SCENT-STATIONS AS INDICES OF ABUNDANCE IN SOME FURBEARERS OF ALABAMA[1]

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Abstract: A cursory evaluation of scent-station techniques was made in 6 physiographic regions of Alabama between January and April 1979 and between October 1979 and April 1980. In addition, predator calling was conducted at 30 stations in each of these 6 regions between November 1979 and March 1980. Synthetic fatty acid scent (FAS) was used as an attractant the first year, whereas FAS, red fox urine, bobcat urine, and a 1:1 mixture of red fox and bobcat urine was used in systematic rotation the second year. Animal visitation was converted to indices of relative abundance for each species, and comparisons were made between years, and among physiographic regions and attractants. Indices of free-ranging dog abundance were similar between years, among physiographic regions, and attractants. Bobcats responded more frequently to predator calling than to scent-stations containing various scents. Their response to scent-stations treated with bobcat urine was significantly greater than responses to stations with other attractants. Dog, housecat, and opossum responses to predator calling were negligable. Predator calling was as effective as various scents in eliciting responses from red and gray foxes. Winter scent-stations on upland sites are believed ineffective for obtaining indices of abundance in raccoons.

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With few exceptions, State Conservation agencies in the southeastern United States have historically given fur resources a low funding priority compared with other wildlife resources. This complacency was due, in part, to relatively little demand for furbearer information and a consensus that furbearers were abundant, doing well, and were without controversy. Interest in furbearers was renewed when the anti-trapping movement by houndsmen, protectionists, and humane groups increased.

Although unsupported by data, some hunting groups suggest that local populations of raccoons *(Procyon lotor)*, red foxes *(Vulpes fulva)*, and gray foxes *(Urocyon cinereoargenteus)*, that are both hunted and trapped, have been severely depleted in some areas of the southeast. Hunter harvest information (Kelly 1971) and reports on harvesting techniques (Atkeson and Hulse 1953) suggest that hunting may impact some populations of raccoon and opossum *(Didelphis marsupialis)* more than trapping. Fox hunting from November through February is believed to be largely nonconsumptive, but this activity may be deleterious at other times.

Increased trapping pressure for foxes in the southeastern states over the past 10 years is believed to have been within harvest levels for sustained yield because land ownership patterns limit trapper access to many interspersed areas that serve as refuges. Nonethdless, precise impacts of trapping have not been documented. With the increased prices

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paid for long-haired furs since about 1975 and the controversy that developed among user groups and protectionists, the desire and need for information on fox, raccoon, bobcat *(Lynx rufus)*, and other mammalian predators increased among houndsmen, conservation groups, researchers, land managers, wildlife managers, trappers, and resource administrators. The need for better information on relative abundance of these mammals in major physiographic regions is prerequisite to sound management decisions that will insure the prepetuation and continued utilization of these valuable wildlife resources.

Simulated calls of a distressed rabbit have been used successfully to call-up various species of mammalian predators (Morse and Balser 1961, Tinsley 1978). The potential use of this technique as an index of predator abundance has not previously been investigated, and should be evaluated.

The scent-station technique developed by Cook (1949), Richards and Hine (1953), and Wood (1959), has been used by the U.S. Fish and Wildlife Service since 1972 to obtain annual indices of relative abundance in coyotes *(Canis latrans)* in the western United States (Linhart and Knowlton 1975). Roughton (1979) refined and improved field efficiency and analytical procedures of the technique. The measurement of relative abundance through scent-stations "rests on the assumption that the relationship between the visitation rate and the density of a given species is sufficiently consistent for the index to provide reliable and useful information" (Roughton and Sweeny 1978). Since 1978, five southeastern states have utilized the artificial scent-station technique to obtain indices of abundance in some furbearers.

