

Habitat use and selection of central rat snakes (*Elaphe spiloides*) in a fragmented forest environment

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Fig. 1 – Photo showing the agricultural fields fragmenting the forest habitat.

Abstract

Habitat fragmentation often results from anthropogenic activities and produces an increased amount of edge habitat. The central rat snake (*Elaphe spiloides*) is a semi-arboreal species of snake inhabiting much of the Eastern U.S. that is commonly found in edge habitat. I investigated the habitat use and thermoregulation abilities of central rat snakes in an agriculturally-fragmented forest environment in Clark County, Illinois. Three rat snakes were relocated daily or on alternate days. Using ArcView GIS, I quantified available habitat as well as that used by rat snakes to test for selection of edge habitat. I calculated home range sizes using the minimum convex polygon method. Additionally, snake thermoregulation effectiveness was compared between forest and forest-edge habitat. Subjects preferred forest and forest-edge habitat to agricultural fields and grasslands. Snakes did not prefer edges to forest, perhaps due to the amount of edge habitat available (up to 50 % within a home range). Ambient temperature and snake core body temperature differed between forest and forest-edges. Thermoregulatory effectiveness did not differ between the two habitat types however. That the effectiveness of thermoregulation is similar between forest and edge habitat may account for the lack of preference by rat snakes for edge habitat.



Fig. 2 – Central Rat Snake (*Elaphe spiloides*)

Introduction

- Habitat fragmentation causes habitat loss, reduced patch size, increased distance between patches, and increased amount of edges [Fig. 1; 1,14].
- An increased amount of edge habitat is accompanied by a variety of negative impacts
 - more variability in abiotic parameters [10].
 - increased predation/competition among species [9].
 - increased range expansion of exotic species [5].
- However, *Elaphe* (Fig. 2) has been shown to prefer edges [4], possibly due to
 - an increased number of avian and small mammalian prey [2].
 - an increased ability to thermoregulate [12].

Purpose of research

- To determine the home range of individuals during the activity season.
- To determine the habitat use by central rat snakes in a heavily fragmented forest.
- To determine if snakes selected for forest edges.
- To determine rat snakes thermoregulatory effectiveness in forest and forest edges.

Methods

- Radio-transmitters including thermistors (providing snake body temperature - ± 0.5 °C) were surgically implanted into adult snakes [6].
- At initial capture and relocations:
 - the coordinates of each snake's position was recorded using a global positioning system.
 - ambient temperature (thermometer) and body temperature (thermistor) were recorded.
- Using ArcView GIS:
 - UTM coordinates were plotted on Illinois Digital Orthophoto Quadrangle (DOQ) maps.
 - eight defined habitat types were quantified.
 - home ranges were calculated using the minimum convex polygon (MCP) method [7].
- Chi-squared tests were performed to detect habitat preferences.
- I used $d_e - d_b$ to calculate effectiveness of thermoregulation [4] in forest and edge habitats where
 - d_e = the deviations of the ambient temperatures from the preferred body temperature range (T_{ser}) of 26.5 °C – 29.8 °C [3].
 - d_b = the deviations of the subject's body temperatures from T_{ser} .
- Univariate analyses of variance (ANOVAs) were conducted on all thermoregulatory data to detect differences in thermoregulatory effectiveness between forest and edges.

