A SURVEY OF PROCEDURES TO DETERMINE RELATIVE ABUNDANCE OF FURBEARERS IN THE SOUTHEASTERN UNITED STATES

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Abstract: A phone questionnaire was used to determine the extent furbearer population surveys are used in the Southeast, describe the procedures used, identify problems and future directions, and quantitatively rank important considerations in using scent-station techniques based on an opinion survey. Eleven of 16 states conduct annual statewide surveys of furbearer population trends (10 of 11 were scent-station surveys) at an average cost of $26,095. There was no consistency among state surveys and most surveyed biologists (11 of 12) believed consistency was important but questions arose regarding timing and feasibility. Many surveys appeared to be in the developmental stages and the need was stressed for technique refinements and investigation of visitation and density relationships. Survey improvements and standardization may be enhanced through a centralized coordinating organization in the Southeast. The ability of recorders to identify tracks (#1) and the analysis and interpretation of data (#2) were ranked the most important considerations in using scent-station surveys. Most biologists believed that scent-station surveys possessed high potential for population monitoring and would likely be incorporated into long-term furbearer management.

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Population surveys to determine the relative abundance of furbearers have been one of the most extensive management techniques to develop in recent years. The United States Fish and Wildlife Service (USFWS) conducts annual surveys of coyote *(Canis latrans)* population trends in 20 western states (Linhart and Knowlton 1975). As of 1978, 5 southeastern states conducted annual population surveys of some furbearers (Sumner and Hill 1980). Traditionally, management of furbearers in the southeastern United States has received little emphasis from state wildlife agencies because populations were believed to be abundant and generated little controversy (Sumner and Hill 1980). Intensifying conflicts among user groups, declining populations in some areas, increasing public sentiment against trapping and hunting, and fur export regulations of the Scientific Authority of the United States Fish and Wildlife Service (formerly the Endangered Species Scientific Authority) prompted many state wildlife agencies to determine trends in furbearer populations as a routine management practice. Information also has been lacking because of difficulties encountered in studying furbearers due to their secretive behaviors, wide-ranging movements, and difficulty of capture. Improved techniques of population monitoring will become increasingly important as pressures on the furbearer resources continue.

After reviewing the procedures available to assess trends in predator abundance, it was concluded that the artificial scent-station technique pioneered by Cook (1949), Richards and Hine (1953), and Wood (1959) was the best alternative (Linhart and Knowlton 1975). The scent-station technique was refined and has been used annually since 1972 by the USFWS to monitor trends and distribution of 20 carnivore species (2 are threatened or endangered) in 20 western states (Linhart and Knowlton 1975, Roughton 1979). Recent developments and improvements in field operations and statistical anaylsis of scent-station surveys are presented by Roughton (1979). The technique is not a "perfected tool" and its application and interpretations for different species and areas should be made with caution (Roughton 1979).

Several southeastern states have adopted the scent-station technique to determine relative abundance for a wide array of furbearers. The original emphasis was on bobcats *(Lynx rufus)* (Brady 1979, Hon 1979) but other surveys have yielded information on additional species (Sumner and Hill 1980). Modifications of track-count indices have been expanded to stream-crossing surveys to monitor relative abundance of aquatic furbearers. The recent and rapid implementation and frequent refinement of techniques to index furbearer populations probably accounts for the general lack of published information in the Southeast. A survey questionnaire appeared to be the best means to obtain information from biologists directly involved in furbearer management. Our objectives were to: (1) determine the extent population surveys are used to monitor the relative abundance of furbearers in the southeastern United States, (2) describe the procedures used, (3) encourage communication and information flow to enhance development, comparability, and the usefulness of furbearer population surveys, (4) identify problems and future directions of furbearer populations surveys, and (5) delineate the relative importance of 15 considerations in using scent-station techniques and determine if a consensus exists among the surveyed biologists.

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METHODS

Information on procedures used by southeastern states to assess relative abundance of furbearer populations was obtained verbally from state representatives after the joint Fur Resources and Furbearer Technical Committee Meeting at the 34th Annual Conference, Southeastern Association of Fish and Wildlife Agencies on 9 - 12 November 1980 in Nashville, Tenn. Other biologists from member states not represented at the meeting were contacted by phone. Input also was solicited in the newsletter of the Southeastern Section of The Wildlife Society. A rough draft of the summarized information was circulated to each state representative for review. Maryland, West Virginia, and Texas were initially omitted but subsequently added.

