

DELMARVA FOX SQUIRREL STUDY
BLACKWATER NATIONAL WILDLIFE REFUGE
REPORT #3 (1980)

Purpose:

This study was carried out to determine the Delmarva fox squirrel population in the 52 acre Egypt Road tract, and to increase the scientific knowledge of the life history and habitat preference of the endangered squirrel. The first census in this location was conducted in 1970-71, and the second in 1976. The original objectives of the study were: (a) to accurately determine the existing population of Delmarva fox squirrels on one major type of Blackwater refuge woodland, (b) to gather base data for population comparisons in the timber stand improvement (TSI) area of the block as to an adjacent woodland area, and (c) to evaluate the censusing method of leaf nest counts.

Justification:

The Delmarva fox squirrel (Sciurus niger cinereus) is a large grayish colored tree squirrel inhabiting four counties of the Eastern Shore of Maryland, with introductions at Chincoteague National Wildlife Refuge, Virginia. This subspecies of fox squirrel is on the endangered species list maintained by the U.S. Department of the Interior. Hunting of this squirrel has been prohibited in Maryland since 1971.

Information such as critical or preferred habitat types and best management techniques for the squirrel are needed to provide criteria for possible future management practices. Through population studies such as this one, squirrel densities in different types of woodlands can be determined. This can then

serve as an indication of the habitat types of greatest value to the survival and recovery of the species.

The study will also provide data for use by the Delmarva Fox Squirrel Recovery Team in evaluating possible restocking programs.

Method:

The same method used in this study in previous years, mark-recapture, was again used for determining the population. The study area laid out in 1970 by a grid system covering the entire 52 acre block located adjacent to Egypt Road was used. Seven transect lines, spaced five chains (330') apart, run magnetic east-west. A post every three chains (198') along the transect lines mark the trap locations. Twenty-nine grid points are in the 52 acre block (see Diagram 1).

One live trap was placed at each grid point. All traps except the eight in Line 5 were pre-baited using ear corn on November 7. Traps were wired open until the evening of November 9 (Sunday), at which time the trapping operation began. These 21 points were trapped Monday through Friday for two weeks. The traps in Line 5 were set during the second week, beginning November 16. All traps were set in the evening at dusk and checked mid-morning after active feeding time. They were left closed during the day and on the weekend, with the corn left in. This procedure was then repeated in December, with pre-baiting December 5 and traps set beginning December 7.

Captured fox squirrels were anesthetized briefly using metofane and then toe-clipped for marking. A numbering system already used by the Delmarva Fox Squirrel Recovery Team on the refuge was followed. The squirrels recovered from the drug in five

to ten minutes and were held fifteen to twenty minutes before being released at the site of capture.

The toe-clip method of marking has proven to be better than the ear tagging, color marking, and ear tattooing methods used in the past. It does not have a detrimental effect on the squirrel, as do tagging and color marking, and is an identification easily recognized for the life of the animal.

Gray squirrels were marked by clipping fur off the end of the tail so that they could be recognized during the trapping period. No permanent markings were used.

All capture data was recorded (see Chart #1), including non-target species and apparent trap malfunctions. The fox squirrel population was determined using the Lincoln index, or mark-recapture ratio. The formula used in this index to calculate estimated population is $N = Tn/t$, where:

T = number marked in the pre-census period
t = number of marked animals trapped in the census period
n = total animals trapped in the census period
N = population estimate

Leaf nests in the block were counted in January 1981. Two to three people in a line made a sweep of each transect, counting nests which appeared to have been built during the current year. Wooden nesting boxes placed in 1975 as part of a Delmarva Fox Squirrel Recovery Team study were checked for nests in February and March.

Results:

Twenty Delmarvas were caught during the two-week pre-census period in November. Thirteen of these were toe-clipped, while the

remainder had already been clipped as part of other studies. Four of the twenty were caught a second time. There were eleven males and nine females (five juveniles).

During the two-week census period in December, twelve Delmarvas were captured. Three of these were new captures (two males and one female) and two of them were captured on the last day of trapping. Of the twelve, five were females and seven were males. Two squirrels were captured a second time and one a third time. (See Chart #1 for complete results.)