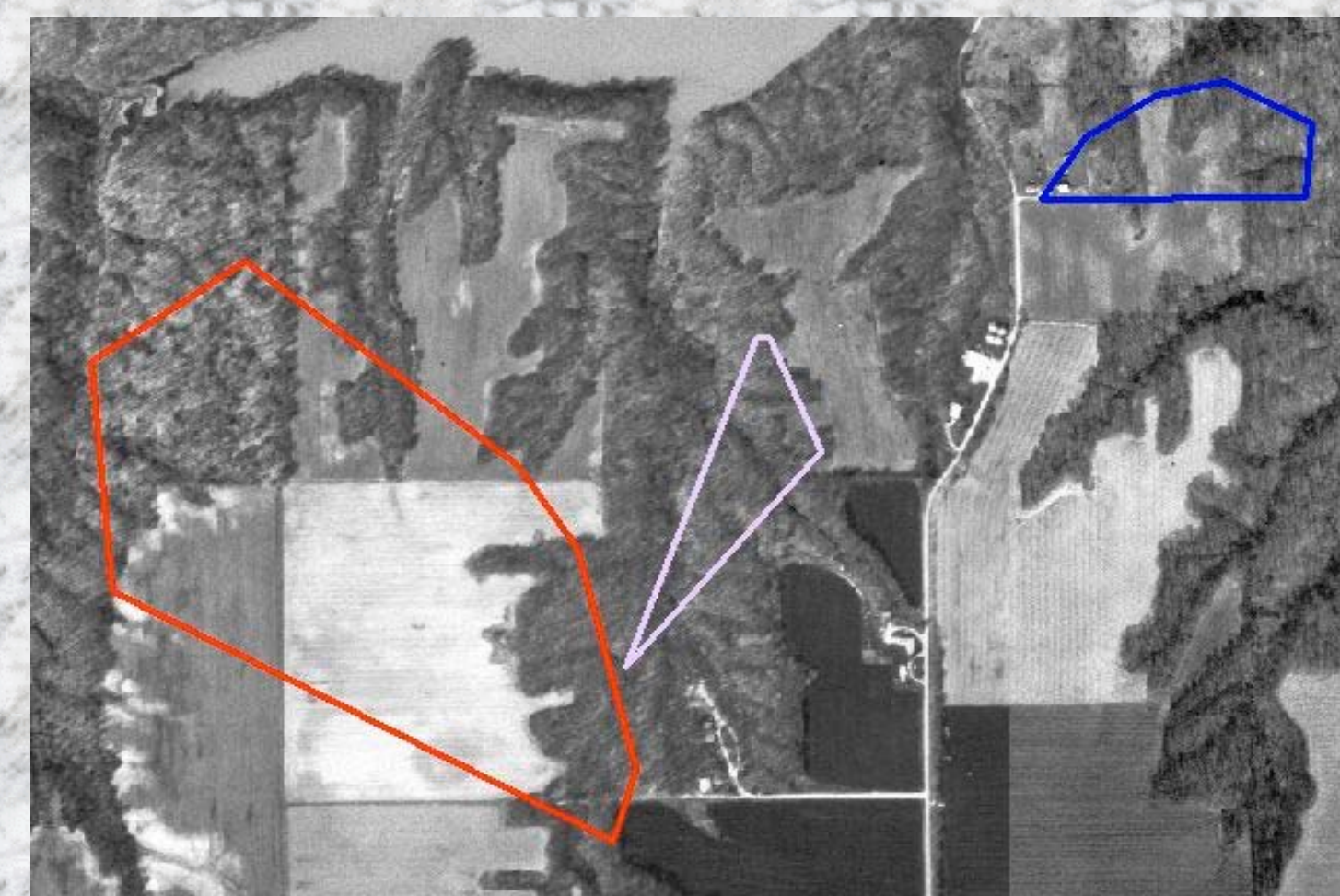


Figure 3 – DOQ photo of study site showing home ranges of subjects.

Results

- Snake home ranges varied from 3.0 ha to 27.1 ha (Fig. 3, 4).
- Snakes used all eight habitat types in a non-random fashion, including the four most common types ($\chi^2 = 26.4$, $df = 7$, $P < 0.001$; Table 1).
- Snakes did not exhibit a preference of edges to forest interiors ($\chi^2 = 1.94$, $df = 1$, $P = 0.222$).
- Ambient temperatures and snake body temperatures differed between forest and forest edges ($F_{(1,113)} = 35.04$, $P = 0.00$ and $F_{(1,111)} = 16.786$, $P = 0.003$, respectively).
- Thermoregulatory effectiveness of rat snakes did not differ between forest and edge habitat ($F_{(1,97)} = 0.821$, $P = 0.37$).
- Corrected for body size, thermoregulatory effectiveness did not differ among snakes ($F_{(2,97)} = 0.563$, $P = 0.572$).

