHODS

Staff with the Louisiana Department of Wildlife and Fisheries (LDWF) captured turkeys using rocket nets during January–February 2014 prior to releasing them in Caddo Parish. Once captured, LDWF staff attached 80-g MiniTrack Backpack GPS transmitters (Biotrack Limited, Wareham, Dorset, United Kingdom) to turkeys backpack-style using 3-mm shock cord (Wilson and Norman 1995). Transmitters measured approximately 7.5 cm by 2.5 cm and were capable of remotely downloading data. All units housed both GPS and VHF components, allowing LDWF staff to monitor turkeys for movement and survival. Transmitters were programmed by LDWF staff to record 3 GPS locations each day (0800, 1600, 2400 local time). Louisiana Department of Wildlife and Fisheries staff also fitted turkeys with aluminum rivet bands (National Band and Tag, Newport, Kentucky, USA) on their right tarsus. They estimated age (adult or juvenile) based on development and barring of 9th and 10th primary feathers (Pelham and Dickson 1992). Turkeys were placed in transport boxes, driven to the release sites, and immediately released within 1 to 3 hours of capture by LDWF staff.

Behavior of translocated animals can be categorized into distinct temporal phases following release (Berger-Tal et al. 2014). These phases are typically associated with exploratory behaviors, demonstrated through changes in range size, movement, and release-site fidelity (Berger-Tal et al. 2014, Berger-Tal and Saltz 2014). To describe our results, we visualized the data to identify shifts in these aforementioned metrics. We then attempted to describe behaviors within these different time periods and demonstrate extremity of behaviors. To describe

