

HIGH RISK FEEDING AND FOOD PREFERENCE IN THE EASTERN GRAY SQUIRREL, *SCIURUS CAROLINENSIS*

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ABSTRACT

Foraging Eastern gray squirrels (*Sciurus carolinensis*) were observed for a period of three weeks to analyze their risk behavior, as well as their food preference. We set up a grid of 20 or 25 feeding sites on a lawn bordering a small woodlot on the southern side of the Brumbaugh Science Center of Juniata College (Huntingdon, Pennsylvania). The study area was chosen because of prior sightings of grey squirrels there. Our data showed that the squirrels would collect peanuts at varying distances from cover (distance from the woodlot) with equal frequency. The squirrels also preferred peanuts over sunflower seeds.

Keywords: Food preferences, grey squirrels, optimal foraging, risk of predation, *Sciurus carolinensis*

INTRODUCTION

The eastern gray squirrel (*Sciurus carolinensis*) is one of eight species of tree dwelling squirrels that inhabit the United States, and one of hundreds of species worldwide. The eastern gray squirrel can be found as far north as Maine, south into Florida and Texas, and as far west as the Dakotas. Normally they grow to be about 18 inches long and weigh between 12 to 26 ounces. Males and females are similar in size and color. They build arboreal nests consisting of leaves, twigs, moss, and sticks and other materials. The eastern gray squirrel may live 15 to 20 years in captivity, but often survive only one year in the wild. Deaths can be attributed to disease, malnutrition, and predation by red-tailed hawks, crows, weasels, foxes, owls, raccoons, cats, dogs, cars, and humans (Ackerman 1995).

The diet of the eastern gray squirrel consists of nuts, acorns, flower shoots, seeds, truffles and other fungi, fruit, insects, tree buds, baby birds, and carrion. Squirrels prefer to eat in the safety of a tree, as they are much more vulnerable on the ground. They most often carry their food to a low branch and eat while holding their food with both hands and keeping an eye on the ground (Lipske 1997). Eastern gray squirrels have a highly adapted sense of sight, even in dim light, as well as a wide field of vision. This trait along with their tough curved claws and the ability to reverse their hind foot 180 degrees makes them highly adapted for climbing trees. They are excellent climbers and can leap considerable distances using their powerful hind limbs (Campbell 1999).

Foraging activity of gray squirrels peaks in the morning, about 2 hours after sunrise, and in the evening, about 2-5 hours before sunset (Halloran 1999). One reason for this bimodal activity may be that temperatures are more moderate during mornings and evenings. If foraging activity is focused at these times rather than the afternoon, exposure to extreme temperatures is minimized (Bryce 2001).

Gray squirrels are non-territorial, with overlapping home ranges that average 5 hectares in size. This is where the squirrels do most of their foraging for food, making nests, and rearing young. Due to an increase in their range during the breeding season, males have a slightly larger range than females, but there is little territorial behavior and many home ranges overlap. Individual squirrels are often seen feeding close to each other without any aggressive activity, but this is due to their acceptance of others which is dependent upon food supply and squirrel population density. These densities are highest in habitats where the numbers of tree species that produce food are highest (Campbell 1999).

We hypothesized that since gray squirrels live in relatively safe wooded areas where it uses its keen climbing ability to escape predation, they should prefer to feed closer to wooded areas than farther away in open areas. We also hypothesized that the squirrels would prefer large peanuts offer smaller sunflower seeds and that they would less likely venture into an open area for sunflower seeds than for peanuts.

METHODS AND MATERIALS

A squirrel foraging area was set up prior to the first day of our experiment, which was conducted from March 27 to April 17, 2003. We set up a grid of twenty feeding sites each 25 to 30 ft. apart (Fig. 1) on a lawn bordering a small woodlot on the southern side of the Brumbaugh Science Center of Juniata College (Huntingdon, Pennsylvania). The grid bordered a woodlot where gray squirrels had frequently been observed, as well as various potential predators, including crows, hawks, dogs, humans, and raccoons. Each feeding area contained two shelled unsalted *Fowlers Famous* roasted peanuts. We marked each sight with blue ribbon tied to sticks placed in the ground at all feeding sights. We observed squirrels from 7:00am till 8:00am and again from 3:00pm till 4:00pm Monday through Friday near the Juniata College Observatory. During these observations we placed two new peanuts if they were eaten and collected data from the feeding sights by noting where the peanut were missing. We also noted squirrel behavior during these times.

