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Project Title: “Predation of Grassland Songbirds by *Elaphe obsoleta* and Other Predatory Snakes”

Abstract:

Grassland songbird populations have been declining in recent years because of loss of native grasslands. The native warm season grasslands that are left are the only refuge for these declining populations. The size of these grasslands may be directly related to the success of these populations based on factors such as predation impact. Smaller grasslands may have lower reproductive success because edge predators, such as snakes, can easily penetrate the interior of the grassland, thus providing no refuge from predators to the songbirds. This project was designed to test the hypothesis that large grasslands have lower abundances of snake predators in the interior than smaller grasslands. This was accomplished by trapping snakes in the interiors of both large and small grasslands with drift fences. Box traps and funnel traps were placed along these drift fences to access the abundance and diversity of snake populations within these two habitats.

Objectives:

The first objective is to test the hypothesis that snake densities are higher in smaller grassland interiors than in larger grassland interiors areas, which may lead to higher songbird mortality. The second objective is to obtain diversity and species richness data of snakes in relation to small and large grassland interior habitats.

Introduction:

Grassland songbird populations are in steady decline and wildlife organizations are becoming more concerned about the management of these declining populations. The Breeding Bird Survey Analysis has shown a negative trend in the majority of grassland songbirds (Sauer et al. 2005). Grasslands are being converted into agricultural farmlands and decimating the grassland songbird populations. On the grasslands that are left, songbird management is important; nest predation by other birds, mammals, and reptiles has a major effect on songbird nest success. Numerous studies have documented nest predation as being an important factor of grassland songbird breeding success (Stoddard 1931, Martin 1993, DeVos and Mueller 1993, Puckett et al. 1995).

Increased edge may be the cause of increased nest predation. Smaller grasslands allow predators to penetrate the interior of the grasslands and allow little refuge to songbirds from predators. In Gates and Gysel (1978), fledgling success was positively and strongly correlated to increase in distance from the edge. Reproductive success has been proven to be lower in smaller grasslands (Robinson 1992, Paton 1994), which may be related to increased penetration into the interior of the grassland by nest predators such as snakes. Larger fields have been predicted to have lower predation rates because predators are discouraged from foraging further away from edges and into more open spaces (Newton and Heske 2001). Some snake species that will hunt for, or opportunistically predate songbirds and their nests include black rat snakes (*Elaphe obsoleta*), black racers (*Coluber constrictor*), and some species of kingsnakes (*Lampropetis calligaster* and *L. getulus*).

In one northern bobwhite (*Colinus virginianus*) study, snakes accounted for 34% of all nest depredations, which was the greatest percentage of any nest predator (Staller et al. 2005). Raccoons (*Procyon lotor*) were the next most frequent predator of the study accounting for 29% of the nest predations. According to Weatherhead, Blouin-Demers, and Cavey (2003), black rat snake (*Elaphe obsoleta*) diets consisted of 30% avian prey with a peak of avian prey during the nesting season. Stake et al. reported black rat snakes, eastern racers (*Coluber constrictor*), and yellow-bellied kingsnakes (*Lampropeltis calligaster*) at nests with video recorders (2005). They recorded the snakes removing the entire contents of the nest 79% of the time, emptying the nests 20% of the time, and at the remaining 1%, snakes were recorded removing one of the four nestlings after consuming the adult female. The other three nestlings later died due to exposure to the elements.

Materials and Methods:

Study Site:

Military installations provide excellent areas for grassland management. These large tracts of land can provide the necessary training areas while also providing ample grasslands for songbird management. Fort Campbell is one of the largest remnant grasslands east of the Mississippi River containing approximately 10,000 ha (Buehler et al. 2000). This installation is managed intensively for grasslands with prescribed fires to allow for drop zone training areas, firing ranges, and other combat training zones. Eighty-seven songbird species have been identified as breeding at Fort Campbell (Buehler et al. 2000). These include some songbirds whose populations are in decline such as *Ammodramus henslowii* (Henslow's sparrows), *Ammodramus savannarum* (grasshopper sparrows, *Spiza americana* (dickcissels), *Eremophila alpestris* (horned larks), etc. (Buehler et al. 2000).