A follow-up phone questionnaire was used to obtain supplemental information and survey opinions concerning problem areas, future directions, and important considerations in using furbearer population surveys. Biologists were asked to rank a list of considerations in using scent-station techniques on the following Likert scale (Babbie 1973:269):

Not Important		Slightly Important			Moderately Important		Very Important		Extremely Important	
0	1	2	3	4	5	6	7	8	9	10

A general standardized design of scent-stations spaced along sample survey lines with an attractant for recording visitation rates to monitor population trends was assumed. Considerations were ranked to show their relative importance; for example, a factor believed to be ½ as important as the most important consideration would be ranked 5. Ranked considerations are listed in Table 2. Means were calculated for each factor to identify the most important considerations and standard deviations were calculated to determine if a concensus existed among surveyed biologists.

RESULTS AND DISCUSSION

Extent Population Surveys Are Used

Eleven of 16 southeastern states conduct annual statewide surveys of furbearer population trends (Table 1). Three states (Ark., Ala., Miss.) indicated no immediate plans to conduct surveys of furbearer population trends but plan to continue fur harvest reporting systems. Two of the 3 states with no immediate plans indicated that surveys of furbearer population trends were a possibility in the future. South Carolina has a scent-station survey proposal drafted and is awaiting funding. Tennessee will evaluate statwide application of scent-station surveys after 3 years of research assessment. Texas presently conducts a spot-light count of furbearers in conjunction with deer counts, but also plans to initiate a scent-station survey in the fall of 1981. The population surveys in Alabama (Table 1) were predominantly for research assessment (Sumner and Hill 1980) rather than direct management applications and will not be continued.

Two states (Mo., Va.) have conducted surveys of population trends for 4 years, 5 states (Fl., Ga., La., Okla., Tex.) for 3 years, 2 states (Ala., N.C.) for 2 years, and 3 states (Ky., Md., W. Va.) for 1 year. Four states plan to reevaluate the use of population surveys after an initial assessment period but 7 states expressed the likelihood of continuing indefinitely to establish a consistent, long-term data base which is paramount in validating the usefulness of the surveys. This strong commitment to continue surveys of population trends was also reflected in the fact that all surveyed biologists believed track-counts possessed potential for monitoring relative abundance of furbearer populations. But all biologists also expressed reservations concerning the techniques and emphasized the need for further evaluation to assess the relationships between track counts and changes in population density. One state (Okla.) stated that the future of surveys along pond and stream banks was questionable because a very high incidence of tracks (70 - 100%) hampered detection of changes in population trends.

The extensive usage of surveys of furbearer population trends in the southeastern states appeared to be initiated primarily by ESSA fur trade regulations (7 of 11 states) but most biologists surveyed (8 of 12) expressed a prior and underlying recognition of the lack of population information in furbearer management. Reasons cited for the lack of information included inadequacies of harvest data, season closures for some species, and low funding priorities. Four states indicated that user conflicts and potential legislation influenced the initiation of surveys of populations. ESSA regulations and user conflicts appeared to prompt administrative funding for surveys of furbearer population trends.

Procedures Used

Most states (11 of 12) monitored relative abundance of furbearers by scent-station surveys (Table 1). Notable variations were track counts at bridge crossings and pond banks (Fl., N.C., Okla., Va.), predominantly to survey aquatic furbearers, spot-light counts (Tex.), and predator calling stations as a potential index (Sumner and Hill 1980).

No 2 state scent-station surveys were identical (Table 1) although most were adapted from the western coyote index (Linhart and Knowlton 1975, Roughton 1979). The lack of consistency among states appeared to result from the wide array of furbearers surveyed, specific versus multi-species monitoring objectives, manpower allocations, habitat considerations, and experience with each species and scent-station surveys. Major sources of variation included scent type, presentation, number of nights conducted, sample intensities, and route selection criteria (Table 1). Line length, distance between stations, and season conducted appeared less variable among states. Most states (8 of 11) apparently used shorter lines and less stations to optimize the statistical, biological, and operational efficiency of scent-station surveys (Roughton 1979).

