AN ABSTRACT OF THE THESIS OF

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Four survey techniques for determining relative abundance of river otters (Lutra canadensis) in east-central Kansas were evaluated in 1986. Scent station surveys and sign surveys were conducted on stream segments and at bridge sites. Survey indices were derived by dividing the number of visits by the number of survey-nights, then multiplying by 10. The numbers of survey-nights for the stream segment scent station survey, the stream segment sign survey, the bridge site scent station survey, and the bridge site sign survey were 200, 100, 200, and 100, respectively. The number of survey-nights for otters was 50% of the total. River otter survey indices were highest at bridge sites with visitation indices of 4.20 and 4.40 for the scent station survey and the sign survey, respectively. There was no significant difference ($P > 0.05$) between visitation rates at paired scent stations and sign survey areas for river otters. Survey indices for raccoons (Procyon lotor) were highest in the bridge site surveys and the sign surveys. The bridge site sign survey produced the highest index of 9.00. Bridge site scent station surveys and stream segment sign surveys each yielded indices of 7.00. There was a significant difference ($P < 0.05$) between visitation rates at paired scent stations and sign survey areas for raccoons. The bridge site sign survey produced the highest index (1.50) for mink (*Mustela vison*), and the stream segment sign survey produced the highest index (1.70) for beaver (*Castor canadensis*). The results of this study indicate that bridge crossing sign surveys and bridge crossing scent station surveys may be effective methods for determining relative abundance of river otters and raccoons in eastern Kansas.

AN EVALUATION OF SURVEY TECHNIQUES FOR DETERMINING RELATIVE ABUNDANCE OF RIVER OTTERS AND SELECTED OTHER FURBEARERS

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INTRODUCTION

The northern river otter (Lutra canadensis) is one of the largest members of the family Mustelidae. River otters are, except for sea otters (Enhydra lutris), the most aquatic member of the family. They have webbed feet, a streamlined body, and other morphological and physiological adaptations that make them well adapted for swimming under water. River otters are usually found in close association with bodies of standing or running water, and much of their food is taken from the water (Knudsen and Hale 1968; Lauhachinda 1978).

The river otter was once found throughout most of North America (Figure 1), but at present its range is greatly reduced (Figure 2). The otter has been considered extirpated from the state of Kansas since the early 1900's (Bee et al. 1981). This has prompted the Kansas Department of Wildlife and Parks to implement a river otter reintroduction program. Several other states have similar programs in progress. A river otter was released 26 May 1983 on the South Fork of the Cottonwood River in Chase County, Kansas. Since that time, 18 additional otters have been released at the site by the Kansas Department of Wildlife and Parks in an attempt to reestablish a viable river otter population in the state. Critical to the project was a method of monitoring the otters' survival and dispersal and to document any reproduction. Radio telemetry was employed to monitor the otters during the first two years of the project. Radio transmitter failure, shortage of funds, and the desire to continue to monitor the released otters stimulated consideration of monitoring methods other than radio telemetry.

