A Comparison of Scent-station Surveys and Track Counts for Monitoring Furbearers

Reginald J. Stapper, *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843*

Danny L. Rakestraw, *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843*

Daniel B. Fagre,[1] *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843*

Nova J. Silvy, *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843*

Abstract: Scent-station and track-count transects were monitored simultaneously in 5 units of the Big Thicket National Preserve. We examined these transects for furbearer tracks for 3 consecutive days every 3 months from January 1987 through March 1988. Greater species diversity and species richness of furbearers were recorded on track-count surveys than on scent-station surveys on 4 of the 5 study units. The number of monitoring periods with no record of a species group was compared between the 2 techniques. Track-count surveys recorded "no presence" of a species group less often than scent-station surveys. Tracks of dog-like canids, fox-like canids, raccoons (*Procyon lotor*), and opossums (*Didelphis virginiana*) were used to compare precision and to correlate the 2 techniques. No difference in precision of the 2 techniques was found in this study. Relevant positive correlations were calculated for the 2 techniques in 6 of 16 cases. Labor and cost requirements for each technique were similar.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 43:452–459

Scent-station surveys have been used for many years to monitor selected furbearer populations. These surveys have been conducted in the southeastern United States to provide indices of furbearer abundance in specific areas and to compare trends over time (Sumner and Hill 1980, Johnson and Pelton 1981). Scent stations attract animals to a specific location using an odor stimulus and thus are dependent on the effectiveness of the odor stimulus (Linhart and Knowlton 1975). Track counts

[1]Present address: Indiana Dunes National Lakeshore, National Park Service, Porter, IN 46304.

have been used primarily to survey deer populations in forested areas (Daniel and Frels 1971). Aquatic furbearers have been surveyed by counting their tracks on stream banks, but the track-count technique has not been used widely for surveying terrestrial furbearers (Johnson and Pelton 1981). Track-count transects are established along roads to record the presence of the animal during its normal movements. Their effectiveness does not depend on attracting individuals to a specific location. Our objectives were to (1) compare precision of the 2 techniques, (2) compare species diversity and richness recorded using each technique, and (3) determine if data from the 2 techniques were correlated.

This study was funded by the National Park Service and the Texas Agricultural Experiment Station. Numerous undergraduate students assisted in data collection. Also, D. Speegle, J. Dragoo, and D. Scarbrough helped in the field. This paper is Contribution No. 24966, Texas Agricultural Experiment Station.

Study Area

The Big Thicket National Preserve (BITH) is comprised of 12 units scattered throughout southeastern Texas in Hardin, Jasper, Jefferson, Liberty, Orange, Polk, and Tyler counties. A variety of pine (*Pinus* spp.), oak (*Quercus* spp.), and other forested habitats occur on BITH (Harcombe and Marks 1979). The 12 units vary in size from 223 to 10,452 ha with a combined area of 34,217 ha. We selected 5 units for use in our study: Beech Creek (1,993 ha), Big Sandy (5,635 ha), Jack Gore Baygall/Neches Bottom (5,335 ha), Lance Rosier (10,452 ha), and Turkey Creek (3,175 ha). These units were selected because of their greater size and accessibility.

Methods

Furbearer populations on BITH were monitored using scent-station transects (Linhart and Knowlton 1975) as modified by Conner et al. (1983). Scent stations were 1-m diameter circles of sifted soil placed on alternate sides of the roads every 0.4 km. The number of stations established in each of the 5 units varied with the size of the unit: Beech Creek Unit, 16 stations; Big Sandy Unit, 18 stations; Lance Rosier Unit, 20 stations; Jack Gore Baygall Unit, 11 stations; and Turkey Creek Unit, 10 stations.