Eleven of 12 biologists surveyed believed that consistency among states conducting scent-station surveys was important but questions arose regarding timing and feasibility under different habitat conditions, weather, information needs, species of interest, and effort. Six of 10 states indicated they would likely change scent station techniques for standardization across the southeast. But 4 states were not receptive to change; consistency among states was not believed to be as important because the major emphasis was within-state management decisions. The number of years of data and confidence in the technique also appeared to influence the receptivity to technique changes. States willing to change scent-station techniques believed that standardization would provide more meaningful and useful data and enhance the opportunity to validate the relationship between visitation trends and population density. States favoring standardization also expressed the need to first assess technique refinements, the influence of technique changes on visitation rates, and possible adjustments for these effects.

The feasibility of standardizing scent-station techniques across the Southeast is enhanced because many state surveys appear to be in the developmental stages. But feasibility will likely decrease with time because more states will have a greater investment in a consistent, long-term data base. The present data base is probably inadequate for standardization decisions but if an expedient decision and commitment is made the opportunity for standardization through technique improvements will be enhanced as scent-station surveys continue to evolve. The establishment of a centralized coordinating organization for surveys of furbearer population trends in the Southeast should be investigated.

Table 1. A survey of procedures used for indexing population trends of furbearers in the southeastern United States.

State	Scent(s)	How Scent Presented	How Station Prepared	Distance Between Stations	Line Length	Sample Intensity[c]	Where Conducted	How Lines Selected	Distance Between Lines	No. of Nights Conducted	Month(s) Conducted	Predominant Species	Biologist, Address, & Phone#
Alabama	Fatty acid scent (FAS) Red fox urine Bobcat urine 1:1 mixture of urines[a]	Directly into soil in center of station.[b]	Cleared & Sifted	0.3 mi	15 mi	3713	Unpaved county roads	Randomly from co. road maps within 6 physiographic regions before going into field. Distributed proportionally among regions.	No rule	1	Evaluated Jan.-April '79 Oct.-April '80 Winter scent-stations ineffective for raccoons on upland sites.	Bobcat Red & Gray foxes Raccoon Dogs Housecats	Ed Hill Dept. of Wildl. & Fish. Miss. St. Univ. Miss. St., MS 39762 (601)325-2643 2647
	Predator calling	Wounded rabbit cassette	—	1 mi	15 mi	11139 30 stations per region 180 statewide	Unpaved county roads	Same lines but at different times than run scent stations	No rule	1	Evaluated Nov. '79-March '80	Bobcat Red & Gray foxes	
Florida	Bobcat urine	Cottonball pushed slightly into soil in center of station	Cleared & Sifted	0.2 mi	1.8 mi	1580	Unpaved secondary farm, or forest roads in "typical" habitat	Systematic for even distribution over regions	No rule	1	Changed from Oct. - late Nov. due to manpower shortages	Bobcat	Jim Brady Fla. Game & Fresh Water Fish Commission Wildl. Res. Lab. 4405 S. Main St. Gainesville, FL 32601 (904)376-6481
	Otter urine or gland extract	Scent-stations at culvert & bridge crossings	Cleared & Sifted	(Not yet standardized; Experimental stage)			Stream crossings on highways	From hwy. maps to encounter max. no. of stream drainages				Otter	

[a] Recommendations differ with species and intent; example, bobcat urine appears best for bobcats, red fox urine good for both fox species.
[b] Recommendations differ with intent; example, visual stimuli may improve bobcat visitation.
[c] Sample intensity was derived by dividing the total area of the state by the number of sample survey lines (sample points for stream-crossing and pond bank surveys) and expressed as km^2 per sample survey line (point).

Table 1. Continued.