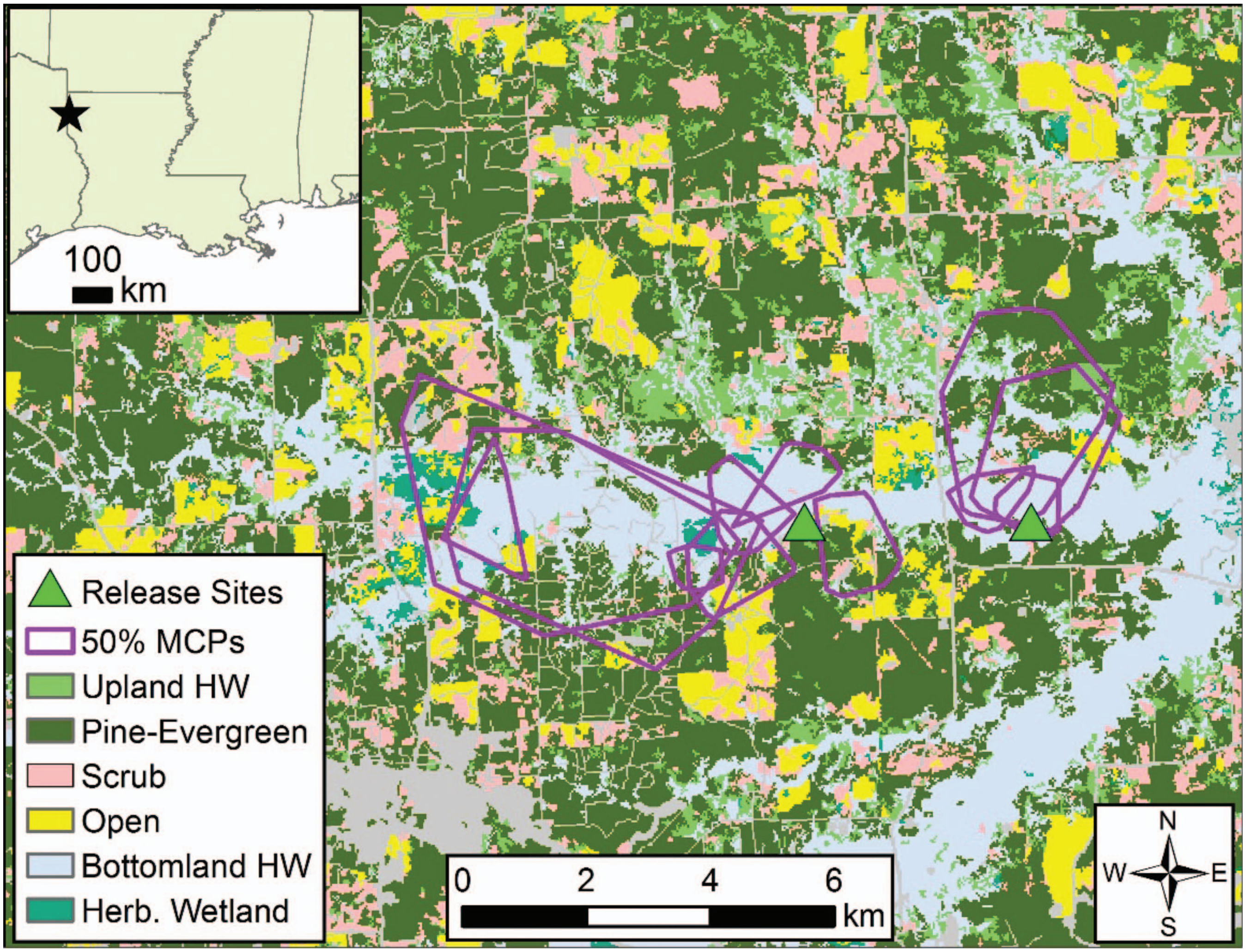

Figure 1. Study area in northwestern Louisiana as depicted with 2011 NLCD land cover types, where 12 (6 adult female, 3 juvenile female, 2 adult male, 1 juvenile male) eastern wild turkeys were translocated during January–February 2014. This study area (within 15 km of release sites) consisted of pine forests (40%), developed areas (16%), bottomland hardwood drainages (11%), upland hardwoods (9%), and open areas such as pastures, cultivated fields, and oil and gas openings (8%). Purple polygons represent 50% Minimum Convex Polygons (core areas) for each turkey's locations until 90 days after release. Grey areas indicate urban and water areas and were not considered important for turkeys.

turkey movements and space use immediately after translocation, we calculated a set of range size and movement statistics for each individual using a 15-day moving window analysis. Because we were interested in space use as turkeys shifted from exploratory to knowledge-based movements, we calculated a 50% (hereafter, core area) and 95% (hereafter, range) minimum convex polygon (MCPs; ha) for each turkey. To examine fidelity to release sites, we averaged distance (m) of the 3 GPS locations taken each day to each turkey's release site to calculate daily distance to their release site. To examine daily movements, we calculated mean distance (m) between the 3 GPS locations taken each day (hereafter, distance traveled). Lastly, because familiarity with suitable roost sites may be an important component of survival (Rumble 1992, Byrne et al. 2015*b*), we calculated average daily distance (m) between consecutive roost sites to determine if turkeys moved increasing distances to relocate known, suitable roost sites. For each metric, we computed a mean and standard error to statistically describe our sample.

We determined which habitat types turkeys selected during their initial exploratory movements after release. For each turkey, we estimated habitat availability by constructing a circular buffer around all of each turkey's locations, with the buffer distance equal to mean daily maximum distance each turkey travelled from its roost site. To assess habitat composition within our study area, we obtained land cover values from the 2011 NLCD (Jin et al. 2013). There has not been a formal accuracy assessment of the 2011 NLCD, although we believe it is reasonable to assume overall accuracy rates of 70% or greater, similar to that reported in an evaluation of the 2006 NLCD (Wickham et al. 2013). To simplify number of habitat types, we removed all urban and water classes, combined all agriculture and cultivated classes into an open class, and combined evergreen and mixed forest types into pine–evergreen. We subsequently compared habitat selection within core areas (used) to selection within circular buffers (available) for turkeys using selection ratios (Manley et al. 2003). We conducted all calculations of selection ratios and associated 95% confidence intervals using the R package adehabitatHR version 0.4.12 (Calenge 2006, R Development Core Team 2013).

RESULTS

We radiotagged and released 15 turkeys between 16 January and 6 February 2014. We excluded 3 turkeys that died within 14 days of release from our analyses, leaving 12 turkeys (6 adult female, 3 juvenile female, 2 adult male, 1 juvenile male), which we pooled for analyses because of small sample size. Based on visual inspection of the data, we decided to present results across 3 time periods: within the first 60 days, when movements and space use tended to be relatively stable; between day 60 and 80, when movements and space use trended largely upward; and after day 80, when movements and space use subsided and day-to-day variability decreased. For the first 60 days after translocation, range size averaged 626 ± 51 ha (mean ± SE). However, between days 60 and 80, mean range size increased by 453% (2,840 ± 135 ha), and peaked on day 74 at 4,170 ± 1,119 ha. Thereafter, range size decreased and stabilized (Fig. 2). Core area sizes showed similar trends, increasing by 784% between the first 60 days (102 ± 8 ha) and days 60 to 80 (799 ± 74 ha), peaking on day 69 at 1,300 ± 406 ha and decreasing thereafter (Fig. 2). Distances traveled gradually increased after release, peaking around day 69 with an average distance of 866 ± 83 m between each 8-hr fix (Fig. 2). After this peak, distances traveled gradually decreased to 550 ± 98 m by day 90. Similarly, distance between consecutive roosts peaked at 820 ± 73 m on day 69 and subsequently decreased to 530 ± 95 m by day 90 (Fig. 2).