Scent-station methodology as used in western states, has a myriad of inherent assumptions and unknowns, and the results of its use on coyotes have been treated with guarded caution (Bean and Roughton 1979, Linhart and Knowlton 1975, Roughton 1975, Roughton and Sweeny 1978). These authors further questioned the value of scent-station methodology for species other than the coyote. These concerns not with-standing, scent-station methodology appears to have potential for providing some of the information needed in fur resources management in the southeast. The objectives of the study were to: (1) implement the scent-station and predator call techniques as indices of predator and medium size mammal abundance in six physiographic regions of Alabama, (2) compare apparent changes or differences in indices of fox, raccoon, and other wild mammal abundance between two successive years among physiographic regions, (3) determine an optimum time for conducting scent-station surveys in Alabama, and (4) determine indices of relative abundance among free ranging dogs and housecats within six physiographic regions of Alabama during a two year period. An objective added to the study during its second year was to determine the visitation response to each of four scented attractants.

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METHODS

The study was designed for field work to continue from October to March during each of two years, but administrative problems delayed establishment of lines until late January the first year.

Scent-station survey lines were established between January and April, 1979 and between October, 1979 and April 1980 (Fig. 1). Each line included a number of scent-stations located at 0.48 km intervals, each adjacent to, but on alternating sides of a continuous stretch of roadway. Scent-stations were 91.4 cm diameter areas of sifted soil to which 10 to 20 ml of liquid attractant (scent) was centrally applied. Scent-station design the first year was essentially the same used in the U.S. Fish and Wildlife Service survey (Linhart and Knowlton 1975) except that we used liquid FAS (synthetic fatty acid scent) whereas, they used powdered FAS attractant contained in a plastic perforated disc. An