Georgia	1:1 mixture of bobcat & red fox urine	Tuft of vegetation in center of station	Cleared, raked, & smoothed. Soil carried in trucks for stations with poor soil conditions	0.2 mi	1.8 mi	643	County maintenanced dirt roads & primitive roads in "typical" habitat	Systematic for even distribution over game mgmt. regions.	No rule	1	October	Bobcat Red & gray foxes Raccoon	Tip Hon Ga. Dept. of Natural Res. Game & Fish Comm. Rt. 2 Social Circle, Ga. 30279 (404)557-2571
Kentucky	1:1 mixture of bobcat & red fox urine	On stick some runs onto ground	Cleared, raked & smoothed	0.2 mi	1.8 mi	1068	Dirt or gravel secondary roads only	Randomly over weather division districts	1.8 mi	1	September October	Red & gray foxes Bobcat	Mike Morton Yellow Bank Wildl. Manage. Area Stephensport, KY 40170 (502)547-6276
Louisiana	Fatty acid scent (FAS)	White scent disc, pinned to ground in center of station with nail	Cleared, raked & smoothed with light sprinkle of lime (light gray)	1 mi	50 mi	4189	Paved or unpaved secondary or forest roads	Distributed proportionally among 6 physiographic regions. Randomly selected starting points	No rule	At least 1 night, 2 nights if possible	October for least rainfall, available manpower, & increased animal activity	Bobcat Red & gray foxes Coyote Raccoons Opossum Skunk Housecats	Greg Linscombe La. Dept. of Wildl. & Fish. New Iberia, LA 70560 (318)369-3808
Maryland	1:1 mixture of bobcat & red fox urine	Scent disc on ground in center of station	Cleared, chopped, smoothed; carry sand in trucks	0.2 mi	1.8 mi	183	Paved & unpaved secondary roads	Randomly from list of available roads	At least 3 mi.	3	October	Bobcat Red & gray foxes Raccoon	James J. DiStefano Maryland Wildl. Adm. 225 E. Main St., Box 212 Sparksburg, MD 21782 (301)432-5784
Missouri	Fatty acid scent (FAS)	6-inch cotton-tipped applicator	Raked & Sifted	0.3 mi	2.7 mi	1631	Dirt or gravel roads	Randomly	1 mi	3	September	Coyote Red & gray foxes Raccoon Opossum Striped skunk	Dave Erickson Mo. Dept. of Cons., 1110 College Ave. Columbia, MO 65201 (314)449-3761

Table 1. Continued.

North Carolina	1:1 mixture of bobcat & red fox urine	Scent disc on ground in center of station	Cleared, chopped, raked, some sifted	0.2 mi	1.8 mi	683	Unpaved county secondary roads	Randomly	At least 5 mi	1	Sept.15-Oct.10	Red & gray foxes Bobcat	Randy C. Wilson 309 N. Cumberland, Wallace, NC 28466 (919)285-7559
	None	—	Check presence of tracks along creek bank at bridge crossings on county roads	No rule	25 bridge crossings per county, 2500 statewide	55	Bridge crossings on county roads	Random survey of major creek drainages in each county	Not conducted on survey line	1	Sept.15-Oct.10	Otter Mink Raccoon Beaver	Denton D. Baumbarger Box 1047 Elizabethtown, NC 28337 (919)862-2522 (predominantly bobcat & otter)
Oklahoma	Fatty acid scent (FAS)	Cotton swab (Q-tip) in center of station	Cleared & Sifted	0.3 mi	15 mi	2352	Secondary, unpaved roads, infrequently traveled through habitat representative of county	Originally to represent vegetative type(s) of county. Some lines are used annually.	No rule	2	August	Bobcat Raccoon Foxes Coyote	Richard Hatcher 1411 N.W. 20th Oklahoma City, OK 73106 (405)528-0866
	None	—	Pond/Creek bank survey for tracks	At least 1 mi between sites	10 sites per county, 770 statewide	235	Pond, lake, or stream shoreline with at least 200 linear ft. of impressionable soil, at least 1 ft. wide	—	Not conducted on survey line	1	August	Bobcat Raccoon Foxes Coyote Beaver Muskrat Mink	

Table 1. Continued.

