EUROPEAN WILD HOG ROOTING IN THE MOUNTAINS OF EAST TENNESSEE[1]

by
ROBERT C. BELDEN
Department of Forestry, The University of Tennessee
Knoxville 37916[2]
MICHAEL R. PELTON
Department of Forestry, The University of Tennessee
Knoxville 37916

ABSTRACT

The occurrence and extent of European wild hog (*Sus scrofa*) rooting at different elevations and vegetation types in the mountains of East Tennessee were studied along trails and roads in three watersheds in the Great Smoky Mountains National Park and in three watersheds in the Tellico Wildlife Management Area, Cherokee National Forest, from April 1971 through March 1972. Rooting was greatest at higher elevations in the warmer months and at lower elevations in the cooler months. The location of rooting in different vegetation types appeared to be related to elevational movement in response to changes in ambient temperature, to food availability, and to farrowing activity. Rooting was common in hemlock and closed-oak types during the spring, in the northern hardwood type during the warmer spring and summer, and in the closed-oak type and fields during the fall and winter. Establishment of a rooting extent index (REI) offers potential as a technique for monitoring population trends of the European wild hog.

INTRODUCTION

Since its introduction into the North Carolina-Tennessee mountain area in 1912, the European wild hog (*Sus scrofa*) has become both a prized big game trophy and an unwanted intruder (Jones 1959). The hog has been hunted on the Tellico Wildlife Management Area of the Cherokee National Forest in Tennessee since 1936. The Tennessee Wildlife Resources Agency considers it an important big game species, thus, a research project was begun in 1959 to determine its life history, population dynamics, and ecology (Matschke 1964). The hog has also been the object of stocking programs in other areas of Tennessee as well as surrounding states.

In the Great Smoky Mountains National Park, the European wild hog is considered a destructive exotic because of its rooting behavior in the bald areas, pastures, and northern hardwood forests. Hogs overturn numerous patches of turf leaving a considerable area without vegetative cover on the balds and pastures. Understory vegetation appears to be greatly disturbed in the northern hardwood forest. Park personnel also feel that the hog is detrimental to ground nesting birds, terrestrial salamander populations, native trout, and vegetation. In accordance with National Park Service policy concerning the elimination of exotics, a control program aimed toward eventual elimination of the species within the Park has been conducted since 1959 (National Park Service 1969).

The major objective of the present study was to determine the seasonal, altitudinal, and vegetational locations and extent of rooting by European wild hogs in the mountains of East Tennessee.

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STUDY AREAS

This study was conducted in the Great Smoky Mountains National Park (GSMNP or Park) and the adjacent Tellico Wildlife Management Area (TWMA), Cherokee National Forest. These areas are in the southern portion of the physiographic division known as the Great Smoky Mountains (the Unaka Mountain Range).

The GSMNP is a 2972 km^2 area located within Blount, Sevier, and Cocke counties in Tennessee and Swain and Haywood counties in North Carolina. It extends northeast along the Tennessee-North Carolina line from the Little Tennessee River and the southern portion of the Cherokee National Forest. The TWMA is a 324 km^2 tract of land within the 728 km^2 Tellico Ranger District of the Cherokee National Forest. This area, which lies entirely within Monroe County, Tennessee, extends

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[2] Present address: Florida Game and Freshwater Fish Commission, Gainesville, Florida 32601.

south from the Little Tennessee River adjacent to the GSMNP and west from the North Carolina state line (Fig. 1).

The terrain is typified by steep-walled, V-shaped valleys and narrow winding ridge crests with sharp peaks. Elevations in the Park range from 271m to 2025m above sea level on Clingmans Dome, the second-highest point in the Eastern United States. The elevations in the TWMA range from 472m to 1665m.