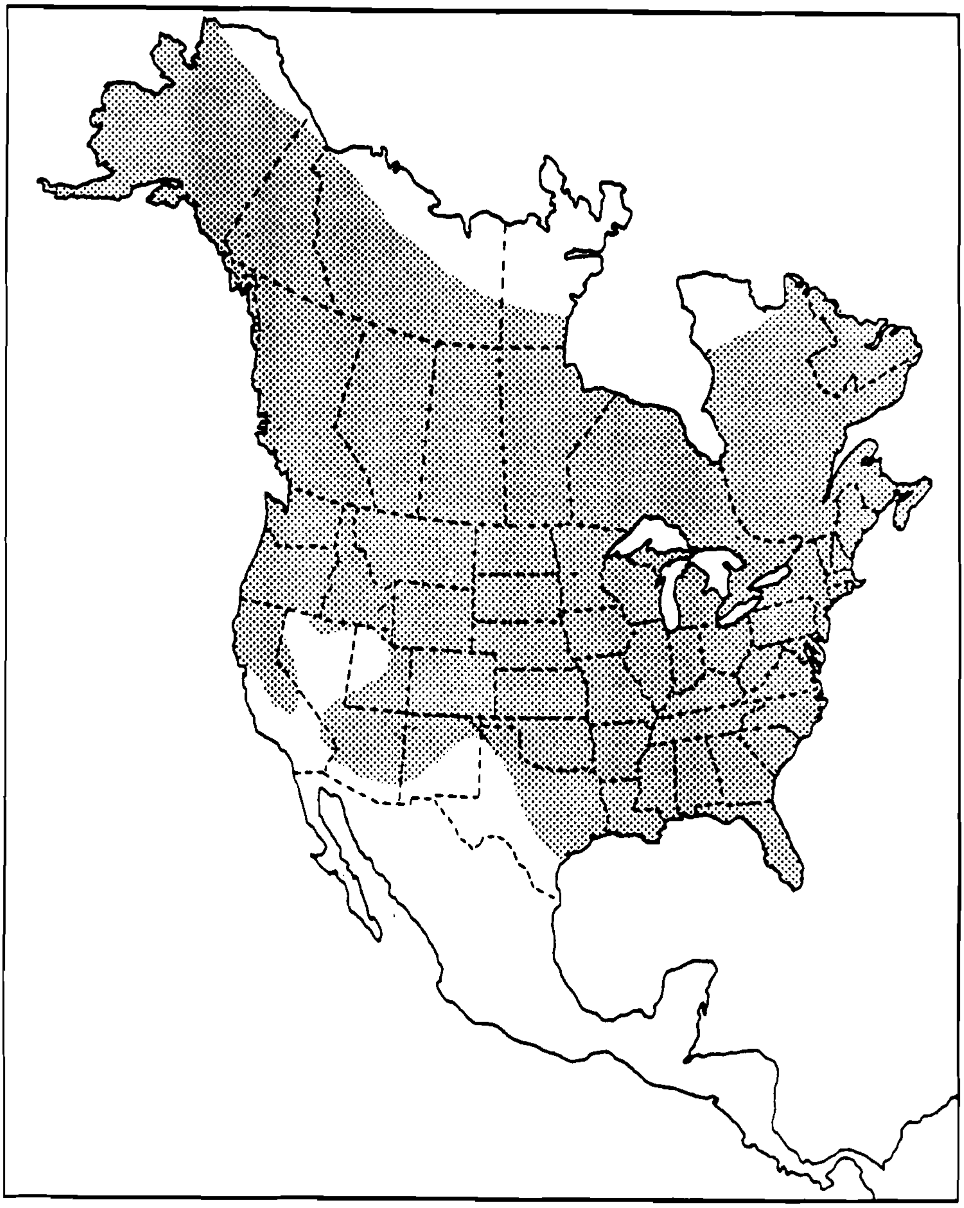

Figure 1. Original distribution of the river otter in North America (modified from Schwartz and Schwartz 1981).

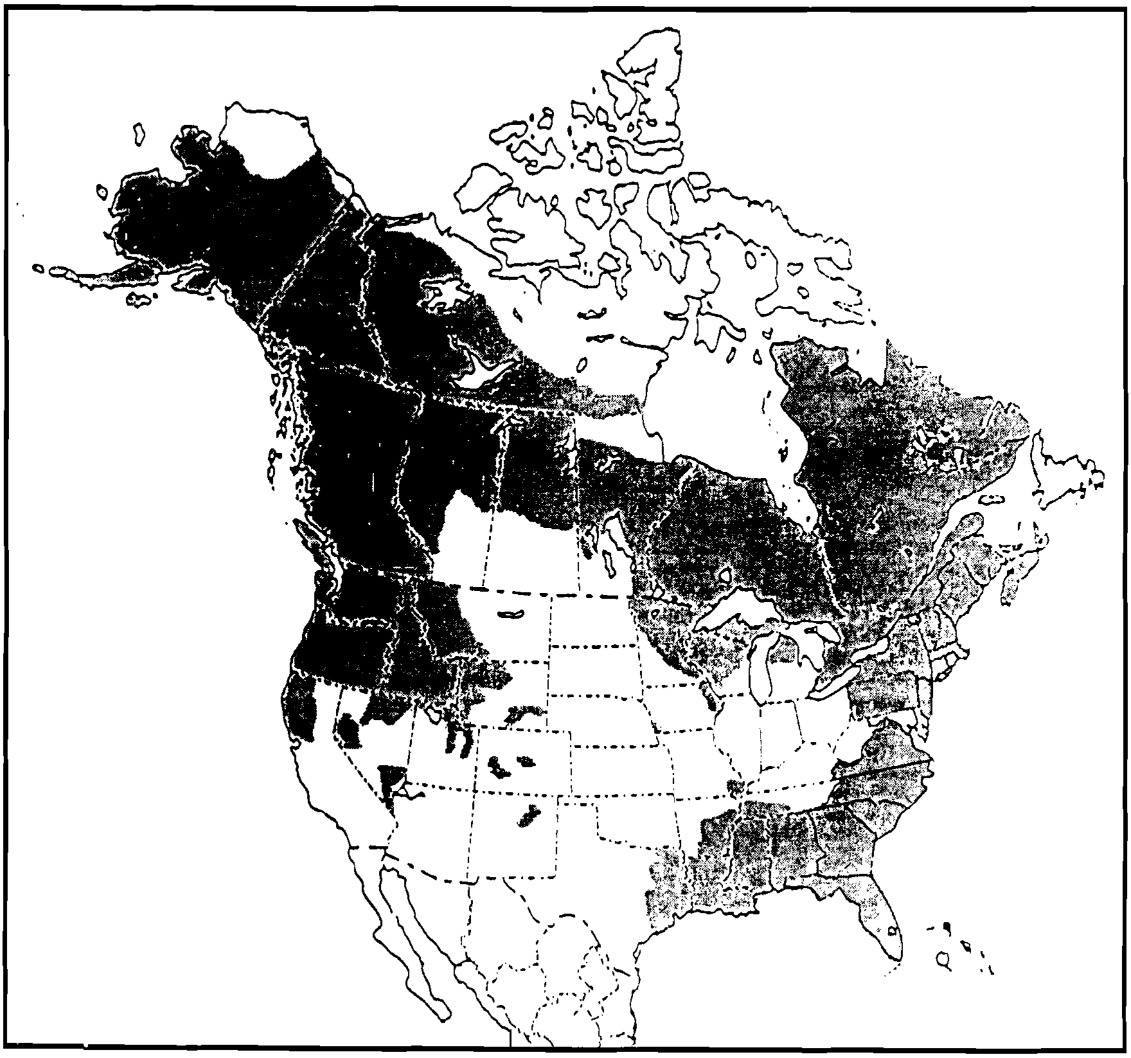

Figure 2. Distribution of the river otter in North America in 1978 (modified from Chapman and Feldhamer 1982).