Texas	— Spot-light accounts of furbearers (mi/furbearer) for annual trend in conjunction with deer counts.	—	—	—	20 mi.	2500	All road types	Proportionally distributed among 10 major habitat types & randomly selected	at least 4 mi.	1	Aug. 15 - Sept.	Raccoon. Not believed to be indicative of fox and bobcat trends	Bill Brownlee 4200 Smith School Road Austin, TX 78744 (512)479-4973 4800 ext.2700
Virginia	Fatty acid scent (FAS)	Scent capsule on stick ½" above ground in center of station	Cleared, Sifted	0.2 mi	1.8 mi	302	Unpaved secondary roads through typical habitat with avg. raccoon, fox & bobcat densities, on public land	—	1 mi	2	October	Raccoon Foxes Bobcats	Joe Coggin Municipal Bldg. Buchanan, VA 24066 (703)254-1997
	Fatty acid scent (FAS)	Scent capsule on bank	Use natural clean sand or muddy areas	At least 1 mi. between stations	10 bridge crossings per county, 300 state-wide	352	Largest drainage in county; 5 on small tributaries (3 - 10' across) & 5 on main stream	Randomly selected bridge crossings within largest drainage in counties where game managers live.	Not conducted on survey line.	2	October	Mink Otter Beaver Muskrats	
West Virgina	Fatty acid scent (FAS)	Cotton swab (Q-tip) in center of station	Cleared & smoothed with trowel; carry sand in trucks	0.2 mi	2.0 mi (11 stations; 1 for insurance)	979	Unpaved secondary, county roads. Avoid residential areas. Within 30' of road berm	Random, used previously selected woodcock survey routes	No rule	3	Sept.	Red & gray foxes, bobcat, dogs, housecats, raccoons, opossum	Richard Hall P.O. Box 67 Elkins, WV 26241 (304)636-1767

Importance Ranking of Considerations in Using Scent-Station Surveys

The ability of recorders to identify tracks was ranked as the most important consideration in using scent-station surveys and showed the highest consensus among surveyed biologists with the lowest standard deviation (Table 2). A related consideration, preparation of the track surface, also ranked high (4th) but exhibited a higher standard deviation. Roughton (1979) recommended that track-stations "ideally should be (1) graded absolutely flat with a hoe, (2) free of rocks, and (3) have a thin layer of fine dust screened evenly over the surface." Use of sands result in poor track surfaces; indistinct depressions due to crumbling often occur (Roughton 1979). Improvements in the track surface should be encouraged; these changes probably would have minimal influence on visitation rates as long as contrasting visual stimuli were avoided. Addition of light gray lime to enhance the track surface also served as a visual attractant and increased bobcat visits (Morrison et al. 1981).

Table 2. Quantitative importance ranking of 15 considerations in using scent-station surveys based on an opinion survey of 12 furbearer biologists in the southeastern United States.

Considerations	Mean[a]	Standard Deviation	Minimum Value	Maximum Value
Ability of recorders to identify tracks	9.50	.80	8	10
Analysis and interpretation of data	9.08	1.62	5	10
Sampling intensity	7.67	3.06	0	10
Preparation of track surface	7.17	2.59	3	10
Scent type	6.79	2.89	2	10
Weather	6.54	3.11	0	10
Criteria for line selection	6.38	3.04	0	10
Month survey conducted	6.33	1.92	3	10
Where conducted	5.92	2.34	3.	10
Distance between track stations	5.17	2.09	2	8
Distance between lines	4.91	2.91	0	9
Presentation of scent	4.67	2.96	0	8
Line length	4.33	2.43	0	7.5
Number of nights conducted	3.96	2.03	0	8
Amount of scent	3.92	1.92	1	8

[a] Based on a Likert ranking scale with 0 representing not important and 10 representing extremely important (see Methods).

Most states (8 of 10) conducted initial training sessions followed by annual, detailed instructions (6 states with more than 1 year of survey experience). Two states did not conduct a formal training session but presented information when feasible at other organizational meetings and also relied on a detailed instruction sheet. The ability of recorders to identify tracks and prepare track surfaces can be improved with stronger training sessions. Particular attention should be given to new personnel, technique refinements such as track surface improvements, and stressing the importance of diligent preparation of track surfaces and track identification. Questionable interpretations increase variation and weaken scent-station trend data (Roughton 1979). An additional "quality control" on track identification involves recording track length and width on data forms (Hon 1979).