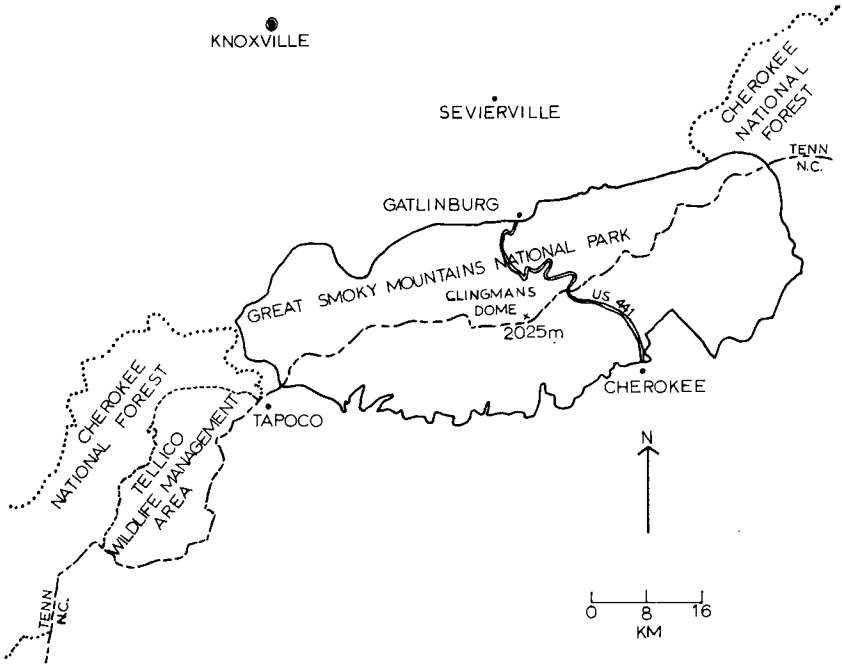

Figure 1. Geographical locations of the Great Smoky Mountains National Park and the Tellico Wildlife Management Area, Cherokee National Forest.

The climate in the study areas varies considerably due to the high relief of the mountains. Temperature decreases at an average rate of 1.24°C per 304.8m rise in elevation, and the higher peaks in the GSMNP average 5.5 to 9.0°C cooler than the base of the mountain during the growing season. This difference is approximately 2 to 3°C for the TWMA. Precipitation averages 140cm per year at lower elevations and 210cm per year at Clingmans Dome in the Park, 140cm per year at lower elevations and 175cm per year at higher elevations on the TWMA (Shanks 1954, U. S. Forest Service 1970). During the study period, record rainfall occurred during July.

Vegetation of the Great Smoky Mountains has been classified by Shanks (1954) into six vegetation types: cove hardwood forests, hemlock forests, northern hardwood forests, spruce-fir forests, closed oak forests, open oak-pine-heath balds. With two exceptions, the classification of vegetation types by Shanks (1954) is followed in this study; health balds is considered a separate type and grassy balds and fields are added to make a total of nine vegetation types.

The cove hardwood forest is located in coves and sheltered slope sites to 1371m elevation. The hemlock forest is typically restricted to sheltered topography along streams up to about 914m, but occurs on more exposed slopes and lead ridges from 914 to 1371m. The northern hardwood forest occurs above 1371m and is dominated by beech *(Fagus grandifolia)* and yellow birch *(Betula lutea)*. The spruce-fir forest also occurs principally above 1371m. The closed oak forest is found on intermediate to dry slopes and is dominated by oaks (originally by the American chestnut, *(Castanea*

dentata). The open oak, pine, and bald (heath and grass) types are characteristically found on more exposed slopes and ridges. The fields are man-made and occur at the lower elevations.

METHODS

From April 1971 through March 1972, European wild hog rooting was noted monthly at different elevations and in different vegetation types by walking established and abandoned trails and roads in three watersheds in the GSMNP (105 linear km) and in three watersheds in the TWMA (55 linear km). Vegetation along the trails and roads was classified into types by an ocular estimate of the proportion in which the various tree species occurred. These vegetation types were marked on a topographic map, and the distance traveled through each type was measured.