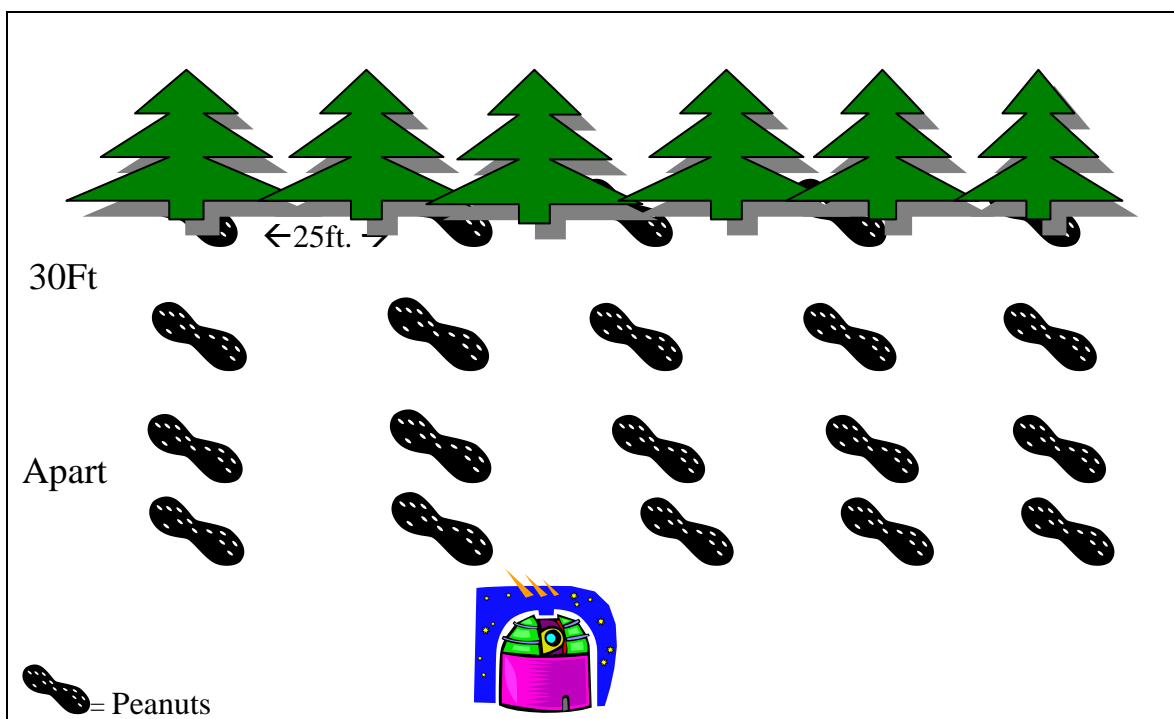


Figure 1. During week one, the squirrel feeding grid behind the Brumbaugh Science Center of Juniata College (Huntingdon, Pennsylvania)

During the second week, started on April 3, 2003 we increased the distance between feeding sites to 50 ft and added another row of feeding sights, for a total of twenty-five sites (Fig. 2). We assumed that increasing the distance between the feeding sites also increased the risk of foraging at them.

