FEMALE EASTERN WILD TURKEY MOVEMENT AND HABITAT USE IN THE PEMBINA VALLEY, MANITOBA

Brian W. Kiss[1,2]
Department of Environment and Geography, University of Manitoba, Winnipeg, MB R3T 2N2, Canada

Richard K. Baydack
Department of Environment and Geography, University of Manitoba, Winnipeg, MB R3T 2N2, Canada

Frank B. Baldwin
Manitoba Conservation and Water Stewardship, Wildlife and Fisheries Branch, Winnipeg, MB R3J 3W3, Canada

Brian L. Joynt
Manitoba Conservation and Water Stewardship, Wildlife Branch, Winnipeg, MB R3J 3W3, Canada

David J. Walker
Department of Environment and Geography, University of Manitoba, Winnipeg, MB R3T 2N2, Canada

Abstract: Eastern wild turkey (*Meleagris gallopavo silvestris*; hereafter, turkey) populations in southern Manitoba, Canada, have grown substantially since being introduced in the late 1950s, even though they are located well north of their native range. With a growing interest in turkey hunting across western Canada, and desires to expand the current population's distribution, there is a need to better understand movement and habitat used by turkeys in this novel environment. Therefore, we radiotagged 43 female turkeys from the Pembina Valley during 2011 and 2012 and collected baseline data on spring dispersal patterns, spring–summer home range size, and habitat use at 2 spatial scales. Spring dispersal occurred prior to 18 April during both years; distances averaged 8.2 km (95% CI = 6.4 to 10.1) for all individuals and were greater for juveniles (11.9 km, 95% CI = 8.4 to 15.4), than adults (6.4 km, 95% CI = 4.6 to 8.3). Spring–summer home ranges averaged 554.4 ha (95% CI = 427.0 to 681.9). At the study area scale, we selected forests, cattle feedlots, and grasslands (in decreasing order of preference) as habitat types. Within home ranges, females favored areas close to grasslands, forests, and intermittent streams during spring–summer. Our results suggest that turkeys at northern latitudes exhibit movements and habitat use consistent with other North American populations, confirming their adaptability and suggesting potential for further expansion within Canadian Prairies. We suggest that future releases in Manitoba and other northern jurisdictions use dispersal distances and home range land cover composition documented in this study as guidelines for selecting introduction sites and conducting prerelease consultations.

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[1] Present Address: Manitoba Conservation and Water Stewardship, Wildlife and Fisheries Branch, Winnipeg, MB R3J 3W3, Canada.

[2] E-mail: Brian.Kiss@gov.mb.ca

Eastern wild turkey (*Meleagris gallopavo silvestris*; hereafter, turkey) populations in southern Manitoba, Canada, are located approximately 500 km north of their ancestral distribution (Kennamer et al. 1992), but have grown considerably since their first introductions in 1958 as a result of trap and transfer activities and natural dispersal (Bidlake 1966, Wunz 1992, Gillespie 2003). Although turkeys in Manitoba endure severe winter temperatures and prolonged snow cover (Gillespie 2003), extensive landscape changes driven by agricultural production have released turkeys from these limitations, which historically prevented natural expansion northward (Hurst 1992, Porter 2007). Concomitant with increasing populations in Manitoba, interest in hunting turkeys and expanding range of this species has led to questions regarding timing of spring hunting and best practices for expanding the species' distribution at its most northerly extent.

Temporal information on dispersal is required to refine hunting season dates and maintain hunter success and satisfaction, while also ensuring that flocks have moved away from wintering sites and are occupying spring ranges before hunting season commences, distributing opportunity and hunting pressure (Baldwin and Ryckman 2011). Further, knowledge of female dispersal is especially important in areas with introduced populations, such as Manitoba, because it aids in identifying isolated flocks, which may suffer from ineffective gene flow (Leberg et al. 1994). Because habitat selection can affect survival and reproductive success (Badyaev et al. 1996*b*), assessing habitat availability relative to turkey needs prior to an introduction can help select establishment locations (Brenner and Brown 1990). Estimating female dispersal, home range size, and habitat selection during nesting and brood-rearing by females will inform future trap and transfer activities by revealing size of the area in which habitat conditions should be evaluated and appropriate composition of said habitat types. Previous studies have found that turkeys can cause measurable depredation to agricultural crops, become a nuisance, and damage personal property in urban areas (Miller et al. 2000*b*, Spohr et al. 2004, Tefft et al. 2005, Gregonis et al. 2011). Thus, consultations with stakeholders prior to further introductions may help determine a tolerance level, so that recreational and economic benefits outweigh negative costs (Miller et al. 2000*b*). Information regarding dispersal potential may help determine extent of needed landowner consultation.