When a rooting site was observed, its location, an estimate of its length, width, and depth, and the plants in the overstory, understory, and ground cover were recorded. Elevation for that site was determined by locating the point on a topographic map — contour interval 12.2m (40 feet). Each rooting site was classified by size from an ocular estimate of its length and width: (1) large area — 2,555 + ft^2 (250+m^2), (2) medium sized area — 400 to 2,500 ft^2 (40 to 250 m^2), and (3) small area — smaller than 400 ft^2 (40 m^2). Rooting sites were also placed into one of the nine vegetation types on the basis of the plants recorded in the vicinity of the rooting site and by noting its location on the topographic map on which the vegetation types were marked.

Data were tested with the Student-Newman-Keuls multiple comparisons tests to determine if any significant differences (0.05 level of probability) existed among the mean elevations of the rooting sites for each month (Sokal and Rohlf 1969).

Mean elevations of rooting sites did not take into account the extent of rooting at any given site; therefore, a weighted average was calculated to adjust for differences in the extent of rooting. This formula is:

$$\bar{X}_w = \sum_{i=1}^{3} (w_i x_i) / \sum_{i=1}^{3} w_i$$

where w represents weighting factors (subjective estimates of area rooted in square feet) for each of the three classifications of rooting extent (large area — 2750, medium sized area — 500, small area — 24), and X is the number of rooting site observations in that classification for each elevation class (1000 ft intervals) and vegetation type. (Data were analyzed using the English rather than the metric system.) The above weighted average was calculated for each elevation class and vegetation type within each study area for each month's observations. These averages were not tested statistically because of the subjectivity involved in their computation.

Correlation coefficients were determined to test the degree of relationship between the mean elevations of the rooting sites and temperature. These coefficients were determined for each month using average, average maximum, and average minimum monthly temperature.

RESULTS AND DISCUSSION

Elevation of Rooting Sites

A total of 1,419 European wild hog rooting sites were observed (Table 1). Mean elevations for hog rooting were above the overall mean during the months of April through August in the Park and the months of March and May through September in the TWMA (Fig. 2). The mean elevation of hog rooting in April on the TWMA was below the overall mean elevation and may have been due to the small sample size for that month. Mean elevations for hog rooting in the GSMNP for April, May, June, July, and August were significantly ($P < .05$) higher than for January, February, March, September, October, November, and December. In the TWMA the mean elevations for rooting in March, May, June, and September were significantly higher ($P < .05$) than mean elevations for January, February, and December (Table 1).

The greater variation of mean elevations for rooting sites in the GSMNP in comparison to TWMA was due to the fact that hogs in the Park had a greater area at higher elevations in which to range. The highest and lowest points on the trails and roads traveled in the Park during this study were 2025 and 445m, respectively. The highest and lowest points traveled in the TWMA were 1440 and 597m. The overall elevational mean for hog rooting in the TWMA was 82m below that of the GSMNP.

In the Park, correlations between the mean elevation for hog rooting and average monthly temperature ($r = .77$), average maximum monthly temperature ($r = .79$), and average minimum

monthly temperature (r = .74) were highly significant (P <.01). Correlations between mean elevations and average monthly temperature (r = .59) and average minimum monthly temperature (r = .56) in the TWMA were non-significant (P >.05), but the correlation between the mean elevation for rooting and average maximum monthly temperature (P = .60) was significant (P <.05).

Table 1. Monthly elevations for hog rooting in the Great Smoky Mountains National Park and the Tellico Wildlife Management Area, Cherokee National Forest.

GSMNP				*TWMA*			
Month	*Number of rooting sites*	*Mean elevation (m)*	*Non-significant ranges*[a]	*Month*	*Number of rooting sites*	*Mean elevation (m)*	*Non-significant ranges*[a]
January	53	643		February	56	810	
November	44	705		December	62	817	
October	53	722		January	32	824	
February	50	738		November	35	873	
December	53	751		April	9	903	
March	78	837		October	99	912	
September	58	891		August	78	950	
April	50	1097		July	46	953	
June	84	1237		June	77	981	
May	93	1253		May	50	1003	
July	57	1364		March	67	1035	
August	88	1384		September	47	1051	

[a] Mean data within a line are non-significant at the 0.05 level of probability.