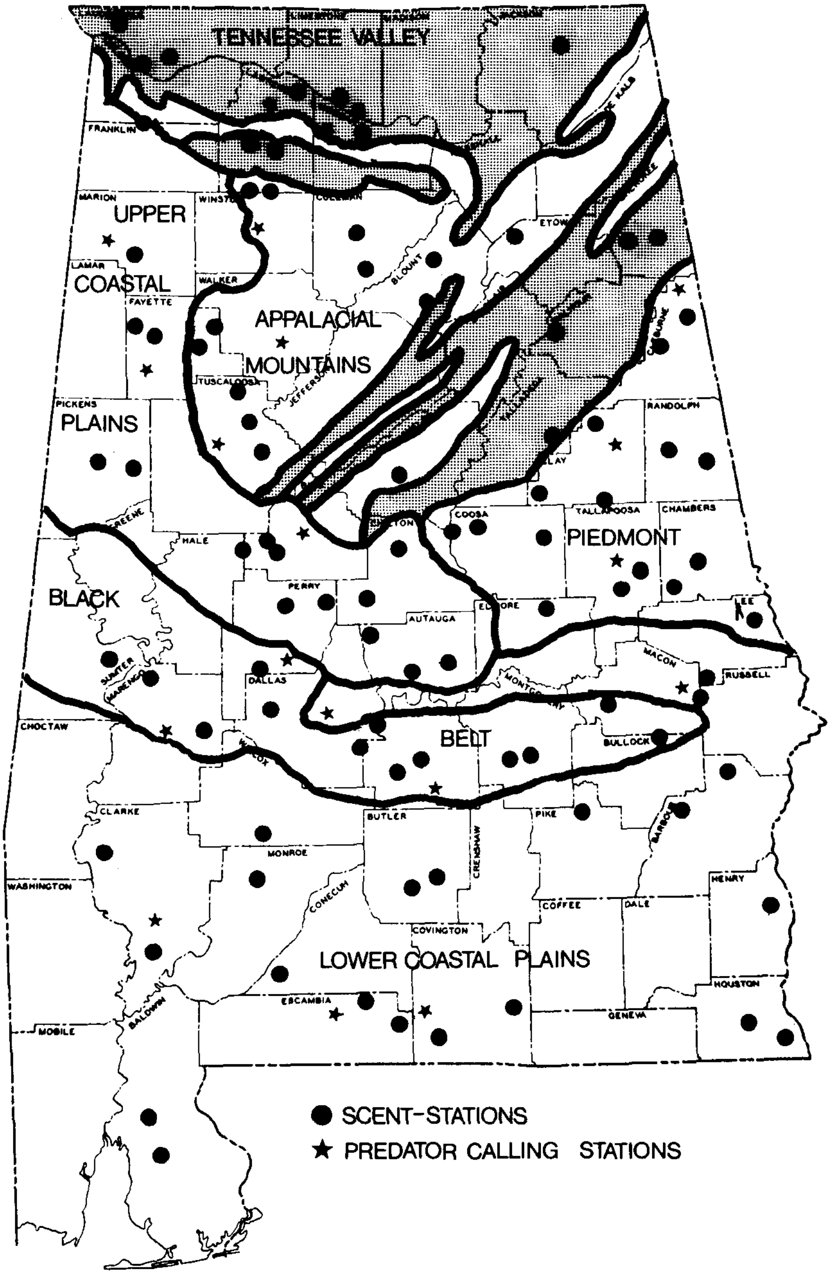

Fig. 1. Map of Alabama showing six physiographic regions and locations where scent-stations and predator calling stations were established January 1979 through April 1980.

parametric tests, nonparametric comparisons were made using Chi square tests and binomial distribution confidence limits from standard tables (Mainland et al. 1956). All statistical tests were conducted at a confidence level of 95 percent or greater.

RESULTS AND DISCUSSION

During the first year, 56 lines (1,149 stations) were run whereas in the second year 36 (1,760 stations) were run. Tracks of opossum, squirrel *(Sciurus* spp.), rabbit *(Sylvilagus floridanus)*, raccoon, red fox, gray fox, coyote, dog, striped skunk *(Mephitis mephitis)*, spotted skunk *(Spilogale putorius)*, deer *(Odocoileus virginianus)*, bobcat, housecat, armadillo *(Dasypus* spp.), wild turkey *(Meleagris galloparo silvestris)*, and livestock were observed on scent-stations. Visitation by the gray fox was significantly greater the second year. Even though the significance level for the difference was less than 0.0003, and differences were significant in nonparametric comparisons, results were viewed with caution because line locations were not identical both years. The only other difference detected between years was an apparent greater visitation by raccoons the second year. This difference is believed biased because, as discussed later, sampling times are thought to have favored greater raccoon visitation the second year.

Ninety-one animals responded to predator calling at 180 stations. Seven animals were not positively identified because of fog or because they failed to come close enough. Identifications could usually be made if animals approached to within about 160 m. No species responded to predator calling that had not been recorded during scent-station routes.

The mean visitation responses of gray fox to all attractants in all regions was greater than in any other species except dogs. Gray foxes, and occasionally dogs, exhibited rolling behavior at scent-stations frequently obliterating tracks of animals that may have visited stations earlier. In the analysis of variance, and Duncan's tests, and Chi square tests, gray fox responses to the three urine treatments and predator calling was significantly greater than responses to FAS treated stations. Gray fox response to red fox urine was significantly greater than to other scented attractants in the chi square test. Although the mean indices of abundance among physiographic regions were different (Table 1), these were not significant when tested statistically.

When data from FAS treated stations from comparable months of both years were considered, analysis of variance revealed that there was significantly different visitation among regions. Subsequent tests identified greater visitation by red foxes in the Tennessee Valley than among the other physiographic regions (Table 2 and 3). Nonparametric comparisons with confidence limits from tables for binomial samples showed that red fox visitation in the Tennessee Valley was significantly greater than the mean visitation rate from the combined data of the other physiographic regions. Greater abundance of red fox in the Tennessee Valley, an area intensively farmed in row crops, was indicated when land use was compared against regional indices of abundance in the Duncan's test. Visitation by red fox was significantly greater in row crop and refuge areas than in grazed and timbered areas. The visitation rate of red foxes was also significantly greater at stations treated with fox urine and mixed bobcat-fox urine than at stations treated with bobcat urine or FAS in the Duncan's, Chi square, and analysis of variance tests.