Although a large volume of work on turkey movement and habitat use exists (e.g., Hurst and Dickson 1992, Lewis 1992, Wunz and Pack 1992, Porter 2007), little has occurred on the northern fringe of this species' distribution, including no research in Manitoba (Kimmel and Krueger 2007). Thus, we sought to understand temporal and spatial patterns of movement and habitat use in an area similar to those in which we intend to apply these results. Our main objectives were to estimate postwinter dispersal distance and timing and spring–summer home range size and habitat use of female turkeys. We also compared our results with existing estimates of dispersal and habitat use to offer insights on adaptability of turkeys to a novel environment relative to introduction or expansion initiatives at the northern edge of their range.

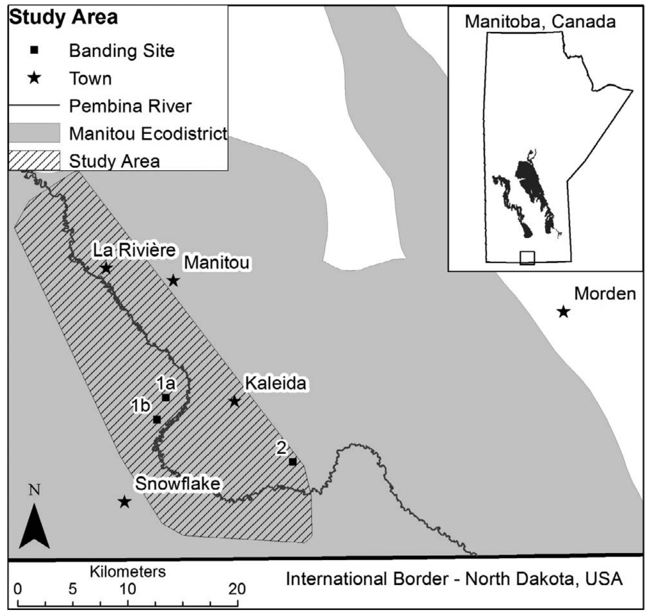

Figure 1. Study area (Minimum Convex Polygon) used by radiotagged female wild turkeys in the Pembina Valley region of southern Manitoba (see inset box for location within province, noting that major lakes are shown for reference).

METHODS

Study Area

We conducted our study in the Pembina Valley region of Manitoba (Fig. 1). Located within the Manitou ecodistrict of the Aspen Parkland ecoregion in south–central Manitoba (Smith et al. 1998), the valley and its eco-district followed the Pembina River and its tributaries from the south–central Canada–United States border, northwest for approximately 120 km. The region's landscape was characterized by a flat glacial till plain intersected by a wide glacial melt water channel (containing the Pembina River) with steep, forested slopes typically ranging from 50 to 150 m in length and a greater than 15% slope (Smith et al. 1998).

The largest stands of contiguous forest cover in the Manitou eco-region existed within the Pembina River valley and its tributaries' ravines. The eastern portion of the valley (our study area) contained forest stands and shrub land composed of mainly bur oak (*Quercus macrocarpa*), trembling aspen (*Populus tremuloides*), hazel (*Corylus* spp.), and saskatoon (*Amelanchier alnifolia*), interspersed with grassland patches dominated by wheat grasses (*Pascopyrum* spp.), fescues (*Festuca* spp.), June grass (*Koeleria cristata*), Kentucky bluegrass (*Poa pratensis*), wild sarsaparilla (*Arilia nudicaulis*), northern bedstraw (*Galium boreale)*, Canada violet (*Viola canadensis*), and meadow rue (*Thalictrum* spp.; Smith et al. 1998, Joyce 2000). Cultivated fields dominated the glacial till plain, while varying in density along the valley floor. A large portion of the forest and grassland portions of the valley were used as pasture with cattle feedlots of varying size (range = approximately 75 to 300 individuals) scattered across the landscape. Untilled land along the valley floor, and to a lesser extent on the glacial plain, was also commonly managed for native hay and forage crops such as alfalfa.

Average daily temperatures recorded in Snowflake, Manitoba, from 1991 to 2007, ranged from –15.7°C in January to 18.8°C in July. Annual rainfall and snowfall averaged 426.5 mm and 138.3 cm, respectively, during the same period (Environment Canada 2010).

Our study area was the site of Manitoba's earliest turkey introductions and, during 2009 to 2013, an annual mean of 37–46% of Manitoba's spring harvest occurred in the Provincial Game Hunting Area, in which our study area was located (Manitoba Conservation and Water Stewardship, unpublished data).