There were no apparent mortalities due to anesthetics or handling, and all squirrels seemed healthy. The toes of most squirrels that had been clipped in the past seemed to have healed satisfactorily. The clipped toes on two very active squirrels, however, were observed to be bleeding, probably due to repeated crashing against the wire cages. One of these was caught again later in the study and the toe appeared to have healed. No evidence of ear tattoos from 1976 marked squirrels was observed.

The weather during the two periods was comparable. Although it did average warmer during November, the temperature ranges were the same, and the overall effect on trapping success should have been minimal. (See Table 1 for weather data.)

Based on the data collected, and using the mark-recapture ratio, the estimated population in the study area is as follows:

$N = Tn/t$, where N = population estimate
 T = number marked in pre-census period
 n = total trapped in census period
 t = marked animals trapped in census period

$N = 20(12)/9 = 26.6$, or approximately 27 squirrels

Standard Error = $\sqrt{\frac{T^2 n (n-t)}{t^3}} = \sqrt{\frac{(20)^2 (12) (12-9)}{(9)^3}} = \sqrt{19.75} = 4.45$

95% Confidence Limit = $27 \pm 4.4 = 23 \rightarrow 31$ squirrels

Only four gray squirrels were captured during the four weeks of trapping, and all were on the western half of the grid, as in 1976. Two were caught in the November period and again in December, with two new ones being caught on December 7th and 10th (last trap days). Using this data in the mark-recapture ratio, the population of grays is:

$$N = Tn/t = 2 * 4 / 2 = 4 \text{ squirrels.}$$

Summary of Delmarva Fox Squirrel Totals:

<u>NOVEMBER</u>	<u>DECEMBER</u>
Total = 20 DFS	Total = 12 DFS (3 new)
15 adults:	3 adults:
11 adult male	2 adult male
4 adult female	1 adult female
5 juveniles:	0 juveniles
5 juvenile female	
0 juvenile male	
TOTAL: 18 adults, 5 juveniles	

Leaf Nests:

A total of 65 limb and trunk nests were counted. This total included 37 in pines, 28 in hardwoods (see diagram #2), and 30 in nesting boxes. It is not possible to distinguish gray squirrel nests from fox squirrel nests in the boxes, so some of these are undoubtedly gray squirrel nests.

Conclusions:

The original study was initiated with three main objectives in mind: (a) to accurately determine the existing population of Delmarva fox squirrels on one major type of Blackwater refuge

woodland, (b) to gather base data for population comparisons in the timber stand improvement (TSI) area of the block as to an adjacent woodland area, and (c) to evaluate the censusing method of leaf nest counts. The mark-recapture ratio was used in all three surveys so that the figures would be comparable, and essentially the same method of trapping was employed. The results clearly show a population increase in fox squirrels, with an estimated twenty-seven in 1980 compared to eighteen and nineteen in 1970-71 and 1976 respectively.

The gray squirrel population showed little change, with an estimated four compared to three in 1976. According to the 1970-71 report, there were an estimated twenty-five grays. Although this figure was based on both a time-area count and the mark-recapture ratio and may not be accurate, it is obvious that there was a significant decrease in their population after 1971.

The reason for the increase in fox squirrels is uncertain and may be attributed to one or a combination of several factors, including TSI, food availability, disease, or a cyclical fluctuation in population. It is difficult to reach any conclusion regarding the cause of the population increase recorded in 1980 with so many variables playing a role. In view of this, it would be advisable in future studies aimed at evaluation of the benefits of TSI to trap two comparable areas with TSI being the only variable between them.

The second objective of the original study, to determine the effect of TSI on fox squirrel populations, unfortunately cannot be met through this survey. No studies have been conducted in adjacent areas where no TSI was performed, as originally proposed. Without a control population in a control area, TSI (initiated in 1975) cannot be singled out as the only variable which could be responsible for the population increase.

Weather can also be responsible for fluctuations in the squirrel population. Production of young may be adversely affected by extreme weather conditions during nesting periods, and this in turn affects population size. Food production, whether mast, berry or farm crops, is dependent upon weather conditions, and the availability of food is probably the greatest limiting factor on squirrel numbers. Food availability for the squirrels in this woodlot is also affected by use of the adjacent farmland to the north and south. These two fields are generally planted in corn or soybeans, both used by the squirrel. However, one may be more important as a food source because of food preferences or availability of the corn and beans before and after harvest.