Correlations between the mean elevation for hog rooting and average maximum monthly temperature appear to be consistent with the behavior patterns for swine. The sparse, bristly hair of swine is inadequate protection from both cold and solar radiation, and skin temperature tends to change with ambient temperature. Because the bodies of swine are well insulated by a thick layer of subdermal fat, and because of the lack of any apparent thermoregulatory sweat glands, swine are better able to cope with cold temperatures than they are with hot temperatures (Mount 1968). In temperate climates domestic hogs will feed and move around at night during the hottest weather, and are quiet at night and active during the daylight hours during the cooler months (Hafez et al. 1962). This tendency was also found in feral hogs on the Savannah River Plant in South Carolina (Kurz 1971).

The extent of rooting by hogs was greatest at lower elevations during the fall and winter months and at higher elevations during the summer months in the GSMNP (Table 2). During the spring months rooting was more dispersed among all elevations. On the TWMA, the extent of rooting was spread fairly evenly between the lower and middle elevations throughout the year. Rooting at higher elevations occurred only during the warmer months.

Monthly Rooting in Relation to Vegetation Type

The percentages of monthly rooting in the different vegetation types in the GSMNP and the TWMA are presented in Table 3. Rooting in the cove hardwood type was greatest during October and November on both study areas, with the amount being consistently greater in TWMA than in the GSMNP.

Hogs in the Park rooted in the hemlock type extensively from March through June, a time period which corresponds very closely to the peak of European wild hog farrowing (Fox 1972, Henry 1966). The hemlock type with its usually dense heath understory would probably offer seclusion, cover, safety, and other attributes of a farrowing habitat (Stegeman 1938).

Rooting occurred in the northern hardwood type more extensively from May through August in the GSMNP and during March, July, August, and September in the TWMA. This increase in the extent of rooting in the northern hardwood type during warmer months is probably due to the emigration of European wild hogs from lower elevations in response to increased ambient temperatures.

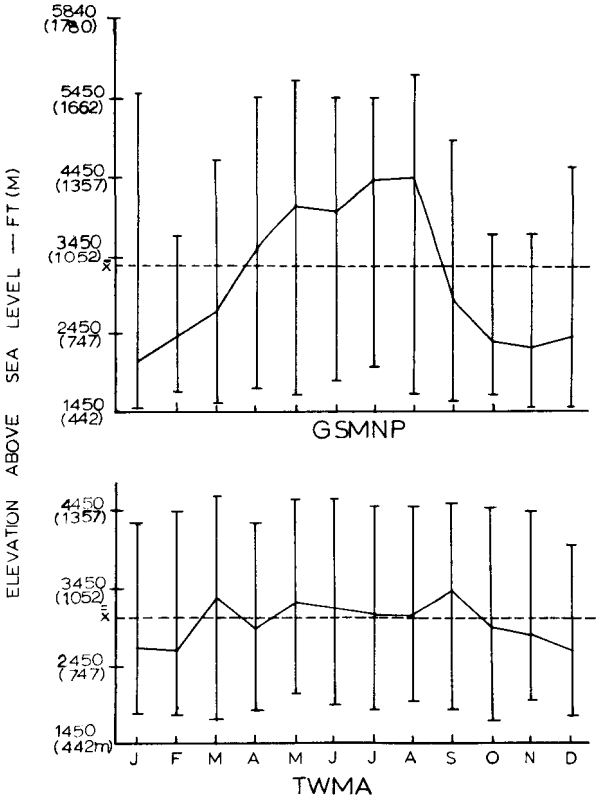

Figure 2. Monthly elevational ranges for European wild hog rooting in the Great Smoky National Park and the Tellico Wildlife Management Area, Cherokee National Forest.

Table 2. Monthly percentages of rooting by elevation classes in the Great Smoky Mountains National Park and the Tellico Wildlife Management Area, Cherokee National Forest.