Capture and Monitoring

We captured turkeys at 3 farm sites during the winters (January–March) of 2011 and 2012, following Bailey et al. (1980) using a WCS Net Blaster™ (Wildlife Control Supplies, East Granby, Connecticut, USA). Once captured, we differentiated adults and juveniles using shape and barring pattern of 9th and 10th primary feathers and tail fan shape (Pelham and Dickson 1992). We fitted females with an 80-gram, model A1540 backpack-style radiotransmitter (Advanced Telemetry Systems, Isanti, Minnesota, USA) and a size 8A aluminum rivet leg band (National Band and Tag, Newport, Kentucky, USA). We conducted all capture and monitoring in accordance with the guidelines provided by the Canadian Council on Animal Care (2003, 2008). We conducted this research under authority of the Government of Manitoba's Wildlife Act and Industry Canada's Radio License 51110817.

We commenced monitoring no less than 3 weeks after the last trapping date during both study years, allowing a post-capture adjustment period before documenting movements of radiotagged turkeys. We monitored radiotagged females during spring–summer (18 April–1 September) of 2011 and 2012. We located each female by either visual observation after homing or by triangulation 3 times per week, at varying times of day. We entered azimuths and data collection locations from turkeys located through triangulation into LOCATE III (Pacer Computer Software, Tatamagouche, Nova Scotia, Canada) to derive an estimated location. We considered females that survived through one monitoring period to the next as new individuals during their second season.

Data Analyses

Based on Vander Haegen et al. (1988), we calculated straight line dispersal distances as distance (m) from an individual's wintering site to that individual's first nest site using ArcGIS 10.1 (Environmental Systems Research Institute, Redlands, California, USA). For non-nesting females, we used distance from that individual's wintering site to the centroid point of its spring–summer home range (Porter 1977). When an individual died before enough locations were collected for home range estimation, we calculated straight line dispersal from wintering site to either their last known live location or mortality site.

We used minimum convex polygons (MCP) to calculate home ranges, based on their prevalence in other turkey studies (e.g., Hoffman 1991, Badyeav et al. 1996*a*, Miller et al. 1999, Miller and Conner 2007). We estimated spring–summer home range size and habitat use for only individuals that survived their entire spring–summer monitoring period to ensure that at least 20 locations would be included in each sample (Thogmartin 2001), and that locations were distributed evenly throughout the entire monitoring period. We calculated home range sizes using Geospatial Modeling Environment 0.6.2.0 (Beyer 2013). We tested the hypotheses that age did not affect either straight line dispersal distance or home range size with a t-test.

Prior to habitat use analyses, we defined our study area (40,752 ha) by creating a MCP around all turkey locations using ArcGIS 10.1. We selected 8 features and land cover types (known wintering sites, cattle feedlots, roads, intermittent streams, major rivers and creeks, cropland, grassland, and forest) for habitat use analyses based on their potential influence on turkey use and availability of similar classification data within existing geospatial databases available for our study area. We included cattle feedlots because, at northern latitudes, turkeys typically concentrate at beef and dairy production sites, as they provide access to food sources during periods of prolonged snow (Vander Haegen et al. 1989). These sites have also historically been used as introduction sites in our study area and elsewhere in Manitoba (Manitoba Conservation and Water Stewardship, unpublished data).

We included roads, as previous studies have found that turkeys both avoid road edges (Rogers et al. 1999) and select nest sites close to roads (Thogmartin 1999). Additionally, much of southern Manitoba's Aspen Parkland ecoregion, where turkeys are currently established or likely to be introduced, is fragmented with a density of roads similar to our study area. We included major rivers and creeks, as greatest densities of forest cover in the Aspen Parkland were typically near streams (Smith et al. 1998) and because these corridors have historically been selected for introductions in Manitoba and North Dakota (Bidlake 1966, Tripp 2003). For roads and watercourses, we altered data layers (Manitoba Land Initiative 2001) to include only maintained roadways and to separate perennial rivers and creeks subject to spring flooding from intermittent streams.

We used a broad classification of cropland, forest, and grassland using the Land Use–Land Cover Landsat TM layer for Manitoba (Manitoba Land Initiative 2001). We adjusted classifications to include the original Agricultural Cropland class, a new grassland class (Grassland–Rangeland and Forage Crops classes combined), and a new forest class (Deciduous Forests and Open Deciduous classes combined). We determined that our study area contained 52% cropland, 25% forests, 18% grasslands, 7 wintering sites, 21 cattle feedlots (approximately 1 per 20 km^2), 3 major rivers or creeks travelling approximately 100 km, and numerous intermittent streams and maintained roads, totaling approximately 500 km and 340 km, respectively (Fig. 2).