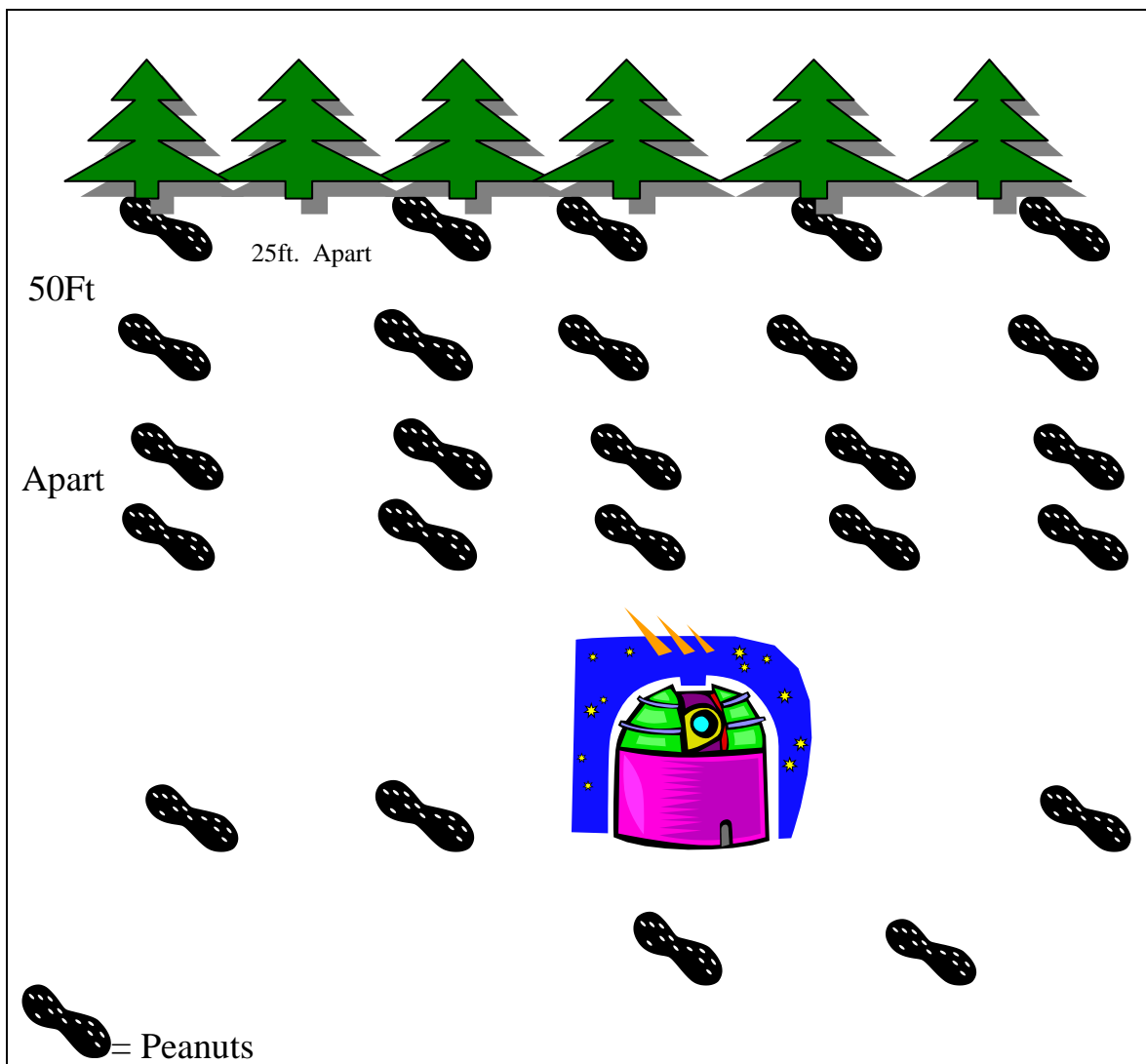


Figure 2 . During week two, the squirrel feeding grid behind the Brumbaugh Science Center of Juniata College (Huntingdon, Pennsylvania)

During the third week, which started on April 24, 2003, we tested the food preference of the squirrels. Three of the rows were switched from peanuts to sunflower seeds (Fig. 3). All other procedural methods stayed the same.