Disease is another factor which can influence population size; However, it is not known if disease has been a problem in this population. The possibility that Delmarva fox squirrels undergo cyclical population fluctuations has been suggested. If true, it would be difficult to pinpoint this as the cause of the population increase recorded in 1980 based on censuses run every four years, Annual counts would be necessary to plot the cycles and determine the time intervals involved.

The decrease in the gray squirrel population while the fox squirrels remained stable or increased could be due to overall changes in habitat conditions prompting the grays to shift to other areas. Competition with the fox squirrels under these conditions may also have played a role. Disease probably was not a factor since their numbers have remained low in this block. Studies have shown that gray squirrels undergo cyclical population fluctuations; however, this does not appear to be a significant factor in their decline here, again because the population has not rebounded.

The decline in grays seems to point more conclusively to an impact of TSI than does the increase in fox squirrels, especially

since those present were found primarily in a relatively small area or the woodlot where no TSI had been performed. Here again, a control population in a similar woodlot would be necessary to confidently arrive at this conclusion.

The third objective of the study was to evaluate the censusing method of leaf nest counts. The investigation of the study in 1970-1 determined that this was not a reliable method for estimating the squirrel population (see Delmarva Peninsula Fox Squirrel Study, Report #1, Blackwater NWR). Leaf nest counts were made in 1976 and the results reported; however, no comparisons were made nor were any conclusions drawn. The use of nesting boxes and the inability to distinguish between fox and gray squirrel use make it difficult, if not impossible, to compare this year's results to those in previous studies and to this year's population estimate based on the Lincoln index.

There were sixty-five limb and trunk nests and thirty box nests for an estimated twenty-seven Delmarvas. This compares to seventy-three nests in 1976 with nineteen squirrels, and ninety-one in 1970-71 with eighteen squirrels. The large difference in the number of nests counted in 1970-71 and 1976 when the populations were nearly the same points to the unreliability of this method (assuming the other censusing techniques were reasonably accurate and consistent).

Summary

To summarize, the Delmarva fox squirrel population in this woodblock was estimated at twenty-seven in 1980, an increase over the eighteen and nineteen estimated in 1970-71 and 1976. The reason for this increase is difficult to determine, due to the number of possible influencing factors involved.

One purpose of the study was to determine the impact of TSI on the fox squirrel population; however, without a control area and control population, TSI could not be named as the only variable that could have been responsible for population changes. Any subsequent studies designed to measure the impact of TSI on the squirrels should be conducted on two similar sites with comparable edge habitat as well as forest habitat, where TSI will be the only difference. Censuses should be taken on both sites before and after TSI is conducted on one of the sites, with censuses continuing at least two to three years after TSI is complete.

