

PROJECT #: T-21-P1

PROJECT TITLE: Ecology and genetics of red squirrels in Illinois

SUMMARY OF PROGRESS:

The primary purpose of this research is to investigate the current distribution and status of red squirrels in Illinois, a conservation priority mammal as defined in the Illinois Wildlife Action Plan. The origins (and therefore the conservation status) of Illinois' red squirrel population is unclear and controversial (Hoffmeister 1989). Field studies commenced in May 2006 and will continue through December 2007. To date tissues from 45 Illinois red squirrels and 93 squirrels from adjacent Midwestern states have been collected for genetic analyses. DNA extractions from these tissues have begun and primers have been purchased for isolating genetic markers. Live-trapping and playback surveys began in May 2006. Red squirrels have been trapped or observed in 13 forests in NE Illinois, extending the documented geographic range of the species in Illinois approximately 30 miles to the south and 30 miles to the west of previously known locations. Forty-eight squirrels were live-trapped at the Iroquois County State Wildlife Area (ICSWA) study site. Of these, 24 were radiocollared and monitored, resulting in 947 locations. Home ranges averaged 5.2 ha and core areas averaged 0.8 ha. Adult males tended to occupy larger home ranges and core areas than adult females and juveniles. Although red squirrels were most commonly found in pine and mixed forests, deciduous forests lacking pines also were used. The presence/absence of red squirrels was surveyed in 25 forested patches in Kankakee, Iroquois, Will, and Grundy counties using playback surveys. The landscape characteristics (e.g. size, habitat type, proximity to crops, other forests, and roads) of these sites are being analyzed to investigate whether red squirrels are limited by forest size, type, or proximity to other habitat types.

Job 1. Investigate the genetic lineage of the Illinois red squirrel population.

This portion of the study is designed to determine whether the red squirrels in Illinois represent a remnant population that has persisted in low numbers, recent immigrants from Indiana, or descendants of squirrels introduced into the Kankakee area from out-of-state. Our approach is to compare the genetic composition of Illinois red squirrels to that of populations currently inhabiting other Midwestern states, specifically Indiana, Michigan, Wisconsin, and Minnesota.

During the past year, we obtained tissues from 118 individual squirrels for genetic analysis. Of these, 45 were collected in Illinois, including individuals from Iroquois County State Wildlife Area (ICSWA), Kankakee State Park, and northwest Will County. We also have developed a network of cooperating scientists, hunters and trappers that has supplied tissues from squirrels in neighboring states. To date, we have processed tissues from 43 red squirrels

from Indiana, 12 from Michigan, and 18 from Minnesota. An additional 20 red squirrels have been collected in northern Wisconsin, but tissues from these animals have not been received at the time of this report.

In the laboratory, we have successfully extracted DNA from the first 6 squirrels and performed PCR on each of these samples. DNA extractions and amplification will continue on the other squirrels this winter.

Job 2. Determine the current distribution, habitat selection, and limiting factors of red squirrels in Illinois.

In this part of the study, we are using telephone interviews, mail surveys, ground searches, and acoustic point-count (“playback”) surveys to define the current distribution of red squirrels in Illinois. We also are conducting an intensive telemetry study of red squirrels at Iroquois County State Wildlife Area (ICSWA) to investigate home range size, habitat use, and movements of adult and juvenile squirrels.

To date, red squirrels have been trapped or observed in 13 forests in NE Illinois (Fig.1, Table 1). These locations extend on a north-south axis of their geographic range in the state from University Park in northern Will Co. to Del Rey in southern Iroquois Co. Squirrels have been observed as far east as the Indiana state line in Iroquois and Kankakee Cos. and as far west as Goose Lake Prairie in eastern Grundy Co. This is a broader geographic range than previously recorded, extending the known distribution of the species approximately 30 miles to the south and 30 miles to the west of previously documented locations. We are continuing playback surveys this winter, targeting forested tracts in Will, Grundy, and LaSalle counties.

A total of 48 red squirrels were live-trapped and marked at ICSWA this summer, including 15 adult males, 6 adult females, 13 juvenile males, and 14 juvenile females. Trap success was relatively low (1 capture/53 trap-nights), but increased later in the summer as juveniles became more active. Adult females tended to be heavier than adult males in the summer (223.4 g vs. 198 g; $P = 0.05$), but the sexes did not differ in total body length (339.1 mm vs. 338.3 mm; $P = 0.96$). Body lengths were comparable to those reported for red squirrels in Wisconsin and Indiana (C. Long, UW-Stevens Point, unpub. data; Mumford and Whitaker, 1982).