Haynes Bottom wildlife management area is located in Montgomery County Tennessee and is owned and managed by the Tennessee Wildlife Resources Agency. The main focus of this management area is on waterfowl hunting. Other hunting opportunites are provided as well. Another part of the management of this area involves grassland bird populations. This area has several large grasslands consisting of many different native warm season grasses that quail, and grassland songbirds prefer to nest in. The last area was a private farm in Todd County Kentucky. The farmer is interested in wildlife management and has planted several fields in native warm season grasses. These fields consist mostly of indian grass and broomsedge as well as various herbaceous vegetation.

Methods:

Methods for sampling grassland habitats included funnel traps, box traps, and visual encounter surveys. Four arrays were constructed, two on the private farm in Kentucky and two in the Haynes Bottom area. Arrays were not constructed on Fort Campbell because they would interfere with soldier training. Each site consisted of four drift fences, each approximately 30 meters long, erected to create an X shape. Silt fencing was used because it was cheaper and easier to manipulate, as opposed to tin. A trench was dug approximately 15-20 cm deep to bury the bottom flap of silt fencing to prohibit most snakes from burrowing underneath. A 1.2m x 1.2m (4ft. x 4 ft.) box trap with four funnels was placed in the middle of the X, or cross. The sides were made of screen mesh

and the tops and bottoms wood. Approximately 1m of each top was hinged for easy opening to retrieve any snakes or other animals. A dish of water was placed in the box traps and funnel traps to keep snakes and other captures from dehydrating. Traps were checked every other day during a week interval. After that interval, the traps were shut down at one area and opened at the other. A trap door was installed and secured with wire to each box trap. This trap door was left open and allowed any animals to leave when the traps were shut down. Along each of the four branches two funnel traps were placed approximately 27 meters from the box trap. The bodies of these funnel traps were constructed from ¼ inch screen mesh and secured with zip ties. Two funnels will also be made from ¼ inch screen mesh and inserted into the bodies. These funnel were removable to allow easy removal of any captures or funnels may be removed when traps were shut down.

Each funnel trap is considered one trap as well as each funnel of the box trap is considered one trap. Each box trap only has four funnels but each funnel is divided by an extending piece of hardware cloth inserted into each funnel and connected to the drift fence. This inhibits any snakes from entering one side and leaving through the other. Therefore, each box trap is considered to consist of eight traps. Weight, length, and sex of all snakes were recorded as well as distance from nearest edge. Edge was said to be any compilation of herbaceous or woody vegetation that would be large enough to provide cover and or ample habitat for snakes. We marked all captured snakes by clipping the third ventral scale anterior to the vent. This did not injure the snake, yet the mark could be observed throughout the duration of the study. No data was taken for other captures besides species identification and abundance.

Visual encounter surveys were conducted in accordance with another project that consisted of searching for grassland songbird nests. The surveys were conducted between 5:00 am and 11:00 am daily at all three areas. When snakes were encountered, an attempt was made to capture it. If the attempt was unsuccessful, approximate length, distance from nearest edge, and a GPS data point was taken. If the attempt was successful, weight, length, sex, distance from nearest edge, and a GPS data point was collected. All snakes captured were marked as well in case of recapture.

Results:

Throughout the duration of visual encounter surveys conducted daily from April 30th through July 11th 2007, thirty-three snakes were captured comprising eight species (Table 3). Thirty-five percent of all incidental captures were *Coluber constrictors*. Of these black racers, none caught or observed were less than 61 cm in total length. Only four out of twelve *Coluber constrictors* were observed less than twenty-nine meters from the nearest edge. No *Elaphe obsoleta* individuals were less than 109 cm in total length. The average distance that a snake was found from the edge was sixty-three meters.

A total of eighteen snakes were captured with the box trap arrays consisting of four species (Table 1). Thirteen of the snakes were caught in box traps while only five there caught in funnel traps. We had a total of 896 trap nights during the duration of the study. For catch per unit effort for each site see table 2. Neither *Elaphe obsoleta* nor *Lampropeltis calligaster* were caught in the interiors of large grasslands, and only one *Coluber constrictor* out of ten was caught in the interiors of large grasslands. This is interesting because these three species are considered to be main predators of grassland

songbird populations. One *Thamnophis sirtalis* was caught in the large grassland interiors as compared to three in the small grasslands. This is not as much of a concern because *Thamnophis* species are not considered to be avian predators.

Table 1. Box trap array captures.

Species	Number caught	Number male	Number female
Elaphe obsoleta	2	1	1
Lampropeltis calligaster	2	0	2
Coluber constrictor	10	5	5
Thamnophis sirtalis	4	1	3
Total	18	7	11

Table 2. Catch per Unit Effort for each grassland. The unit of effort is one trap night.