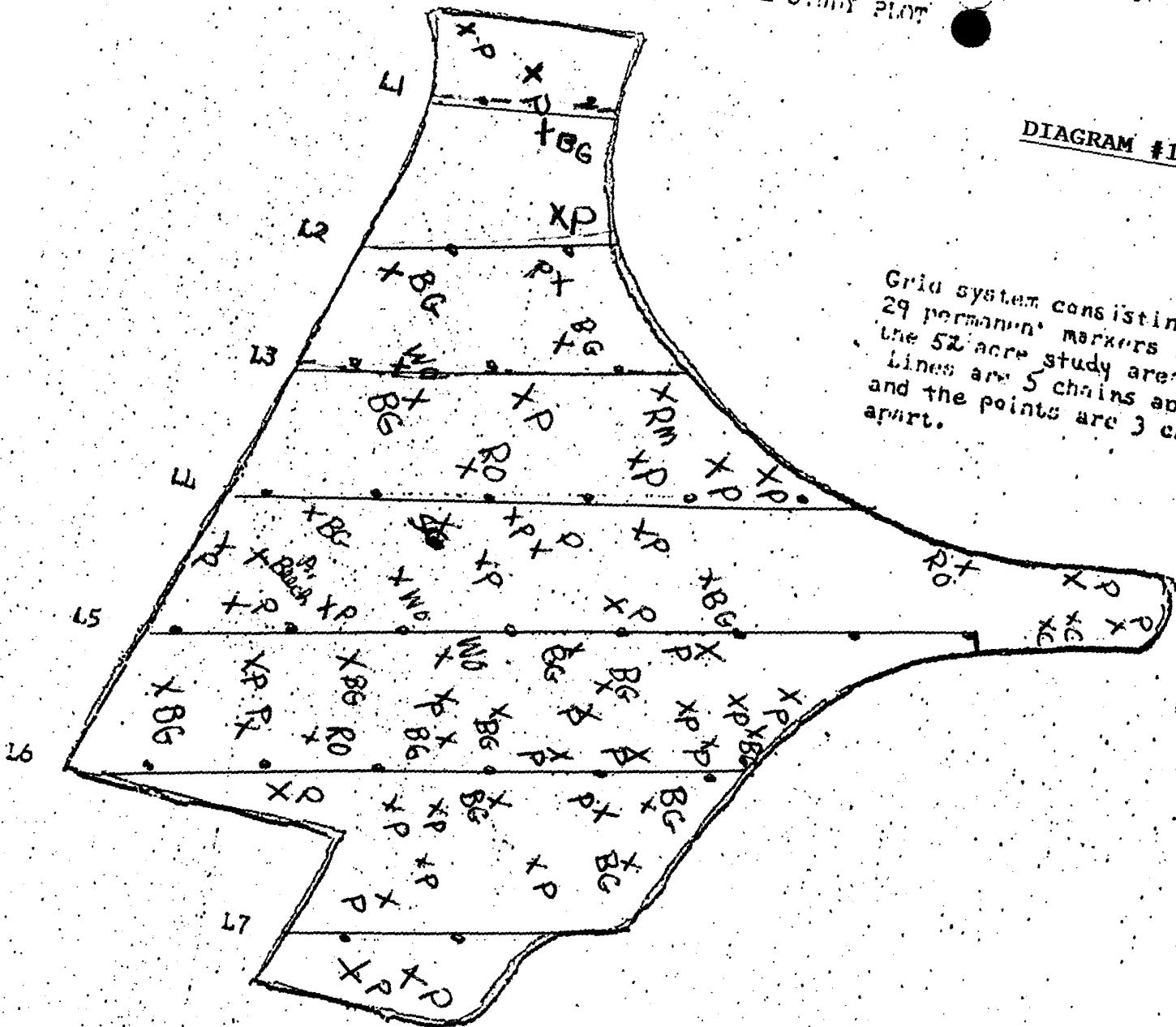
Three years of data have indicated that the leaf nest count method of estimating Delmarva fox squirrel populations is not dependable or accurate, and therefore is not recommended as a census method. Perhaps the only value in checking for leaf nests is to determine the squirrels' presence in the area.

SQUIRREL STUDY PLOT

UNIVERSITY OF MICHIGAN

DIAGRAM #1.

Grid system consisting of 29 permanent markers in the 52 acre study area. Lines are 5 chains apart and the points are 3 chains apart.



- Key
- P - Pine
 - BG - Black Gum
 - SW - Sweet Gum
 - RM - Red-Maple
 - RO - Red oak
 - WO - White oak
 - AB - American Beak
 - C - Cherry

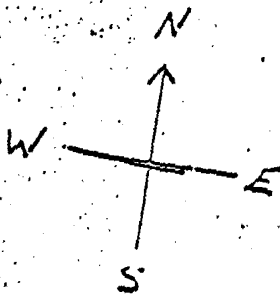


TABLE 1. 1980 DELMARVA FOX SQUIRREL STUDY

* = new squirrel (not trapped in precensus)

	11/10/80	11/11/80	11/12/80	11/13/80	11/14/80
L1 - P1		Corn gone.			
L1 - P2	Tripped				
L2 - P1	DFS - escape	A ♂ #48			
L2 - P2			A ♂ #51 toenail missing		A ♀ #2
L3 - P1	Gray				
L3 - P2	Corn gone.				
L3 - P3	A ♂ #22*				
L4 - P1	J ♀ #44				
L4 - P2	Gray				
L4 - P3			A ♂ #52		
L4 - P4	J ♀ #42				
L4 - P5	Corn gone.	Raccoon			
L4 - P6	A ♂ #43	A ♀ #33			
L5 - P1					
L5 - P2					
L5 - P3					
L5 - P4					
L5 - P5					
L5 - P6					
L5 - P7					
L5 - P8					
L6 - P1				A ♂ #53	
L6 - P2	A ♀ #45			A ♂ #54	
L6 - P3	Corn gone				
L6 - P4	A ♂ #46		J ♀ #50		Opossum
L6 - P5	Tripped				
L6 - P6	Corn gone		Corn gone		
L7 - P1					
L7 - P2	J ♀ #47			A ♂ #11	
WEATHER	Daytime: mild, 50-60's	Daytime: cool, windy, 40-50's	Daytime: cool, windy (20-30mph) 40-50's	Daytime: mild, 50-60's Night: 40's	Daytime: warm, upper 60's

TABLE 1, Continued

(r) = recapture during same 2-week period.