Twenty-four squirrels were trapped, radiocollared, and monitored between May and October 2006, resulting in 947 independent radiolocations. From these data, we calculated the 95% fixed kernel home range size and 50% kernel core area size for each squirrel (Table 2). Home ranges averaged 5.2 ha for all individuals, but varied among classes with adult males occupying larger ranges than adult females or juveniles (Fig. 2). Core areas averaged 0.8 ha, but core areas occupied by adult males tended to be larger than those of other classes.

Each time that a squirrel was radiolocated or observed, the habitat type it occupied was recorded. During 2006, 1,000+ independent records of habitat occupancy were accumulated. Locations were entered into an ArcGIS database to investigate habitat preferences (habitat-use versus availability). Six habitat types were digitized and overlaid on digital ortho-quadrangle (DOQ) aerial photographs of the ICSWA study site. Habitats were categorized as pine forest, deciduous forest, mixed forest, marshes, agricultural fields, and grasslands.

Habitat preferences are currently being assessed at 3 spatial scales: (1) home range, (2) core area, and (3) specific foraging and nesting sites. To investigate habitat selection at the level of home ranges, the habitat composition of individual home ranges is compared to that of the whole study area. Similarly, habitat selection within home ranges is measured by comparing the composition of core areas to that of the home ranges, and foraging and nesting preferences is assessed by comparing the habitats used for these activities to the habitat composition of the home range. Differences in habitat use versus availability for each of the 24 squirrels are being tested using compositional analysis (Aebischer et al. 1993).

Job 3. Use information on habitat use and movements to evaluate landscape-level effects on the current and future distribution of red squirrels in Illinois.

Twenty-five forests were surveyed this year to investigate site occupancy by red squirrels. Playback surveys were conducted by walking transects established at 50m intervals through the long axis of each forest. The number and length of transects varied, but were distributed to ensure that each site was surveyed thoroughly and uniformly. Along each transect, researchers stopped for 2 minutes every 50 m and played recorded red squirrel calls for 10 seconds, then listened 20 seconds for responses. This sequence was repeated 4 times at each point. The presence or apparent absence of squirrels at each site was recorded based on visual observations and vocalizations. Sites were surveyed at least twice during the summer, approximately 3 weeks apart.

Landscape metrics are being calculated for each surveyed site using DOQs, INHS 1999 Land Cover maps, Fragstats, and ArcGIS. These metrics include: patch size, patch composition, interior size, edge:interior ratio, proximity to nearest forest patch, proximity to agriculture, proximity to permanent water, proximity to roads or buildings, and distance to nearest occupied patch. Metrics for occupied versus unoccupied sites will be used to investigate whether red squirrels are restricted by forest type, patch size, patch shape, distance between patches, or barriers such as roads or rivers.

Literature Cited:

Aebischer, N. J., P. A. Robertson, and R. E. Kenward. 1993. Compositional analysis of habitat use from animal radio-tracking data. *Ecology* 74:1313-1325.

Hoffmeister, D. 1989. *Mammals of Illinois*. University of Illinois Press, Champaign, IL. 348 pp.

Mumford, R. E. and J. O. Whitaker. Jr. 1982. *Mammals of Indiana*. Indiana University Press, Bloomington, IN. 537 pp.

Table 1. Thirteen forested locations where red squirrels were live-trapped or observed during ground surveys, May-November 2006.

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1. Goose Lake Prairie State Natural Area – Grundy Co.
 2. Des Plaines Conservation Area – Will Co.
 3. Custer Park – Will Co.
 4. Thorn Creek Woods Nature Preserve – Will Co.
 5. Perry Farm, Kankakee – Kankakee Co.
 6. Kankakee River State Park – Kankakee Co.
 7. Waldon Arboretum – Kankakee Co.
 8. Island Park, Momence – Kankakee Co.
 9. Momence Wetlands – Kankakee Co.
 10. Iroquois Woods (*aka* Campbell's Woods) – Kankakee Co.
 11. Iroquois County State Wildlife Area – Iroquois Co.
 12. Grant Park – Iroquois Co.
 13. Del Ray – Iroquois Co.
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Table 2. Home range (95% fixed kernel) and core area (50% fixed kernel) size of red squirrels radio-collared at Iroquois County State Wildlife Area, May-October, 2006.