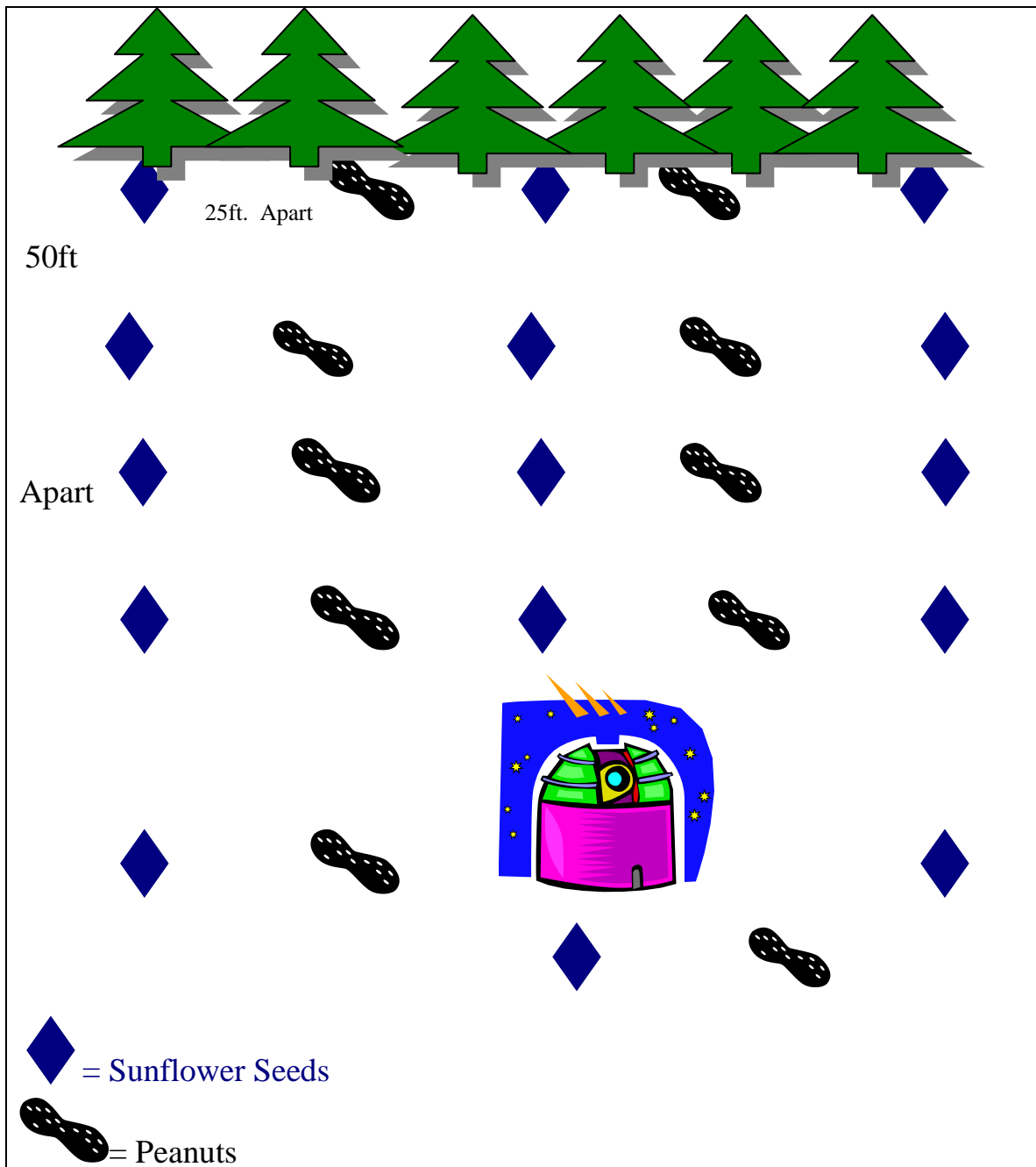


Figure 3. . During week three, the squirrel feeding grid behind the Brumbaugh Science Center of Juniata College (Huntingdon, Pennsylvania)

RESULTS

During our first week of observation (Table 1), the squirrels did not show a preference for low risk peanuts close to the woods. They missed the lowest risk peanuts, located in the cover of the edge of the woods for the first few days, and were observed running out to the furthest feeding site and then slowly

making their way back stopping at each sight to eat peanuts. The average number (out of a possible five at each distance) of sights visited by squirrels was 4.2 at 0 ft, 4.9 at 30 ft, 4.8 at 60 ft, and 4.9 at 90 ft from the woods. Our null hypothesis that squirrels would consume the same amount of peanuts at each different distance, could not be rejected ($\chi^2 = 0.386$, $P = 0.945$).

Table 1. Week one data of squirrel foraging behavior: number of feeding sites visited each day at various distances from the woods (out of a possible 5 sites for each distance).

	Number of feeding sights visited by squirrels at various distances				Total	Mean	Standard Dev.
	0ft	30ft	60ft	90ft			
Thursday 7:00 AM	1	5	3	4	13	3.25	1.71
1:00 PM	3	4	5	5	17	4.25	0.96
Friday 7:00 AM	3	5	5	5	18	4.50	1
1:00 PM	5	5	5	5	20	5.00	0
Monday 7:00 AM	5	5	5	5	20	5.00	0
1:00 PM	5	5	5	5	20	5.00	0
Tuesday 7:00 AM	5	5	5	5	20	5.00	0
1:00 PM	5	5	5	5	20	5.00	0
Wednesday 7:00 AM	5	5	5	5	20	5.00	0
1:00 PM	5	5	5	5	20	5.00	0
Total	42	49	48	49			
Average	4.2/5	4.9/5	4.8/5	4.9/5			
Standard Dev.	1.4	0.32	0.63	0.32			

The squirrels did not show a preference for low risk peanuts close to the woods even after the risk factor was significantly increased in our new set up during the second week of our observations (Table 2). The squirrels ate 100% of the peanuts at each distance everyday of the week.