In the Duncan's test, temperature did not affect the visitation rate in red foxes but in the analysis of variance there was significantly greater visitation ($P < 0.07$) at temperatures between 33 and 40°F than at temperatures above 40°F. This difference is believed to be related to the higher indices of abundance in red foxes noted in the Tennessee Valley and its attendant cooler winter temperatures.

Since the raccoon is regionally an important furbearer, added justification for implimentation of scent-station methodology would be gained if it provided a reliable indices of raccoon abundance. Results of this study indicates that mid-winter scent-stations may not accurately reflect raccoon population densities. The mean indices of abundance for attempt was made to distribute the routes proportionally among 6 physiographic regions of Alabama and among biweekly and monthly periods. Regions were: Lower Coastal Plains, Upper Coastal Plains, Piedmont, Appalacian Mountains, Black Belt, and the Tennessee Valley.

Scent-station routes were selected without regard to habitat types or land use features, and were designated on county road maps prior to their establishment in the field. Alternative routes were selected in the field if the original route was unacceptable because of bridge washouts, impassibility, or high commercial or residential development. All routes were located on county secondary, gravel, or graded dirt roads.

During route establishment, meteorological data, land use, land surface type, and dominant vegetation types were recorded on standardized data forms. All routes were established and manned by a single research technician. After establishment, each route was examined the following morning to identify tracks. When an entire route was destroyed by adverse weather or some other factor, the route was reestablished and checked at a later time.

In the first year, each scent-station line consisted of 25 scent-stations. In optimum weather conditions the observer could check a scent-station line, travel to another physiographic region, and set another line in the same day.

In the 1979-1980 survey each scent-station line consisted of 50 scent-stations. Liquid FAS, bobcat urine, red fox urine, and a 1:1 mixture of bobcat and red fox urine was applied (10 - 20 ml each) to individual stations in systematic rotation so that a given attractant was applied to every 4th station. The latter 3 attractants were applied with a plastic spray bottle whereas the FAS was applied with an eyedropper. The FAS and urine attractants were premixed in quantities to last throughout the study to insure consistancy between years. Urine attractants were stored frozen. The four attractants were utilized in an attempt to evaluate the magnitude of the visitation response by the mammalian species present. Routes the second year were started earlier and providing indices of abundance before, during, and after the state trapping and hunting seasons. Scent-station numbers differed among physiographic regions between years and lines, and lines were not necessarily repeated the second year. Growth of vegetation, grading, and construction precluded using scent-stations more than one year.

Thirty predator-calling stations were established at least 1 km apart within each of the 6 physiographic regions between November 1979 and March 1980 in an attempt to (1) verify and compare responses with those at scent-stations, (2) identify species that may not have been attracted to the scent-stations, and (3) evaluate an alternate index of relative predator abundance (Fig. 1). A predator call was played for 15 minutes, and responding predators were identified with the aid of a red light and binoculars. The Burnham Brothers Model T-4 eight track caller with cartridge No. 101 was used to call, and a 200,000 candlepower Q-Beam spotlight with red filter used to identify animals that responded[1]. All predator-calling was done on low-wind nights from 1 hour after sunset until midnight only during dark moon phases and in areas where, or times when scent-stations were not operated. Visitation rates at scent-and predator-calling stations were coverted to indices of abundance (Linhart and Knowlton 1975):

$$\frac{\text{No. Visits}}{\text{No. Operable Stations}} \text{ X } 1000 = \text{Index}$$

Indices of abundance were computed within physiographic regions, and statewide by species. Statistical comparisons were made by general linear models procedures and Duncan's multiple range tests. When significant differences were noted with these

[1]Use of these items of equipment does not constitute a recommendation.

Table 1. Mean indices of abundance in gray foxes in 6 physiographic regions of Alabama derived from visitation at scent-stations containing one of 4 attractants from October 1979 through April 1980.