Prior to analyses, we used ArcGIS to generate random locations within both the study area and individual home ranges at a 1:1:1 ratio with individual turkey locations. We

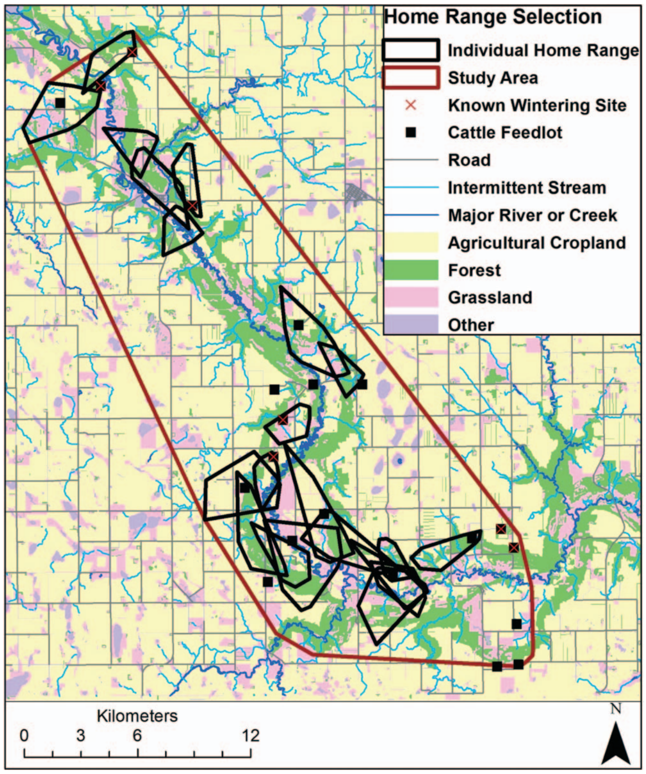

Figure 2. Home range selection in relation to habitat features using minimum convex polygons (MCP) for radiotagged female wild turkeys, monitored during spring–summer (18 April–1 September) 2011 and 2012, in the Pembina Valley of southern Manitoba.

then calculated distances (m) from both sets of random points and individual locations to nearest representative of each feature and land cover type (Miller et al. 2000*a*). We then used Euclidean distances (Conner and Plowman 2001; Conner et al. 2003, 2005) to assess habitat use for all individuals that survived each spring–summer monitoring period. We chose this approach due to its ability to assess importance of features not directly used by an individual and its robustness to moderate levels of location error (Conner and Plowman 2001). Following Johnson (1980), we analyzed habitat use for second (home range selection within the study area) and third (use within individual home ranges) order selection.

Starting with second order selection, we calculated a mean nearest distance from random study area points assigned to each individual (i) to each habitat feature, creating a vector of mean expected distances (r) to each habitat feature for each individual. Using distances calculated for random home range points, we created a second vector of mean selected distances (u) to each habitat feature. Next, we created a vector of ratios (d) for each habitat feature by dividing (u_i) by (r_i). In theory, a mean ratio (d_i) of 1.0 indicates that a particular habitat feature was selected at random, (d_i) <1.0 demonstrates that a feature was favored, and (d_i) >1.0 shows avoidance (Conner and Plowman 2001). We used multivariate analysis of variance (MANOVA) to determine if non-random habitat use occurred across all habitat features, by testing if the mean ratio (d_i) differed significantly ($P \leq 0.05$) from a control vector of 1.0's, using the Wilks-Lamda statistic. If significant, we used 1-way ANOVA results to determine which features and land cover types were used disproportionately.

Finally, we used pair-wise *t*-tests to determine if use was associated with one feature or land cover type over another and created a ranking matrix of habitat features (Aebischer et al. 1993). We then used this same process to evaluate habitat use at the third order, comparing distances calculated for random points generated in individual home ranges and distances calculated for individual turkey locations. We conducted all statistical analyses using SPSS 21 (IBM Corp., Armonk, New York, USA). We accepted significance as $P \leq 0.05$ for all analyses.

RESULTS

We captured and radiotagged 43 female turkeys during winters of 2011 and 2012, with 3 radiotagged females active during multiple years, resulting in a potential sample size of 46. We removed 4 of these 46 due to mortality ($n = 2$), harness failure ($n = 1$), and signal loss ($n = 1$). We collected 1,372 turkey locations through either triangulation ($n = 1{,}036$) or visual observation ($n = 336$). Nine individuals from 2011 and 12 individuals from 2012 survived the entire spring–summer study period each year, averaging 50.2 (95% CI = 47.8 to 52.6) locations each.