Distance to release site generally increased throughout our study, with individuals being 5,769 ± 1,047 m from their release site by day 90 (Fig. 2). Turkeys selected for bottomland hardwood areas, avoiding open areas, pine–evergreen, scrub, and upland hardwoods (Fig. 3). Herbaceous wetlands were most selected on average, but this selection also was the most variable among individuals (Fig. 3).

DISCUSSION

We recognize that our results, and inferences made from them, are constrained because we were forced to pool data across age and gender due to a small sample size. Likewise, the end of our study period coincided with mid to late March, which is the beginning of the preincubation and nesting season for female turkeys at similar latitudes (e.g., Byrne and Chamberlain 2013), and was likely within the breeding period for some turkeys we monitored. Therefore, it is difficult to partition breeding behaviors, which may involve shifts in space use, from behaviors attributed solely to translocation. Hence, we developed inferences under these caveats.

Estimates in range size can vary based on telemetry technology used, calculation methods used, temporal period examined, biological phenomena, and habitat type and complexity. This, coupled with differences in gender and age composition of samples within studies, makes comparisons among studies difficult. Nonetheless, our translocated turkeys maintained larger ranges following release than resident turkeys from comparable regions. Our estimates for range size during the 20-day period from day 60 to 80, which increased approximately 453% and 784% compared to the mean of all previous days, and which coincided with the beginning of the breeding period, were considerably larger than reported for males and females during similar periods in Arkansas (Wigley et al. 1986, Thogmartin 2001), Louisiana (Smith et al. 1990), Mississippi (Godwin et al. 1996, Miller et al. 1997, Miller and Conner 2005), and Oklahoma (Stewart et al. 1998). These findings are similar to previous studies that noted larger range sizes for translocated turkeys relative to resident turkeys (Bowman et al. 1979, McMahon and Johnson 1980, McGuiness et al. 1990). For example, McGuiness et al. (1990) reported a mean spring home range size >2,000 ha for 18 translocated females. However, it is interesting to note that Isabelle et al. (2015) found 55 female turkeys translocated in east Texas to maintain spring and summer ranges similar to reports for resident turkeys within the southeastern United States.

We found that translocated turkeys tended to move farther distances than residents from comparable studies. For example, resident turkeys in Arkansas averaged only 438–552 m traveled daily (Thogmartin 2001), whereas turkeys in Louisiana traveled only 307–378 m daily (Smith et al. 1990). Although these studies used different telemetry techniques (VHF radiotelemetry) than our study, turkeys we monitored moved 300 m between 8-hour fixes, meaning they typically moved at least 900 m daily. Our estimates of daily distances moved are similar to translocated turkeys in Mississippi (Marable et al. 2012), in which great variability in distances moved across different release sites was also observed.

Although roosting behavior is poorly understood, roosts provide protection from inclement weather and predation (Rumble 1992, Swearingin et al. 2011), making familiarity with roost sites critical to turkey survival. Turkeys in our study had relatively short distances between consecutive roosts after translocation, although around day 60 these distances started trending upward, subsiding by day 90, and becoming similar to reports for resident turkeys during the reproductive season in South Carolina and Louisiana (Byrne et al. 2015*b*).

We found that translocated turkeys tended to select habitat similar to resident turkeys in comparable ecosystems during late winter and early spring (Palmer et al. 1996, Chamberlain and Leopold 1998, Miller et al. 1999, Miller and Conner 2007, Martin et al. 2012). Specifically, they selected for mature, bottomland hardwoods and herbaceous wetlands, while also moving away from release sites throughout the course of the study. Collectively, although translocated turkeys used similar habitat types to resident turkeys in comparable landscapes, they likely used it less optimally, as indicated by their large ranges, distances moved daily, and movement away from preselected, suitable habitat types at release sites.