To attract the greatest variety of species, 2 odor attractants were used in scent-station capsules during the study. These were Carman's Distant Canine Call (Russ Carman, Milford, Penn.) and W-U lure (developed by R. Teranishi, U.S. West. Reg. Res. Ctr.; W. E. Howard, Univ. Calif., Davis; and their coworkers). Both substances have been effective in attracting furbearers (Martin and Fagre 1988). The 2 lures were alternated between scent stations along the transects. The lures also were alternated at each scent station each monitoring period. Human contamination was kept to a minimum by using plastic gloves when preparing the capsules and when placing them at the scent stations.

Scent stations within all 5 units were examined each morning for 3 consecutive

days once every 3 months from January 1987 through March 1988. Visits to the scent stations by furbearers were identified by the tracks and sign left in the sifted soil of the scent stations. Discerning between feral dog, coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), and red fox (*Vulpes vulpes*) tracks was difficult and was considered unreliable. Thus, these tracks were grouped based on size into the general categories of dog-like or fox-like canids.

Scent stations were grouped by unit for each quarter to calculate visitation rates. When analyzing the data, scent stations were not separated by lure used. Visitation rates for furbearers were calculated by dividing the number of stations visited by each furbearer species each day by the number of operable scent stations (i.e., those not disturbed by wind or rain such that tracks were obscured).

Track-count transects (Tyson 1959) were established within all 5 units and were examined each morning for 3 consecutive days once every 3 months from January 1987 through March 1988. The surfaces of track-count transects were prepared using a 1.2- by 2.4-m flexible-tine harrow pulled behind a vehicle. The track-count transects were established down the center of infrequently traveled roads or on the shoulders of frequently traveled roads and usually required 2–3 passes to create a readable tracking surface. The 1.2-m wide transects varied in length from 0.8–2.4 km, depending on the study area (Beech Creek—1.6 and 0.8 km, Big Sandy—1.6, 0.8, and 1.6 km, Lance Rosier—0.8, 0.8, and 0.8 km, Jack Gore Baygall—1.6 km, and Turkey Creek—2.4 km).

All tracks were identified to species or assigned to the above-mentioned species groups. Data were recorded as number of crossings/km by species. A crossing was defined as an individual animal crossing the transect and leaving identifiable tracks. Individual animals obviously "zig-zagging" across the transect were recorded as only 1 crossing. After each reading, the harrow was pulled over the transect to erase tracks from the previous day.

Track-count and scent-station transects were surveyed concurrently on the 5 units of BITH and transects for the 2 techniques never overlapped within a unit. The 2 techniques were used either alternately on the same roads, or on different roads in close proximity to each other, depending on road availability in the unit.

Daily visitation rates on scent-station transects and crossings/km on track-count transects of raccoons, opossums, dog-like canids, and fox-like canids were computed for each study unit each quarter. Means and standard deviations of these indices were calculated for each furbearer group by study unit on a quarterly basis. The 2 techniques were compared in 4 ways: (1) general species diversity and species richness recorded for each technique, (2) percentage of species indices calculated by quarter for each unit with values of zero for each technique, (3) precision of indices, and (4) relative cost and labor of each technique. Correlation coefficients also were calculated to determine if the techniques were measuring similar characteristics of the furbearer population. We assumed that if the techniques were measuring similar population characteristics, the 2 indices would be positively correlated.

Species richness, evenness, and general diversity (Odum 1971:144) were calcu-

lated for the 2 techniques and then compared. The techniques with the higher indices was considered superior.

The percentage of species indices calculated by quarter for each unit with values of zero were compared between the 2 techniques. A zero value for a species index resulted when no tracks for that species occurred during a particular quarter on a particular unit. The technique with the fewer zero values was considered superior.

We calculated the precision (coefficient of variation, Ott 1988:419) for each technique by unit and quarter for each species group and then for all furbearers combined. The coefficients of the 2 techniques then were compared using a Wilcoxon sign test (Siegel 1956).

We also compared the visitation rate at scent stations and crossing/km on track-count transects after 1 day and 3 days to determine if these indices increased or decreased over time.