All female turkeys dispersed from wintering sites before we began monitoring (18 April) during both years. We observed 5 females initiating nests by this date in 2012. We included movements of 42 turkeys for dispersal analysis. We calculated dispersal distances to 31 first nest sites, centers of 9 home range MCPs, 1 last known live location, and 1 mortality location. Dispersal distance differed between age classes ($t_{40} = -3.15$, $p = 0.003$), with adults averaging 6.4 km (95% CI = 4.6 to 8.3) and juveniles averaging 11.9 km (95% CI = 8.4 to 15.4; Table 1).

We included 21 turkeys in home range analyses. Home range size did not differ ($t_{19} = 0.55$, $p > 0.05$) by age class, averaging 554.4 ha (95% CI = 427.0 to 681.9) across all individuals, and ranged from 243.3 ha to 1,283 ha (Table 2). Home range size was 543.3 ha (95% CI = 397.7 to 688.9) for 18 nesting females and 621 ha (95% CI = 78.7 to 1163.5) for 3 non-nesting females. Of females that nested, 11 individuals that hatched broods had home ranges averaging 414.8 ha (95% CI = 303.9 to 525.7), while 7 unsuccessful individuals had home ranges averaging 745.3 ha (95% CI = 425.6 to 1065.0).

We used 21 turkeys (11 adults and 10 juveniles) that survived their entire spring–summer study period for habitat use analyses. Habitat selection occurred at both second ($F_{7, 33} = 51.12$, $p < 0.001$) and third ($F_{7, 33} = 4.56$, $p = 0.001$) orders of selection. At the second order of selection, home ranges were closer than expected to cattle feedlots ($F_{1, 40} = 86.22$, $p < 0.001$), major rivers and creeks ($F_{1, 40} = 25.91$, $p < 0.001$), intermittent streams ($F_{1, 40} = 33.32$, $p < 0.001$), forests ($F_{1, 40} = 58.52$, $p < 0.001$), and grasslands ($F_{1, 40} = 73.36$, $p < 0.001$). A ranking matrix of pair-wise *t*-tests revealed that females selected home ranges based on proximity to forests, cattle feedlots, and grasslands (in decreasing order of preference; Table 3). Mean proportion of forest (0.38, 95% CI = 0.33

Table 1. Mean spring dispersal distances (km; including standard error [SE], 95% confidence intervals [CI], minimum [min.], and maximum [max.] distances [km]) for 42 radiotagged female wild turkeys, monitored during spring–summer (18 April–1 September) 2011 and 2012, in the Pembina Valley of southern Manitoba, Canada. This includes dispersal distances to 31 first nest sites, centers of 9 home ranges, 1 last known live location, and 1 mortality location.

Year	Age Class	$\bar{x}$ (km)	n	SE	95% CI	min.	max.
2011							
	All	6.6	23	1.0	4.5 to 8.7	1.4	19.4
	Adult	5.8	18	1.0	3.6 to 7.9	1.4	17.9
	Juvenile	9.4	5	2.8	1.6 to 17.2	3.7	19.4
2012							
	All	10.3	19	1.5	7.2 to 13.4	1.5	22.9
	Adult	7.7	10	1.8	3.5 to 11.8	1.5	18.5
	Juvenile	13.2	9	1.9	8.8 to 17.7	6.6	22.9
Both Years							
	All	8.2	42	0.9	6.4 to 10.1	1.4	22.9
	Adult	6.4	28	0.9	4.6 to 8.3	1.4	18.5
	Juvenile	11.9	14	1.6	8.4 to 15.4	3.7	22.9

to 0.44) and grassland (0.27, 95% CI = 0.22 to 0.32) cover types within spring–summer home ranges was greater, and cropland (0.31, 95% CI = 0.25 to 0.37) was less, than what was available in the study area (Fig. 3).

At the third order of selection, individual locations were located closer than expected to grasslands ($F_{1, 40} = 7.75$, $p = 0.008$). Individual locations were farther than expected from major rivers and creeks ($F_{1, 40} = 5.56$, $p = 0.023$) and cropland ($F_{1, 40} = 11.41$, $p = 0.002$). Individuals selected areas in proximity to grasslands, forests, and intermittent streams (in decreasing order of selection) over all other features and land cover types (Table 4).