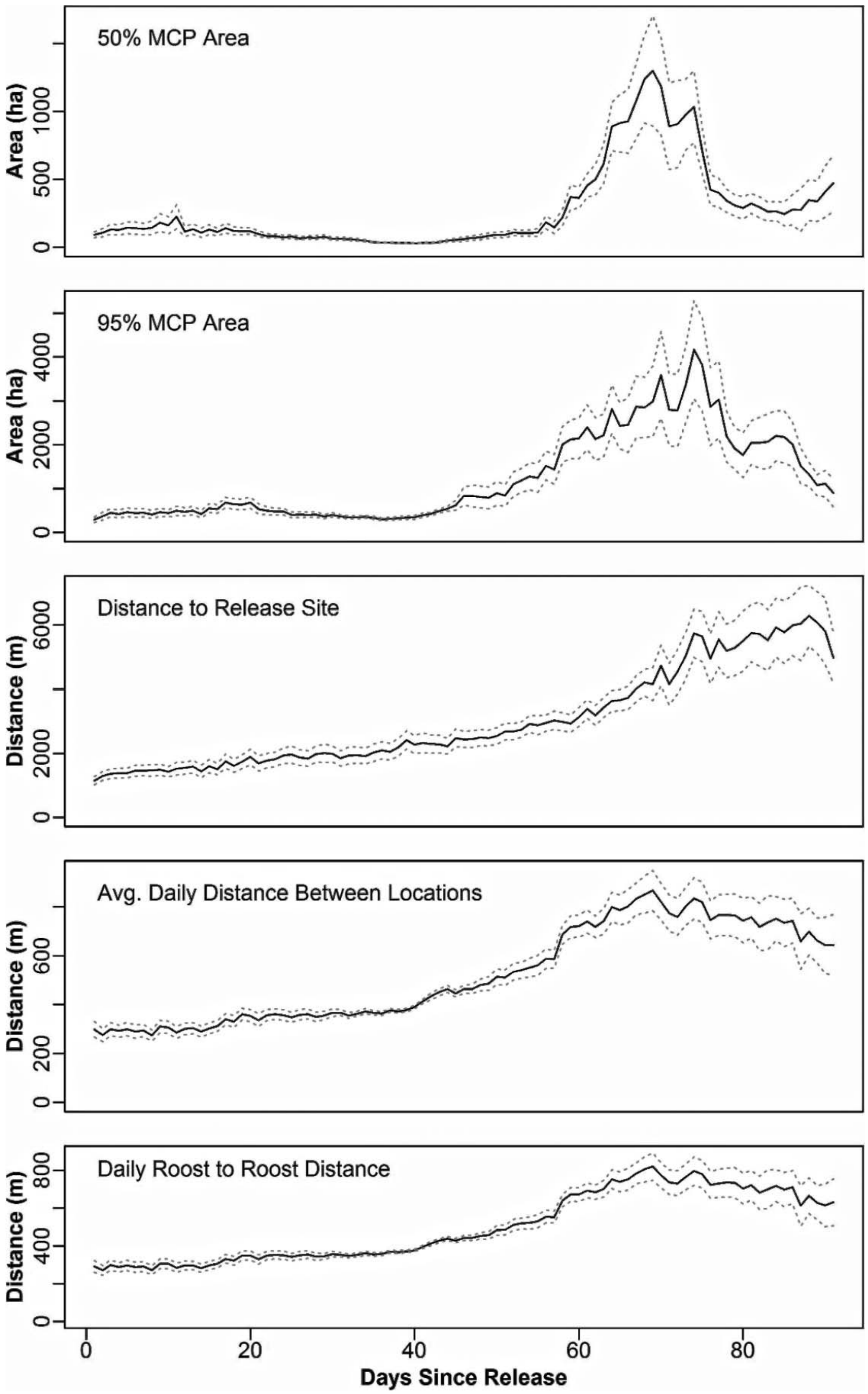

Figure 2. Metrics of daily movement (m; daily distance between locations, daily distance between consecutive roosts), space use (95% and 50% Minimum Convex Polygons [MCP]), and release site fidelity (distance to release site) within a 15-day moving window for 12 (6 adult female, 3 juvenile female, 2 adult male, 1 juvenile male) eastern wild turkeys translocated during January–February 2014 in northwestern Louisiana. Solid black lines indicate means and dashed grey lines are +/- 1 standard errors.