Labor requirements and relative cost of the 2 techniques were estimated and compared. Skill required for the 2 techniques was similar, therefore cost/hour was assumed to be equal.

Results and Discussion

Seventy-eight scent stations (monitored for 3 days each quarter) provided a total of 844 exposure nights (Beech Creek, 181; Big Sandy, 230; Lance Rosier, 162; Jack Gore Baygall, 138; and Turkey Creek, 133).

Tracks of dog-like canids, fox-like canids, raccoons, opossums, bobcats (*Felis rufus*), and spotted skunk (*Spilogal putorious*) were found at scent stations. Dog-like canids, raccoons, and opossums were recorded at scent stations on all 5 units. Fox-like canids were recorded on all but the Turkey Creek Unit, spotted skunks were only recorded on Turkey Creek and Jack Gore Baygall units, and bobcats only on the Beech Creek and Big Sandy units.

A total of 202.3 km (Beech Creek, 59.5; Big Sandy, 55.1; Lance Rosier, 21.3; Jack Gore Baygall, 19.7; and Turkey Creek, 46.7) of track-count transects was monitored during the study. Tracks of dog-like canids, fox-like canids, raccoon, opossum, bobcat, spotted skunk, striped skunk (*Mephitis mephitis*), and river otter (*Lutra canadensis*) were found on track-count transects. Dog-like canids, fox-like canids, raccoon, and opossum were recorded on all units. Striped skunk tracks were recorded on all but the Lance Rosier Unit. Bobcat tracks were only recorded on the Beech Creek and Big Sandy units. Spotted skunk and river otter tracks only were recorded on the Jack Gore Baygall Unit.

In 4 of the 5 units, greater species-richness indices were recorded on track-count transects than scent-station transects (Table 1). However, the species-evenness indices were greater for scent-station transects than track-count transects. Few furbearer species had large numbers of individuals that visited scent stations, which made visitations at scent stations more consistent and provided larger evenness indices. In contrast, track-count transects recorded both the abundant and less

Table 1. Species richness (d_3), species evenness (e), and general diversity ($\overline{H}$) indices for scent stations and track-count transects at 5 units in Big Thicket National Preserve, Texas, January 1987 to March 1988.

Unit	Scent station			Track count		
	d_3	e	$\overline{H}$	d_3	e	$\overline{H}$
Beech Creek	5	0.82	0.57	6	0.81	0.63
Big Sandy	4	0.78	0.47	6	0.69	0.54
Lance Rosier	4	0.81	0.49	4	0.78	0.47
Jack Gore Baygall	5	0.80	0.56	7	0.71	0.60
Turkey Creek	4	0.70	0.42	5	0.70	0.49

abundant furbearers, which probably caused the lower evenness indices for track counts. The general diversity indices, which included both richness and evenness, were greater for track counts for 4 of the 5 units.

The percentage of species indices calculated by quarter for each unit with values of zero showed scent stations had 32% zero values, whereas track-count transects only had 10%. Track counts appeared to be intercepting furbearers more often than scent stations.

The highest visitation rate for scent stations occurred in spring 1987 and winter 1988 and was lowest in winter 1987 (Table 2). Precision (CV's) of the visitation rate at scent stations was greatest during summer and fall 1987 and winter 1988 and was lowest in the spring 1987 (Table 2).

Crossings/km on track-count transects were highest during summer and fall 1987 and lowest during winter 1988 (Table 3). Track counts had the greatest precision in the summer and the lowest in the spring (Table 3).

Table 2. Mean daily visitation (%) with coefficients of variation for dog-like canids, fox-like canids, raccoon, opossum, and all furbearers combined (also includes bobcat and spotted skunks) during 5 quarters and for all quarters combined on scent stations for 5 units of Big Thicket National Preserve, Texas, January 1987 to March 1988. Numbers have rounding errors.