DISCUSSION

In our study, juvenile females dispersed farther than adults, which is similar to other studies (Hayden 1980, Vander Haegen et al. 1988, Miller et al. 1995, Keegan 1996, Timmins et al. 2003), and the general ecological phenomenon wherein younger individuals tend to disperse farther than mature individuals (Smith and Smith 2003). We recorded greater mean spring dispersal distance in our study than in many other turkey studies and maximum distance we recorded was at the top end of maximum dispersal range (8.5–24 km; Ellis and Lewis 1967, Porter 1977, Hayden 1980, Vander Haegen et al. 1988, Kurzejeski and Lewis 1990). Large dispersal distances can indicate competition for resources or lack of proximate nesting habitat (Waser 1985). However, populations in Manitoba exist at relatively small densities compared to other jurisdictions (Tapley et al. 2011), and females do not appear to be overly selective when choosing nesting sites (Manitoba Conservation and Water Stewardship, unpublished data). Therefore, reasons for this result remain unknown.

Different methods preclude direct comparisons of space use across turkey studies (e.g., Brown 1980, Laver and Kelly 2008). Nonetheless, our mean spring–summer home range size was consistent with other studies conducted in landscapes dominated by row crop and cattle production with a relatively even forest to open area composition (Ellis and Lewis 1967, Hayden 1980, Kurzejeski and Lewis 1990, Lehman et al. 2003).

Of the 8 features and land cover types that we examined, forests, cattle feedlots, and grasslands were the 3 most important for home range selection. While forests provide roosting structure (Zwank et al. 1988, Porter 1992,

Table 2. Mean home range sizes (ha; including standard error [SE], 95% confidence intervals [CI], minimum [min.], and maximum [max.] sizes [ha]), calculated using minimum convex polygons for 21 radiotagged female wild turkeys, monitored during spring–summer (18 April–1 September) 2011 and 2012, in the Pembina Valley of southern Manitoba, Canada.

Year	Age Class	$\bar{x}$ (ha)	n	SE	95% CI	min.	max.
2011							
	All	645.7	9	103.3	407.5 to 884.0	243.3	1283.0
	Adult	613.1	7	132.3	289.5 to 936.8	306.6	1283.0
	Juvenile	759.9	2	9.7	636.3 to 883.5	750.2	769.6
2012							
	All	485.9	12	71.1	329.4 to 642.5	243.3	980.9
	Adult	460.7	4	174.0	0 to 1013.8	259.4	980.9
	Juvenile	498.6	8	73.3	325.3 to 671.8	243.3	820.2
Both Years							
	All	554.4	21	61.1	427.0 to 681.9	243.3	1283.0
	Adult	557.7	11	102.6	329.2 to 786.2	259.4	1283.0
	Juvenile	550.8	10	67.5	398.2 to 703.5	243.3	820.2

Table 3. Ranking matrix (*p*-values) from pair-wise comparisons (univariate *t*-tests[a]) of features and land cover used at the second order of selection (home range selection within the study area) by 21 radiotagged female wild turkeys, monitored during spring–summer (18 April–1 September) 2011 and 2012, in the Pembina Valley, Manitoba, Canada.

Habitat feature	Cattle feedlots	Grasslands	Major rivers and creeks	Intermittent streams	Known wintering sites	Roads	Cropland	Rank[b]
Forests	0.521	0.201	0.093	0.004	0.004	<0.001	0.003	1
Cattle feedlots		0.683	0.321	0.018	0.006	0.001	0.001	2
Grasslands			0.329	0.081	0.023	0.002	0.004	3
Major rivers and creeks				0.444	0.057	0.012	0.009	4
Intermittent streams					0.095	0.002	0.007	5
Known wintering sites						0.246	0.037	6
Roads							0.098	7
Cropland								8

[a] Testing the null hypothesis that: [mean random study area point (*r*) distance to feature A/mean random home range point (*u*) distance to habitat A] – [mean random study area point (*r*) distance to feature B/mean random home range point (*u*) distance to habitat B] = 0.
[b] One = the highest ranking and most preferred habitat feature. Ranking based on the magnitude of *t*-statistics associated with each comparison.

Byrne et al. 2015), forests are also a key food source when they are comprised of trees that produce hard mast (Hurst 1992, McShea et al. 2015). Grasslands provide nesting and brood-rearing cover and abundant insect populations, which young turkeys depend on for growth (Porter 1980, Kurzejeski and Lewis 1990, Porter 1992, Swanson et al. 1994). Turkeys commonly associate with dairy and cattle operations throughout North America and cattle production sites are generally used during fall and winter (Vander Haegen et al. 1989, Healy 1992, Parent et al. 2007). Yet, we found them to be important even after spring dispersal. At northern extents of turkey range, where emergence of vegetation is delayed longer into spring, these sites may continue to function as food sources in spring and summer. We also found that composition of home ranges for female turkeys was closer to the ideal 1:1 ratio of woodland to open-area suggested by Kurzejeski and Lewis (1990) and Brenner and Brown (1990) than the study area as whole.