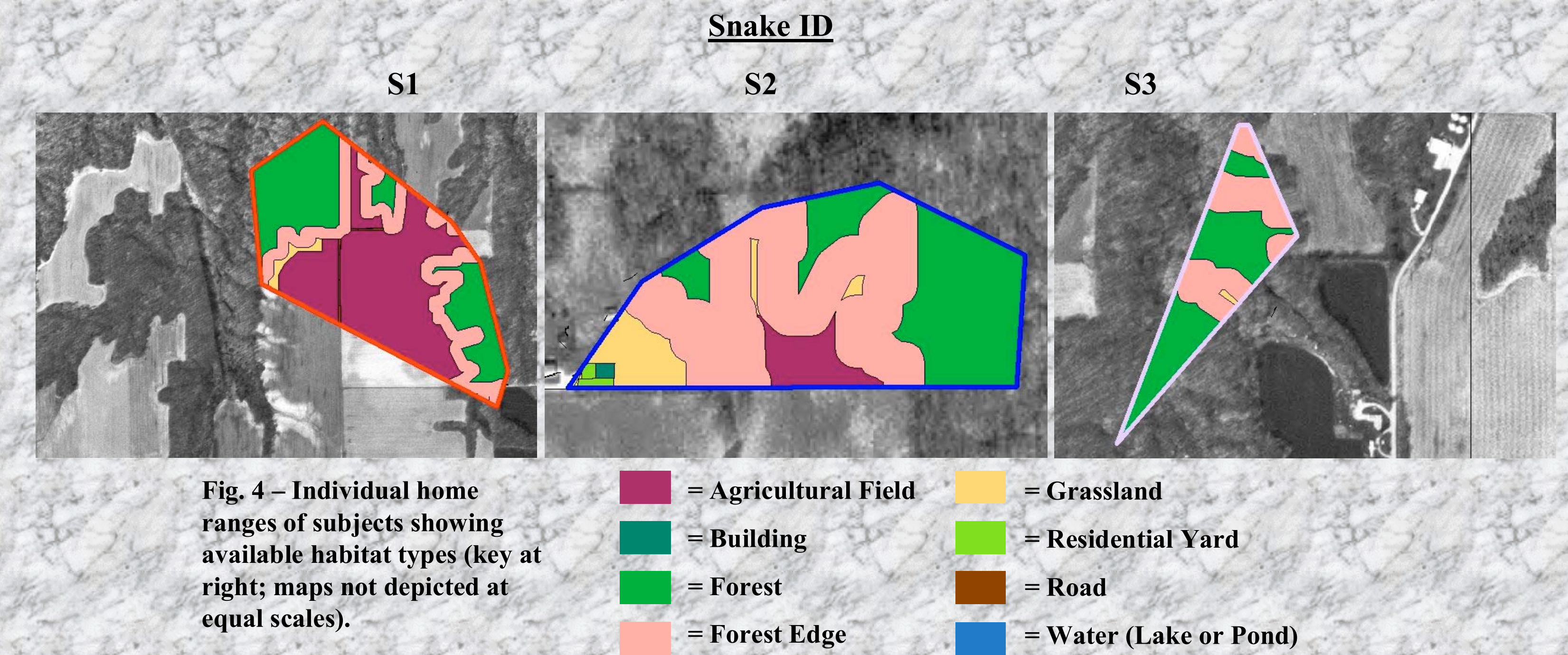


Fig. 4 – Individual home ranges of subjects showing available habitat types (key at right; maps not depicted at equal scales).

Table 1 – Actual and expected number of relocations between habitats of all snakes, showing preference for forest and edges, and avoidance of fields and grasslands.

Habitat Types	Snake ID S1		Snake ID S2		Snake ID S3	
	Actual	Expected	Actual	Expected	Actual	Expected
Agricultural Field	0	6.6459	0	1.5938	0	0
Building	0	0	1	0.09522	0	0
Forest	7	4.4648	10	7.5219	4	7.4899
Forest Edge	8	3.4197	11	11.7235	9	5.4225
Grassland	0	0.2115	0	1.8473	0	0.0876
Residential Yard	0	0	0	0.18768	0	0
Road	0	0	1	0.03059	0	0
Water (pond/lake)	0	0.0043	0	0	0	0

Conclusions

- Data include 129 relocations yielding 51 sample points.
- Although I used a small sample size, all calculated home ranges were within reported values of 1.4 ha [13] and 28.3 ha [11].
- Snakes exhibited a preference for forest and edges, avoiding more open habitat types (agricultural fields and grasslands), but did not prefer edges to forest interiors.
- This habitat use is similar to that of a nearby population in Vermillion County, Illinois [8] - geographic difference in habitat use patterns may exist between rat snake populations of central Illinois and those in the Northeast U.S. and Ontario [2,3,4].
- The similarities of thermoregulatory effectiveness between forest and edges may account for this lack of preference by rat snakes for edge habitat.
- Lack of preference by rat snakes for edge habitat may be due to the amount of edge habitat available at the study site however.

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