Table 2. Week two (increased risk factor) data of squirrel foraging behavior: number of feeding sites visited each day at various distances from the woods (out of a possible 5 sites for each distance).

	Number of feeding sights visited by squirrels at various distances					Total	Mean	Standard Dev.
	0ft	50ft	100ft	150ft	200ft			
Thursday 7:00 AM	5	5	5	5	5	25	5	0
1:00 PM	5	5	5	5	5	25	5	0
Friday 7:00 AM	5	5	5	5	5	25	5	0
1:00 PM	5	5	5	5	5	25	5	0
Monday 7:00 AM	5	5	5	5	5	25	5	0
1:00 PM	5	5	5	5	5	25	5	0
Tuesday 7:00 AM	5	5	5	5	5	25	5	0
1:00 PM	5	5	5	5	5	25	5	0
Wednesday 7:00 AM	5	5	5	5	5	25	5	0
1:00 PM	5	5	5	5	5	25	5	0
Total	50	50	50	50	50			
Average	5.0	5.0	5.0	5.0	5.0			
Standard Dev	0.0	0.0	0.0	0.0	0.0			

Week three data showed that the squirrels preferred peanuts over sunflower seeds (Table 3; $\chi^2 = 17.73$, $P < 0.001$). However, having a less preferred food source present did not change the risk behavior in squirrels. The seeds appeared to be taken by squirrels only at the high risk feeding sights at 150-200 ft from the trees.

Table 3. Week three data of squirrel foraging behavior: number of peanut feeding sites visited (possible of 2) each day as compared to the number of sunflower seed sites (possible of 3) visited each day at particular distances.

	Number of feeding sights visited by squirrels (possible number of peanuts = 2, seeds =3)									
	0ft		50ft		100ft		150ft		200ft	
	peanuts	seeds	peanuts	seeds	peanuts	seeds	peanuts	seeds	peanuts	seeds
	2	0	2	0	2	0	2	1	2	0
1:00 PM	2	0	2	0	2	0	2	0	2	1
Friday 7:00 AM	2	0	2	0	2	0	2	1	2	1
1:00 PM	2	0	2	0	2	0	2	1	2	1
Monday 7:00 AM	2	0	2	0	2	0	2	1	2	0
1:00 PM	2	0	2	0	2	0	2	1	2	1
Tuesday 7:00 AM	2	0	2	0	2	0	2	0	2	0
1:00 PM	2	0	2	0	2	0	2	1	2	1
Wednesday 7:00 AM	2	0	2	0	2	0	2	0	2	1
1:00 PM	2	0	2	0	2	0	2	1	2	1
Total	20	0	20	0	20	0	20	7	20	7
Average	2	0	2	0	2	0	2	0.7	2	0.7
Standard Dev.	0	0	0	0	0	0	0	0.48	0	0.48

DISCUSSION

Our data show that gray squirrels in our study area foraged for peanuts at all sites regardless of possible differences in predatory risk. They did not prefer to feed closer to cover than out in the open, even though potential predators had been observed in the vicinity. They also appeared to show no fear toward people, as they fed within a few feet of us, even when we were walking about replenishing food on the feeding grid.

However, the grey squirrels preferred to eat peanuts rather than sunflower seeds. Perhaps the squirrels perceived the seeds as not being as worth the risk to collect in an exposed habitat than were the larger peanuts. However, even the sunflower seeds were consumed by squirrels in high-risk areas (150 ft and 200 ft from the woods).

More data are needed to determine whether squirrels in our study area actually take into account predatory risk while foraging, as predicted by optimal foraging models (Ricklefs and Miller 2000). Future studies should consider ways of increasing the risk factor. It is possible that we didn't create a situation of high enough risk. Another possibility is to perform this study on squirrels that do not live in a highly human populated area. Because the squirrels live on a college campus, high-risk behavior may be beneficial for their survival. Humans are messy with their food and give risk-taking squirrels many opportunities for obtaining a meal.

LITERATURE CITED

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