Field	CPUE	Average number of trap nights to capture one individual
Haynes Bottom small	0.026	38
Haynes Bottom large	0	Unknown
Private farm small	0.049	20
Private farm large	0.009	111

Table 3. Visual encounter survey captures.

Species	**Distance from nearest edge (meters)**	**Sex**	**Total length (inches)**
Elaphe obsoleta	95	M	64
	95	F	61
	50	M	57
	5	F	43
	5	F	51.8
Coluber constrictor	100	U	approx 24
	95	F	53
	70	U	approx 36
	60	F	46.25
	50	U	approx 30
	50	U	approx 36
	43	F	36.2
	29	F	38
	15	F	26
	15	U	approx 30
	7	U	approx 36
	5	F	43.5
Storeria dekayi	300	M	8.5
	100	F	11.2
	60	F	9.7
	40	M	9.6
	15	M	10
	10	F	9.5
Thamnophis sirtalis	125	U	approx 30
	10	U	U

Thamnophis sauritus	2	M	22.1
Lampropeltis calligaster	40	M	11.9
Lampropeltis getula	95	M	38
	95	M	40.1
Opheodrys aestivus	370	F	31
	20	F	26
	2	F	29.8
	2	M	28.4

Discussion:

There were some individuals that did skew the data of the visual encounter surveys. The only *Thamnophis sauritus* was found dead two meters from the edge. This individual could have been move by the animal that depredated it or by a scavenger, however this is not significant since this species is not a species that predates songbirds. Two *Lampropeltis getula* were found 95 meters from the nearest edge, but were found under a large piece of wood. This could be considered as edge, or cover for the snakes. Also, an *Opheodrys aestivus* was found approximately 320 meters but was found in a field of timothy, where as the other four individuals were found < 20 meters from the nearest edge in grasslands or scrub/shrub areas. Excluding these four individuals from the average distance from the edge would give an average of 52 meters.

The total number of trap nights for the box trap arrays was 896. There were an equal number of trap nights for each of the four arrays (224). By calculating the catch per unit effort, it is evident to see that small grasslands had more snakes occurring in the interiors than large grasslands (Table 2). It took an average of twenty and thirty-eight trap nights on the two small grasslands to capture one individual. On the other hand, it took 111 nights to capture an individual in one large grassland, and no snakes were caught in the other grassland. This is consistent with my data from the visual encounter surveys that stated that on average snakes rarely penetrate farther than 52 meters. The farther from the edge, the less likely a snake is willing to travel because of more of a predation risk, thus that is the reason we caught few snakes in the large grassland interiors. Also, the two snakes that were caught in large grassland interiors (one *Coluber constrictor* and one *Thamnophis sirtalis*) were both female. These two captures may have coincided with the movement of these females to their nest sites and may not be directly related to avian populations or distance from nearest edge.

I cannot compare the data from the visual encounter surveys to the data from the box trap arrays because more fields were sampled using the visual encounter surveys than were sampled with box traps. I feel that it is worth to mention that only six snakes were caught incidentally in the same fields that were being trapped with the box trap arrays but only one was caught during visual encounter surveys. Of these six snakes, three *Storeria dekayi* were found under ground while digging the trenches for the fencing to be placed in. Also, one *Coluber constrictor* was found in front of the trencher as we were digging the trench. This implies that at least in these fields, the box traps were superior in

catching snakes (eighteen), than were visual encounter surveys. Also, the fields were searched more than they were trapped as well. As stated above, the traps were only open for a week, then closed down for a week, and the cycle repeated. This was because we did not have enough funding to drive to both area and check the box traps every other day.

Conclusion:

Of the twenty-nine snakes captured with visual encounter surveys, only eight penetrated farther than 60 meters. This excludes the four outlying snake captures. Also, for the box trap captures, only one snake (*Coluber* constrictor) was recorded in large grassland interiors. *Elaphe obsoleta*, *Lampropeltis calligaster*, and *Lampropeltis getula* were not observed to be present in interiors of large grasslands. Since the four species mention are the main four predators to grassland songbirds and were not encountered, except for one incident in the interiors of large grasslands, my data suggests that large grasslands would provide grassland songbirds with refugia from snake predators. My data also suggests that if snakes are going to be the focus of management, then several small grasslands would increase snake populations because they would not have to venture as far away from cover to obtain food resources such as small mammals and avian prey.

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