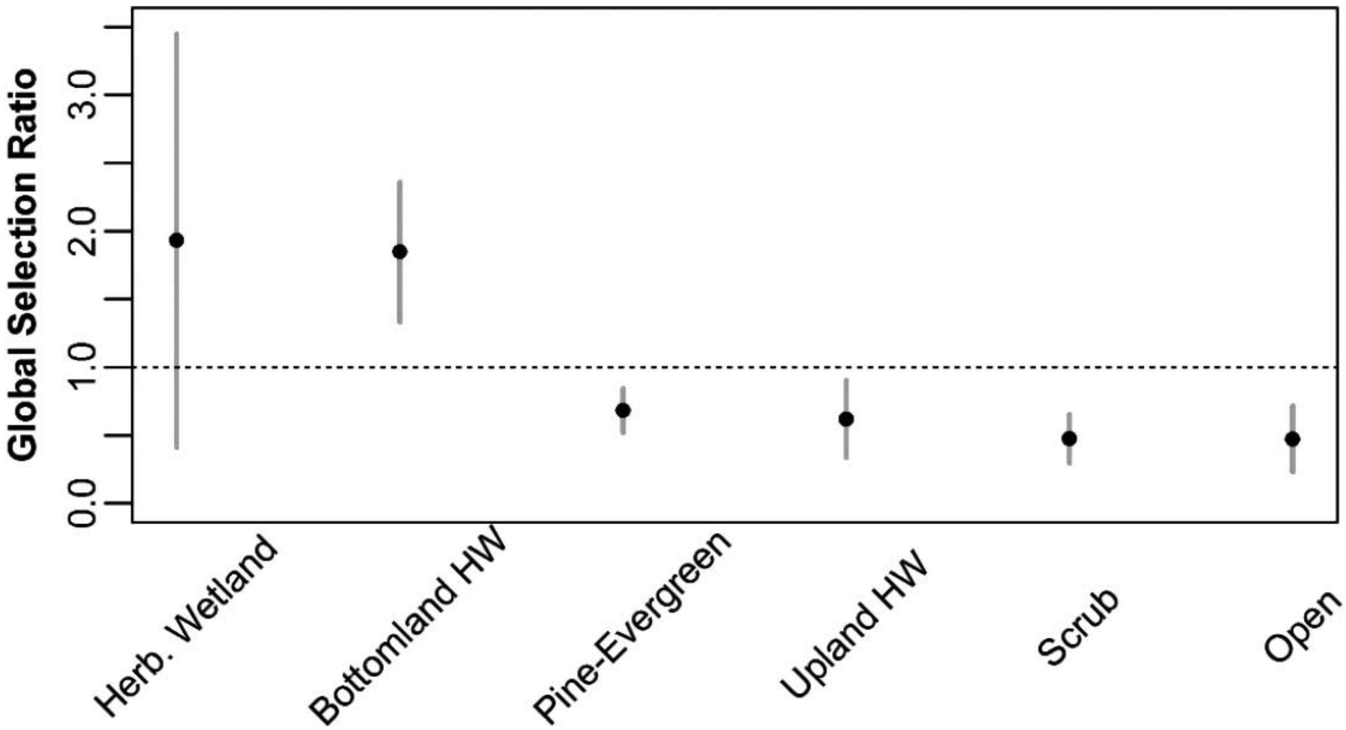

Figure 3. Habitat selection ratios for the first 90 days after translocation for 12 (6 adult female, 3 juvenile female, 2 adult male, 1 juvenile male) eastern wild turkeys translocated during January–February 2014 to northwestern Louisiana. Black dots indicate mean for all individuals and vertical gray bars indicate 95% confidence intervals.

MANAGEMENT IMPLICATIONS

Lopez et al. (1998) hypothesized mortality risk of translocated turkeys was driven by increased movements during pre-nesting, unfamiliarity with release sites, or nesting events, all of which magnified susceptibility to predation. Clearly, our work was designed to describe movements of turkeys after translocation, rather than detail patterns of mortality or predict translocation success. However, our findings suggest that increased movements, at least during the first 90 days after translocation, are an unlikely cause for mortality through increased predation risk, as we recorded no mortalities, despite relatively great movement rates. We noted differences in behavior between translocated turkeys and resident turkeys from comparable landscapes, but because of small sample size, were unable to infer differences across ages and genders. Because successful restocking events rely on quick establishment around release sites to minimize risky behaviors, a closer examination of behavior and factors affecting temporal periods needed for site-familiarity, particularly of female turkeys, seems warranted. Future research should seek to clarify differences in exploratory behaviors across gender and age, and focus on potential negative consequences of females selecting nests if still unfamiliar with their new surroundings.

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Tom Prebyl received his M.S. from the Warnell School of Forestry and Natural Resources at the University of Georgia in 2012 and is currently a research professional with the school. His prior work has largely focused on using spatial analyses and statistical models to assist in conservation planning, including studies on greater prairie-chicken habitat in Kansas, habitat fragmentation and land cover changes in grasslands, the influence of mountain climate on forest phenology, and space use of white-tailed deer. Currently he is involved with research projects investigating movement patterns in wild turkey and white-tailed deer, and developing GIS tools to aid the prioritization of stream habitat connectivity.

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