Furbearer categories	Quarter											
	Winter 87		Spring 87		Summer 87		Fall 87		Winter 88		All	
	CV	%	CV	%	CV	%	CV	%	CV	%	CV	%
Dog-like canids	12.8	0.7	11.9	0.7	13.9	0.5	9.8	0.3	20.2	0.3	13.6	0.3
Fox-like canids	0.0	–[a]	0.0	–[a]	1.6	1.2	4.0	1.3	1.4	1.4	1.3	0.5
Raccoon	3.6	0.6	13.1	0.6	6.9	0.4	4.6	0.4	2.4	1.2	5.7	0.4
Opossum	1.3	2.2	11.1	1.1	6.6	0.7	12.8	1.1	9.8	0.4	7.4	0.5
All	19.3	0.4	33.8	0.5	29.0	0.2	30.3	0.2	33.9	0.2	28.5	0.2

[a]Unable to calculate coefficient of variation because mean was zero.

Table 3. Mean tracks/km with coefficients of variation for dog-like canids, fox-like canids, raccoon, opossum, and all furbearers combined (also includes bobcat, striped and spotted skunks, and river otter) during 5 quarters and for all quarters combined on track-count transects for 5 units of Big Thicket National Preserve, Texas, January 1987 to March 1988. Numbers have rounding errors.

Furbearer categories	Quarter											
	Winter 87		Spring 87		Summer 87		Fall 87		Winter 88		All	
	$\bar{x}$	CV	$\bar{x}$	CV	$\bar{x}$	CV	$\bar{x}$	CV	$\bar{x}$	CV	$\bar{x}$	CV
Dog-like canids	3.6	0.5	1.6	0.9	3.6	0.5	1.0	0.5	2.1	0.3	2.5	0.2
Fox-like canids	0.2	1.0	0.8	2.0	0.7	1.4	0.8	1.7	1.0	1.5	0.9	1.0
Raccoon	1.3	1.0	2.0	0.4	3.0	0.1	3.8	0.6	4.7	1.2	2.2	0.2
Opossum	0.4	1.3	3.2	1.6	1.7	0.9	2.2	1.4	0.8	1.2	1.6	0.6
All	5.7	0.4	7.6	1.1	9.3	0.3	9.3	0.9	4.4	0.5	7.1	0.2

There were no consistent trends in visitation rates or crossing/km for any of the species across quarters. There also were no consistent trends by quarter in precision of techniques by furbearer group. The Wilcoxon sign test on CV's showed no difference ($P > 0.05$) in the precision of the indices calculated from the 2 techniques.

Visitation rates and crossings/km did not increase or decrease consistently from 1 day of monitoring to 3 days of monitoring (Wilcoxon sign test, $P > 0.05$). This may indicate furbearers neither avoided nor were attracted back to scent stations or to track-count transects after visiting them the first day.

Mean species indices per quarter from scent-station and track-count transects were positively correlated ($P < 0.1$) for raccoons and opossums in the Beech Creek and Lance Rosier units, for raccoons in the Turkey Creek Unit, and for dog-like canids in the Jack Gore Baygall Unit (Table 4). We assumed a positive correlation indicated both techniques were equal to their ability to measure trends in furbearer densities. Negative correlations ($P < 0.1$) occurred for dog-like canids on the Big Sandy and Lance Rosier units. One explanation for this negative correlation was the

Table 4. Correlation coefficients (r) between scent-station visits and track counts computed from mean-quarterly population indices for raccoon, opossum, dog-like canids, and fox-like canids for 5 units in Big Thicket National Preserve, Texas, January 1987 to March 1988.