<u>Sex-age class</u>	<u>N</u>	<u>Home range</u>		<u>Core area</u>	
		<u>Mean</u>	<u>SE</u>	<u>Mean</u>	<u>SE</u>
Adult male	13	8.0	3.8	1.3	0.6
Juvenile male	4	1.7	0.8	0.4	0.4
Adult female	3	2.0	0.8	0.3	0.1
Juvenile female	<u>4</u>	<u>1.9</u>	0.5	<u>0.2</u>	0.1
Total	24	5.2		0.8	



Figure 1. Stars indicate locations where red squirrels (*Tamiasciurus hudsonicus*) were live-trapped or observed during surveys conducted May-November, 2006.

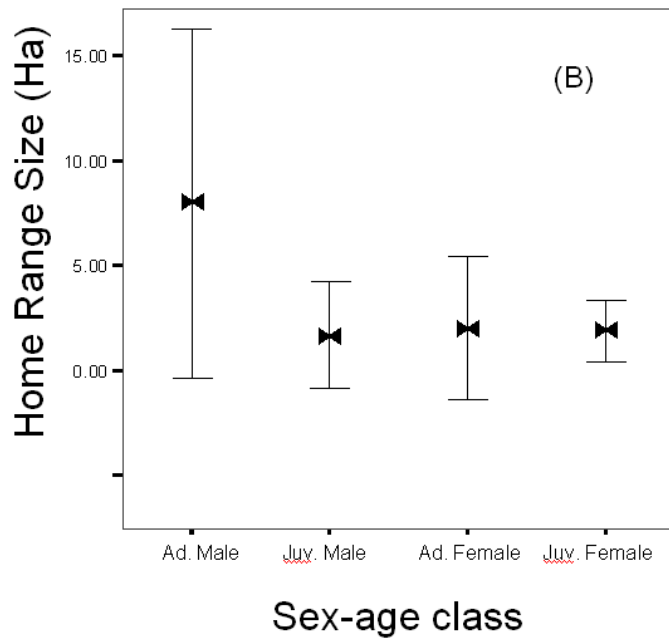
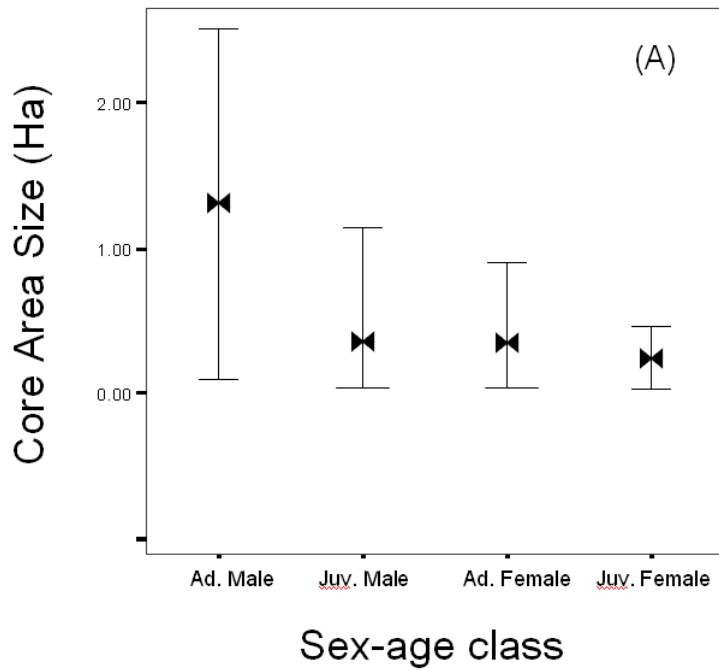


Figure 2. Mean size (ha) and 95% confidence intervals of core areas (A; 50% fixed kernel) and home ranges (B; 95% fixed kernel) of 24 red squirrels in 4 sex-age classes at Iroquois County State Wildlife Area in IL. Each squirrel was radio-located 30-60 times from May to October, 2006.