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	11/17/80	11/18/80	11/19/80	11/20/80	11/21/80
L1 - P1					
L1 - P2			J ♀ #55		
L2 - P1					
L2 - P2					
L3 - P1					
L3 - P2			A ♀ #2 (r)		
L3 - P3					
L4 - P1	Gray (r)				
L4 - P2				Gray (r)	
L4 - P3					Tripped
L4 - P4		A ♂ #43 (r)			
L4 - P5		A ♂ #14 toes bleeding			
L4 - P6		Corn gone.			
L5 - P1					
L5 - P2			A ♂ #13		
L5 - P3					
L5 - P4					
L5 - P5	A ♀ #32 toes bleeding	A ♀ #33 (r)	Tripped		Tripped
L5 - P6					
L5 - P7			A ♂ #11 (r)		
L5 - P8					
L6 - P1					
L6 - P2					
L6 - P3					
L6 - P4					
L6 - P5					
L6 - P6					
L7 - P1					
L7 - P2		Raccoon	Opossum		
WEATHER	cloudy, cold, breezy, 20-30's, rain afternoon	rain/drizzle night A.M. cold, 30-40's overcast	clear, cold, windy, 30-40's	clear, cold 30-50's	clear, cool, frost, 30-50's

TABLE 1, Continued

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	12/08/90	12/09/90	12/10/90	12/11/90	12/12/90
L1 - P1					
L1 - P2			A ♂ #22 (r)		
L2 - P1		A ♂ #48 (R)			
L2 - P2	A ♀ #2 (R)				
L3 - P1					Gray (r)
L3 - P2					
L3 - P3					
L4 - P1	A ♂ #22 (R)		Gray		
L4 - P2	Corn gone				
L4 - P3	A ♀ #32 (R)				
L4 - P4					Gray
L4 - P5					
L4 - P6		A ♀ #33 (R)			
L5 - P1					
L5 - P2					
L5 - P3					
L5 - P4					
L5 - P5					
L5 - P6					
L5 - P7					
L5 - P8					
L6 - P1					
L6 - P2	A ♂ #11 (R)				
L6 - P3					
L6 - P4					
L6 - P5				Raccoon	
L6 - P6					Corn Gone
L7 - P1				Raccoon	
L7 - P2				*A ♂ #5	
WEATHER	Daytime: warm, sunny, upper 60's Overnight: 50's	Daytime: warm, overcast, rain, upper 60's Overnight: Upper 50's	Cool, overcast, upper 40-50's	Daytime: 30-40's, partly cloudy, breeze Night: cold, 30's	Daytime: 30-40's, partly cloudy Night: 30's

TABLE 1, Continued

Weekend - cool/mild

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	12/15/80	12/16/80	12/17/80	12/18/80	12/19/80
L1 - P1					
L1 - P2					
L2 - P1					
L2 - P2					
L3 - P1	A ♂ #22 (r)				
L3 - P2					
L3 - P3					
L4 - P1					
L4 - P2				Corn gone	
L4 - P3	A ♂ #46 (R)	Gray (r)		Gray (r)	Gray (r)
L4 - P4					
L4 - P5			Corn gone		
L4 - P6					
L5 - P1			Corn gone		
L5 - P2				A ♀ #45 (R)	*A ♂ #58
L5 - P3	Gray (r)			Corn gone	
L5 - P4					
L5 - P5					
L5 - P6					
L5 - P7					
L5 - P8					
L6 - P1					
L6 - P2		*Gray			*Gray
L6 - P3					A ♂ #48 (r)
L6 - P4	A ♂ #11 (r)				
L6 - P5				Corn gone	
L6 - P6	A ♂ #43 (R)		Corn gone		
L7 - P1					
L7 - P2					*A ♀ #28
WEATHER	20's night, 30's sunny - overcast	30-40's overcast	30's - sunny windy	20° night, 40's partly cloudy, breezy	40's-light breeze