	Beech Creek	Big Sandy	Lance Rosier	Jack Gore Baygall	Turkey Creek
Raccoon	0.9[a]	0.3	0.7[a]	−0.4	0.9[a]
Opossum	0.8[a]	b	0.8[a]	0.3	−0.1
Dog-like	0.5	−0.7[a]	−0.8[a]	0.7[a]	0.4
Fox-like	0.1	0.1	—[b]	—[b]	—[b]

[a] $P < 0.1$.
[b] Unable to calculate correlation because of insufficient data.

presence of private inholdings in each of these units. Scent stations were located in closer proximity to these inholdings than were track-count transects and dogs were commonly sighted on both units. Because of the closer proximity to scent stations and because scent stations used a lure as an attractant, dogs probably altered their normal behavior and visited these stations. In contrast, dogs were only recorded on track-count transects during their normal movements through an area.

Labor requirements were similar for scent stations and track counts. Initially, scent stations were more labor intensive because of time required to prepare odor capsules, clear vegetation, and sift soil over the stations. Also, if scent stations were visited by furbearers, soil had to be resifted and some capsules had to be replaced. However, once established, scent stations could be monitored using a vehicle while track counts required close inspection and had to be walked and then reworked with the harrow.

Scent stations required the purchase of capsules, lure, sponges, plastic gloves, screen and lumber to build sifters, a shovel, and a hoe (about $200). The initial investment of the flexible-tine-harrow (about $400) was the only major cost associated with track counts. However, capsules, lure, plastic gloves, and sponges were not reusable as was the harrow. Gas required for the vehicle was similar for each technique since track-count transects had to be dragged again each day with a vehicle. Overall cost for the 2 techniques was similar.

Conclusions

The differences we found between the 2 techniques were in the diversity of species recorded and the number of zero values for species indices/quarter. Since species indices/quarter for track counts had 10% zero values and scent-station surveys had 32% zero values, track-count transects were intercepting furbearers more often than were scent stations. Also a greater diversity of furbearers was recorded on the track-count transects in 4 of the 5 study units. Because of the lower percentage of zero values and the greater furbearer diversity recorded, we believe that track counts can be more sensitive to fluctuations in population abundance and community structure. Thus, track counts should be considered as a technique for surveying furbearer populations in areas where track-count transects are practical, but additional research needs to relate the track-count index to actual population density.

Literature Cited

Conner, M. C., R. F. Labisky and D. R. Progulske. 1983. Scent station indices as a measure of population abundance for bobcats, raccoons, gray foxes, and opossums. Wildl. Soc. Bul. 11:146–152.

Daniel, W. S. and D. B. Frels. 1971. A track-count method for censusing white-tailed deer. Texas Parks Wildl. Dep. Tech. Ser. No. 7. 18pp.

Harcombe, P. A. and P. L. Marks. 1979. Forest vegetation of the Big Thicket National Preserve. Natl. Park Serv. Southwest. Reg. Contr. No. PX7029-8-0437. 113pp.

Johnson, K. G. and M. R. Pelton. 1981. A survey of procedures used for indexing population trends of furbearers in the southeastern United States. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 35:261–272.

Linhart, S. B. and F. B. Knowlton. 1975. Determining the relative abundance of coyotes by scent station lines. Wildl. Soc. Bul. 3:119–124.

Martin, D. J. and D. B. Fagre. 1988. Field evaluation of a synthetic coyote attractant. Wildl. Soc. Bul. 16:390–396.

Odum, E. P. 1971. Fundamentals of ecology. Third ed. W. P. Saunders Co., Philadelphia, Pa. 574pp.

Ott, L. 1988. An introduction to statistical methods and data analysis. Third ed. PWS-KENT Publ. Co., Boston, Mass. 835pp.

Siegel, S. 1956. Nonparametric statistics. McGraw-Hill Book Co. N.Y. 312pp.

Sumner, P. W. and E. P. Hill. 1980. Scent stations as indices of abundance in some furbearers of Alabama. Proc. Annu. Conf. Southeast. Assoc. Fish. and Wildl. Agencies 34:572–583.

Tyson, E. L. 1959. A deer drive vs. track census. Trans. North Am. Wildl. Conf. 24:457–464.