Elevation class[a] *(m)*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*	*Nov*	*Dec*
					Great Smoky Mountains National Park							
457- 762	63	43	77	13	10	02	00	06	34	63	65	43
762-1067	04	57	05	29	20	01	00	02	43	17	34	08
1067-1372	33	00	04	07	00	15	00	04	04	20	01	37
1372-1677	00	00	14	10	63	82	64	16	19	00	00	12
1677-1982	00	00	00	41	07	00	36	72	00	00	00	00
					Tellico Wildlife Management Area							
457- 762	65	13	28	30	38	19	42	54	11	55	32	68
762-1067	06	45	23	14	04	27	20	04	44	06	34	16
1067-1372	29	42	48	56	46	30	36	40	18	39	34	16
1372-1677	00	00	01	00	12	24	02	02	27	00	00	00

[a] Based on a topographic map with 12.2m contour intervals.

Table 3. Monthly percentages of rooting by vegetation type in the Great Smoky Mountains National Park and in the Tellico Wildlife Management Area, Cherokee National Forest.

Vegetation Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Great Smoky Mountains National Park												
Cove HW	06	06	07	05	04	01	00	13	13	34	34	20
Hemlock	19	00	72	60	33	39	00	00	00	00	00	00
Northern HW	00	00	03	12	24	51	88	65	09	00	00	07
Spruce-Fir	00	00	00	00	00	00	08	10	00	00	00	00
Closed Oak	11	70	02	11	33	03	00	05	62	54	30	15
Open Oak-Pine	02	02	04	03	01	00	00	01	07	12	09	05
Heath Bald	00	00	00	01	04	00	00	00	09	00	00	00
Grassy Bald	00	00	00	00	01	06	04	06	00	00	00	00
Fields	62	22	12	08	00	00	00	00	00	00	27	53
Tellico Wildlife Mangement Area												
Cove HW	17	04	07	06	34	42	38	19	18	49	64	22
Hemlock	00	00	00	00	00	05	03	00	00	04	07	00
Northern HW	00	00	39	00	03	05	33	77	25	00	04	00
Closed Oak	03	64	30	50	52	44	21	03	35	43	21	17
Open Oak-Pine	01	17	01	00	11	02	04	01	17	04	00	00
Heath Bald	00	00	00	00	00	00	00	00	05	00	00	00
Fields	79	15	23	44	00	02	01	00	00	00	04	61

Rooting occurred in the spruce-fir forest in the Park only to a small extent during July and August. These were the two hottest months of the year and rooting in the spruce-fir was likely associated with the thermoregulatory response of the European wild hog to move into higher elevations.

The closed oak forest received rooting by hogs throughout the year on both study areas except during July in the Park. February, May, September, October, and November were the months of greatest use of this type by hogs in the GSMNP, and the months of February, April, May, June, September, and October in the TWMA. The closed oak type was probably used for the acorns to be found there. Henry and Conley (1972) and Scott and Pelton (1975) reported that acorns were utilized more than any other plant or animal food source during the fall months.

Hog rooting was relatively light in the open oak-pine forest, with the greatest amount occurring from September through November in the GSMNP, and in Feburary, May, and September in the TWMA. The hogs probably utilized the above type for its acorns also (Henry and Conley 1972, Scott and Pelton 1975).

Rooting was rare on the heath balds. Grassy balds were included in the transects in the Park only, and were rooted lightly by hogs from May through August. The balds occur at high elevations, and like the spruce-fir and northern hardwood types, rooting here was associated with the tendency of hogs to move into higher elevations during the summer. Hog rooting was most intensive in fields during January and December.

CONCLUSION

European wild hogs in the mountains of East Tennessee root mainly at lower elevations in the closed oak, cove hardwood, and field vegetation types during the fall and winter months. During this period they feed mainly on mast, grapes, and roots (Henry and Conley 1972, Scott and Pelton 1975). In the spring and summer months the distribution of hog rooting is more widespread, but the tendency is for rooting to occur at higher elevations as the temperature increases. At higher elevations, most of the rooting occurs in the northern hardwood vegetation type. Apparently hogs that do not move into higher elevations are found around heads of moist coves in the cove hardwood type (Fox 1972 and Strickland 1972). In late August and early September, when mast again becomes

available (Strickland 1972), the hogs return to lower elevations into the closed oak and cove hardwood types. The rooting extent index (REI) indicates the relative use of various habitat types by the hog and offers potential as a technique for monitoring population trends.

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