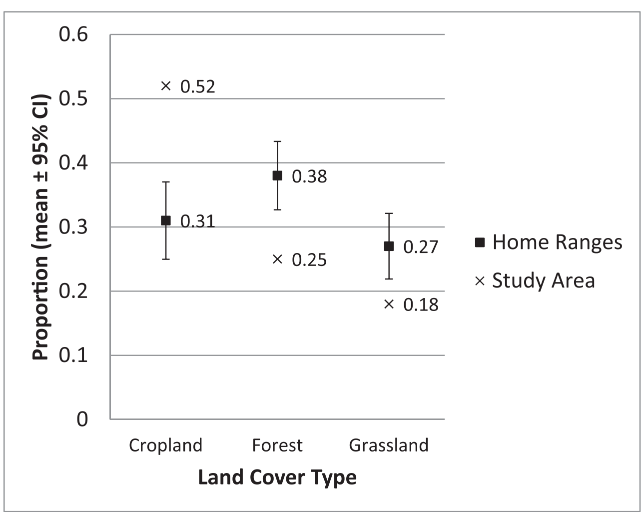

Figure 3. Comparison of mean land cover composition (showing 95% confidence intervals) within a study area minimum convex polygon (MCP) and home ranges MCPs of radiotagged female wild turkeys, monitored during spring/summer (18 April–1 September) 2011 and 2012, in the Pembina Valley of southern Manitoba.

Given that woodlands were concentrated along the Pembina River valley in our study area, this suggests that riparian corridors offer good quality habitat composition and essential movement corridors for turkeys on prairie landscapes that are dominated by open lands (Hall et al. 2007, Phillips et al. 2011).

We ranked croplands and roads lesser during home range selection, and turkeys avoided croplands within home ranges. Lesser ranking of maintained roads is likely due to their lesser densities within the river valley, where other important habitat features (e.g., forests, cattle feedlots, and grasslands) were more prevalent. Avoidance of cropland within home ranges suggests that forests and grasslands may provide better resources (e.g., seeds and invertebrates) to female turkeys during nesting and brood-rearing in our study area. However, it is possible that importance of cropland could increase during fall and winter (Vander Haegen et al. 1989). It is also important to note that cereal and oil grains dominated crop production in our study area, although corn and soybean production is rapidly increasing across Manitoba (Statistics Canada 2015) and potential impact of this change on turkey habitat use remains unknown.

Ranking of intermittent streams as the third most favored feature within home ranges likely reflects importance of easy access to water sources, which are thought important when selecting roost sites (Hurst and Dickson 1992, Chamberlain et al. 2000) and nests (Badyaev 1995). Female avoidance of major rivers and creeks within home ranges may have been related to annual spring flooding of these waterways on our study area, which obviously prevented use during flooding events and may have limited growth of vegetation needed for nesting cover and food resources.

MANAGEMENT IMPLICATIONS

Our study suggests that female turkeys, in a novel landscape hundreds of miles north of their natural range, exhibited similar patterns of movement and spring and summer habitat use to individuals found within their ancestral distribution. Based on our findings, habitat requirements during breeding season were general, and

Table 4. Ranking matrix (*p*-values) from pair-wise comparisons (univariate *t*-tests[a]) of features and land cover used at the third order of selection (selection within home ranges) by 21 radiotagged female wild turkeys, monitored during spring/summer (18 April–1 September) 2011 and 2012, in the Pembina Valley of southern Manitoba, Canada.

Habitat feature	Forests	Intermittent streams	Roads	Cattle feedlots	Known wintering sites	Major rivers and creeks	Cropland	Rank[b]
Grasslands	0.968	0.256	0.081	0.011	0.007	0.001	0.001	1
Forests		0.466	0.476	0.293	0.207	0.053	0.032	2
Intermittent streams			0.714	0.262	0.1	0.015	0.005	3
Roads				0.504	0.24	0.064	0.002	4
Cattle feedlots					0.337	0.036	0.006	5
Known wintering sites						0.048	0.005	6
Major rivers and creeks							0.152	7
Cropland								8

[a] Testing the null hypothesis that: [mean random home range point (*r*) distance to feature A/mean individual location point (*u*) distance to habitat A] – [mean random home range point (*r*) distance to feature B/mean individual location point (*u*) distance to habitat B] = 0.
[b] One = the highest ranking and most preferred habitat feature. Ranking based on the magnitude of *t*-statistics associated with each comparison.

met by turkeys without large movements. Because agricultural landscapes similar to our study area are common throughout the Canadian prairies (Keer and Cihlar 2003) and, given the general nature of habitat use by turkeys we documented, there are likely many locations in western Canada where turkey populations could become established. Despite this, we urge jurisdictions to consider not only ecological implications of introducing turkeys, but also social and agricultural tolerances necessary for long-term sustainability of populations.