	Physiographic Regions[1]						
Attractant[2]	L.C.P.	U.C.P.	P.	B.B.	A.M.	T.V.	Regional Means
Red Fox Urine	327.9	289.5	336.5	298.0	232.9	272.4	292.8
Bobcat Urine	205.1	313.0	269.2	195.5	244.6	188.4	235.9
Mixed Urine	369.9	244.2	305.5	248.2	193.2	200.7	260.3
FAS	135.7	143.9	182.2	215.5	141.1	140.1	159.7
Attractant Means	259.6	247.6	273.3	239.3	202.9	200.4	

[1]L.C.P.—Lower Coastal Plain; U.C.P.—Upper Coastal Plain; P.—Piedmont; B.B.—Black Belt; A.M.—Appalachian Mountains; and T.V.—Tennessee Valley.

[2]FAS—Synthetic fatty acid scent.

Table 2. Mean indices of abundance in 6 mammals from 6 physiographic regions of Alabama derived from visitation at scent-stations containing FAS[1] from January through May 1979 and October 1979 through April 1980.

	Species					
Region	Raccoon	Red Fox	Gray Fox	Opossum	Dog	Bobcat
Lower Coastal Plain	41.5	27.0	93.3	61.2	83.3	11.6
Upper Coastal Plain	13.6	16.4	81.2	38.2	128.4	0.0
Piedmont	23.0	20.4	95.6	51.6	129.7	0.0
Black Belt	51.6	13.8	124.4	25.2	130.6	0.0
Appalacian Mountains	31.7	14.4	78.5	55.1	119.2	0.0
Tennessee Valley	48.9	53.1	139.6	29.7	110.6	15.15
Total Mean	35.1	24.2	102.1	43.5	116.9	4.4

[1]Fatty Acid Scent.

Table 3. Mean indices of abundance in red fox in 6 physiographic regions of Alabama derived from visitation at scent-stations containing one of 4 attractants from October 1979 through April 1980.

	Physiographic Regions[1]						
Attractant	L.C.P.	U.C.P.	P.	B.B.	A.M.	T.V.	Regional Means
Red Fox Urine	61.1	53.3	76.0	38.4	65.1	80.1	63.0
Bobcat Urine	51.3	12.8	0.0	38.4	26.7	94.4	37.3
Mixed Urine	29.9	58.3	76.4	84.6	75.7	70.7	65.7
FAS[2]	27.7	29.0	13.8	27.7	13.8	73.2	30.9
Attractant Mean	43.0	38.4	41.8	47.2	45.3	79.6	

[1]L.C.P.—Lower Coastal Plain; U.C.P.—Upper Coastal Plain; P.—Piedmont; B.B.—Black Belt; A.M.—Appalacian Mountains; and T.V.—Tennessee Valley.

[2]FAS—Synthetic fatty acid scent.

Table 4. Mean indices of abundance in bobcats in 6 physiographic regions of Alabama derived from visitation at scent-stations containing one of 4 attractants from October 1979 through April 1980.

	Physiographic Regions[1]						
Attractant	L.C.P.	U.C.P.	P.	B.B.	A.M.	T.V.	Means
Red Fox Urine	77.9	12.8	0.0	12.8	25.6	0.0	21.5
Bobcat Urine	51.3	26.7	51.3	51.3	97.2	26.7	50.7
Mixed Urine	15.1	0.0	0.0	0.0	0.0	0.0	2.5
FAS	13.8	0.0	0.0	0.0	0.0	30.3	7.4
Mean	39.5	9.9	12.8	16.0	30.7	14.2	

[1]L.C.P.—Lower Coastal Plain; U.C.P.—Upper Coastal Plain; P.—Piedmont; B.B.—Black Belt; A.M.—Appalacian Mountains; and T.V.—Tennessee Valley.

[2]FAS—Synthetic fatty acid scent.

Table 5. Mean indices of abundance in 5 mammals from 6 physiographic regions of Alabama derived from visitation at predator calling stations from and October 1979 through April 1980.