The analysis and interpretation of scent-station data ranked 2nd in importance and also possessed the 2nd lowest standard deviation (Table 2). The Fisher randomization test and the Wilcoxon signed rank test appear to be the best statistical procedures to analyze data on scent-station trends (Roughton 1979, personal communication). High concerns over interpretations appear to revolve around the validity of area-to-area comparisons, sensitivity of visitation rates to change in density and technique refinements, and statistical sampling considerations. The importance of sampling considerations is further reflected in sampling intensity being ranked as the 3rd most important consideration (Table 2).

Scent type ranked 5th in importance (Table 2) and generated many comments because most biologists believed high potential existed for survey improvements through scent refinements. Sumner and Hill (1980) indicated that urine scents were more attractive and appeared more species specific for foxes and bobcats. But problems with unknown deterioration factors and inconsistencies among suppliers and batches detract from urines as a uniform attractant. Florida mixes orders of bobcat urine from several suppliers in an attempt to balance inconsistencies. Georgia recently initiated an attempt to isolate the highly attractive components of bobcat urine and reproduce them synthetically to enhance attractiveness and uniformity. Scent refinements and visual components of attractants, presentation, and track surface preparations are fertile areas for further research.

The month surveys were conducted and weather considerations had similar mean importance values (Table 2). These considerations were likely viewed as being interrelated because the influence of inclement weather can be minimized by selection of the month (or season, survey question was probably too specific) with the annual precipitation minimum. The probability of interference from inclement weather can also be reduced by conducting surveys for 1 night. Hon (1979) showed that conducting scent-station surveys for 1 night yielded comparable data with surveys for 3 nights for bobcat visitation. Reevaluation of the western coyote scent-station survey also indicated that 1-night surveys were adequate (Roughton 1979). One-night surveys also would substantially reduce operational costs. Manpower, cooler temperatures, and increased animal activity were other important considerations in the timing of surveys.

The criterion for line selection (planning considerations) and where scent-stations are conducted (specific field placement) were also likely viewed as being related considerations. These considerations are highly variable across the Southeast (Table 1) and there is very little information of the effects of these considerations on visitation rates. Selection of survey routes by field personnel in Oklahoma was believed to increase visitation because the areas of better habitat were favored. Roughton (1979) questioned area-to-area comparisons without selecting sample survey lines at random. He also stated that random selection of road segments may not fulfill random sampling requirements because predators exhibit nonrandom use patterns of roads. But careful "representative" sampling of road segments in uniform habitat may adequately index population trends of furbearers from a biological and statistical viewpoint (Roughton 1979). Selection of sample survey routes by 1 person, preferably from a well defined, written set of criteria guidelines would increase survey consistency and reduce variations in the index. Consistency in sampling considerations would enhance comparisons among areas if habitat and movement differences were considered.

Remaining considerations in using scent-station surveys ranged between moderately important and slightly important but relatively large standard deviations indicated no clear consensus among biologists except possibly for the amount of scent (Table 2).

Other Survey Questions

Future directions listed for surveys of furbearer population trends included: (1) measurement of the relative abundance of dogs and house cats and their relationships with other wildlife species, (2) technique refinements for both multi-species and single-species monitoring, (3) analysis of data on distribution of furbearers for delineating habitat areas and areas of habitat loss, (4) monitoring in areas with disease problems, (5) monitoring range expansion of coyotes and species interrelationships, (6) expansion of the surveys and incorporation into comprehensive management of furbearers, and (7) eventual calibration of visitation rates with density levels.

Responses to major problems encountered and recommended changes in surveys of furbearer population trends strongly substantiated the quantitative importance ranking results (Table 2). Additional problems listed were: (1) lack of consistency among states, (2) attrition of sample lines, (3) a tendency for biologists and particularly administrators to consider trend data as abundance or census data, (4) inconsistent effort and reporting within states, and (5) administration of surveys across agency divisions.

The average cost of annual state-wide surveys of furbearer population trends for 9 Southeastern states was $26,095 and ranged from $12,662 to $50,000. Two states at the upper cost range conducted surveys of stream-crossing or pond-bank track incidence in addition to scent-station surveys. The average annual cost for 6 states conducting only scent-station surveys was $19,019. States indicated that furbearer population trend surveys were expensive compared with other wildlife or range surveys but generated large amounts of information for the cost.

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