We suggest our mean estimate of 8.2-km dispersal be used as probable movement distance away from an introduction site and incorporated into the consultation process for future turkey releases to help reduce potential conflicts with landowners. We found dispersal distances of up to 22.9 km and, while such movements were not common, this distance should be used as a guideline to fully consider potential human-turkey conflicts and gauge possible connectivity among populations once a population is established.

Our estimates of seasonal home ranges and habitat use (roughly 1/3 forests, 1/3 grasslands, and 1/3 cropland) could be one of several metrics used to assess habitat suitability within a radius (e.g., 8.2 km) of candidate release sites. Secondly, based on their known importance as a winter food source in many jurisdictions, but also for their importance as a habitat feature after spring dispersal (this study), we suggest density of cattle production sites be incorporated into release criteria. Future research should assess density of these sites in areas of Manitoba with relatively stable populations versus areas where past introductions have not been successful. Lastly, as we found that most home ranges were clustered along our study area's river valley, we recommend that managers continue to target these river valleys as possible future introduction sites, as they appear to have the most suitable mixture of general habitat requirements on prairie landscapes (Fitch and Adams 1998).

We suggest that Manitoba Conservation and Water Stewardship begin conducting spring gobbling counts to determine timing and annual variability of peak gobbling activity. Managers could then pair gobbling data with our finding that female turkeys had already dispersed and were established on their spring–summer home ranges before Manitoba's spring hunting season during multiple study years to consider timing of spring seasons. Amendments may be required to allow hunters to be on the landscape closer to periods of peak gobbling and improve opportunity to harvest male turkeys, while still ensuring that dispersal from wintering sites has occurred, which spreads out hunting opportunity and pressure.

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Brian W. Kiss is a habitat mitigation biologist for Manitoba Conservation and Water Stewardship's Wildlife and Fisheries Branch. He received a Bachelor of Environmental Studies (Honors) in 2009 and a M.S. in 2015 from the University of Manitoba. His graduate research focused on wild turkey biology in southern Manitoba. In the past he has also worked for Manitoba Conservation and Water Stewardship's Big Game Health Program and Waterfowl Crop Depredation Prevention Program, and in the consulting industry conducting wildlife research for various hydroelectric generation and transmission projects.

Frank B. Baldwin is the Provincial Game Bird Manager with the Department of Conservation and Water Stewardship in Manitoba. His primary responsibilities include development and delivery of harvest management and monitoring programs, with particular focus on sub-arctic nesting waterfowl, temperate nesting Canada geese, and wild turkeys. Frank received his B.S. (Honors) from the University of Winnipeg and his M.S. from the University of

Saskatchewan, where he studied a nesting association between Ross's geese and cackling geese in Nunavut.

Richard K. Baydack is Professor and Chair of Environmental Science and Studies at the University of Manitoba, where he has been employed since 1979. He holds a B.S. (Zoology) and Master of Natural Resources Management from the University of Manitoba, and Ph.D. in Wildlife Biology from Colorado State University. His research interests include applied ecosystem management, conservation of biological diversity, and human dimensions of wildlife management. He has been awarded the Hamerstrom Award for Excellence in Prairie Grouse research and management, the University of Manitoba President's Outreach Award, and has been recognized by The Wildlife Society as a Certified Wildlife Biologist. His university teaching is in Ecosystem Management, Biogeography, Environmental Field Investigations, Wildlife Management, and Sustainable Environmental Management. He was elected 2014–2015 President of The Wildlife Society. Rick has also completed the coveted 'Royal Slam' of the National Wild Turkey Federation.

Brian L. Joynt is the Manager of the Game, Fur and Human–Wildlife Conflict Section for Manitoba's Wildlife and Fisheries Branch, Department of Conservation and Water Stewardship. He leads efforts intended to sustainably manage the province's game and fur resources for all Manitobans, as well as programs and policies aimed at reducing human–wildlife conflict. Brian joined the Branch to become more engaged in a broader array of wildlife management issues. Prior to this, he enjoyed a 20-year career with the research group of Ducks Unlimited Canada, conducting field research in the Canadian Prairie–Parkland Region.

David J. Walker specializes in geomatics (GIS, remote sensing, and spatial statistics) and has experience in statistical analysis of complex physical and human geography data sets. He is a quantitative, terrestrial ecologist with research programs in the Canadian boreal forest and temperate grassland, and international projects in the tropics and sub-tropics. David's research interests are primarily in landscape systems, including invasive species research, geographic information systems, data integration and modeling, and spatial methods.