Region	Species				
	Raccoon	Red Fox	Gray Fox	Bobcat	Coyote
Lower Coastal Plain	0.0	33.3	433.3	66.7	0.0
Upper Coastal Plain	33.3	0.0	166.7	0.0	0.0
Piedmont	66.7	33.3	300.0	66.7	0.0
Black Belt	33.3	133.3	266.7	66.7	66.7
Appalacian Mountains	66.7	0.0	200.0	333.2	0.0
Tennessee Valley	33.3	166.7	333.3	0.0	66.7
Total Mean	38.9	61.1	283.3	72.2	11.1

October and April was about 3 times greater than the mean computed from monthly indices for November through March. Most scent-station routes were on roadways along dryer upland areas that are not as intensively used by raccoons during the winter months as are stream bottoms, beaver ponds, and wet sites. Seasonal food habits studies by Johnson (1970) suggested that in spring, raccoons move from winter aquatic habitats to upland habitats associated with ripening berries, fruits, and agricultural crops. These seasonal uses of habitat types compound the task of obtaining reliable indices of abundance in raccoons from upland scent-stations in winter. Scent-station surveys conducted between April and October on upland sites may better reflect existing raccoon densities than mid winter scent-stations. Mid-winter scent-stations beneath bridges or at stream crossings may also provide better index to raccoon density than stations systematically spaced on upland sites. If it is desirable to obtain information on indices of abundance in raccoons from scent-station methodology designed for other species on upland sites, we believe that seasonal distribution of raccoons is influenced by available foods and dictates that stations be run before the end of October.

In analysis of variance, Duncan's, and nonparametric tests, bobcat visitation to stations treated with bobcat urine was significantly greater than to stations treated with other attractants. Nonparametric comparisons also revealed that bobcat visitation at stations treated with fox urine was significantly greater than visitation at stations treated with FAS or mixed urine. Bobcat tracks on FAS treated stations appeared to be associated with their random movements rather than with investigative behavior. Their response to mixed fox and bobcat urine was very low (Table 4). At stations treated with bobcat urine, bobcats showed a significantly greater visitation response in the Appalacian mountains than in other physiographic regions combined. This difference appeared correlated with indices of abundance within other physiographic regions as indicated by visitation at predator calling stations (Tables 4 and 5), suggesting that both approaches to indices of abundance appear to have merit.

Bobcats are not known to have a highly developed sense of smell compared with their senses of hearing and sight. We believe that bobcat visitation at scent-stations would have been greater had we used a centrally placed visual stimulus for scent presentation, rather than spraying the scent on bare ground. Bobcat responses to other than aromatic stimuli was born out by significantly greater bobcat visitation at predator calling stations than at scent-stations.

Miller (1980) mentioned the potential role of exclusive spacing patterns in bobcats in the lower coastal plain. If avoidance or exclusive spacing behavior in bobcats is a valid concept, it could bias visitation responses of bobcats at stations treated with bobcat urine in areas of high population density. Further research is needed to validate scent-station methodology by using bobcat urine or its fractions as indices of bobcat abundance.

The mean indices of abundance in dogs was 116.9 for both years (Table 1). Differences in regional means were not compared because they were believed to be related to human population densities.

The indices of abundance in house cats was 6.1 the first year. House cats responded twice as frequently at stations treated with bobcat urine than to those with other attractants. The mean indices of abundance were 26.2 and 10.0, respectively, at stations with bobcat urine and at those with other attractant .

Comparisons of indices of abundance from fall scent-stations to those obtained after the season of harvest are not believed valid, because movement behavior in raccoons associated with food sources and in foxes and bobcats associated with the onset of reproduction may influence rates of visitation.

There is need for continued evaluation, modification, and refinement of scent-station methodology for various habitats and species. Improved, broad-spectrum synthetic attractants for multiple species that will permit comparisons among physiographic regions and states are needed.

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