Scent station surveys have been utilized to estimate and monitor changes in relative population densities of many mammalian species. One of the earliest studies using this method was by Cook and Maunton (1949) in New York to estimate the relative abundance of foxes. A scent post survey technique was used by Wood (1959) to determine relative abundance of gray and red foxes (Urocyon cinereoargenteus and Vulpes vulpes, respectively) in the southeastern United States. Lindzey et al. (1977) utilized a scent station survey to estimate relative abundance of black bears (Ursus americanus) in Washington. Scent stations were used to survey bobcats (Felis rufus) and raccoons (Procyon lotor) in Florida (Connor et al. 1983).

One of the more intensive and large scale studies utilizing scent station surveys was initiated in 1972 by the U.S. Fish and Wildlife Service (Linhart and Knowlton 1975). Scent station lines were established throughout 17 western states to determine the relative abundance of coyotes (Canis latrans). Fifty scent stations at 0.3 mi. intervals along a continuous 14.7 mi. transect comprised one survey line. Each scent station consisted of a 36 in. diameter circle of sifted earth or sand with a capsule containing Fatty Acid Scent (F.A.S.) in the center. In 1972, survey lines were checked daily for four consecutive days. Visitations, as determined by tracks within the circle, were recorded for coyotes and other mammalian species. The method was refined in later years so that one survey line consisted of 10 scent stations, and they were checked only once each survey period (Roughton and Sweeny 1982).

Humphrey and Zinn (1982) set out "combination lines" to measure relative abundance of river otter and mink (Mustela vison) in Florida. Transects were established with a line of 10 scent stations set out at 60 m intervals. Hawbaker otter and mink lures were used at alternating stations. Each station consisted of one 0.4 m^2 Masonite trackboard covered with chalk dust. A small wooden dowel in the center of each trackboard was used to retain the lure. Clark (1982) used a similar technique in his study of river otters in Georgia. He set out trackboard survey lines along streams using otter lure as an attractant. In addition to the trackboard station lines, he set out scent station lines utilizing a natural substrate. In a manner similar to Linhart and Knowlton's (1975) method of constructing scent stations for coyote surveys, Clark's (1982) stations consisted of a 1 m diameter area of mud or sifted sand. Hawbaker otter lure was placed on a stick or tuft of grass in the center of each station. Survey lines consisted of 20 stations spaced at 100 m intervals along the banks of streams and beaver ponds. Surveys were also conducted at bridge crossings using the sand substrate scent stations. Bridge crossings were sites where road bridges spanned streams. In a Montana study, two scent posts per kilometer were placed along eight to 28 km lengths of streams (Zackheim 1982). His scent posts were placed on mud, snow, or a prepared ash and chalk dust surface.

A study in Florida (Robson 1982) utilized another variation of the stream bank survey technique. Designated stretches of stream banks were checked at standard distance intervals for presence of river otter sign. Stream bank surveys for otter sign have also been conducted in Pennsylvania (Serfass et al. 1986). Other studies on surveying or estimating river otter populations include Tabor and Wright (1977), Knaus et al. (1983), Melquist and Hornocker (1983), and Shirley et al. (1988).

The objectives of this study were to evaluate four techniques of surveying Kansas' reintroduced river otter population. The four techniques were to be evaluated according to sensitivity of the survey technique in detecting the otters' presence and time and effort required to carry out the survey. The goal of the study was to determine a practical and effective survey technique for monitoring the reintroduced population of river otters. The surveys' effectiveness in measuring relative abundance of other furbearer species was to be evaluated also.

STUDY AREA

The study took place in Chase and Lyon counties, Kansas (Figure 3). Study area boundaries were determined from previous radio telemetry monitoring of reintroduced otters (Eccles 1984). The study area was located at approximately 38° 30′ N latitude and 96° 30′ W longitude. The study area, in the Flint Hills region of Kansas, is characterized by rolling hills interspersed with broad, flat stretches of bottomland along streams. Much of the area is rangeland dominated by tallgrasses such as big bluestem (Andropogon girardii), little bluestem (Andropogon scoparius), indiangrass (Sorghastrum nutans), and switchgrass (Panicum virgatum). The bottomland is farmed with corn, milo, soybeans, wheat, and alfalfa as major crops. Dominant tree species occurring along the drainages include cottonwood (Populus deltoides), sycamore (Platanus occidentalis), box elder (Acer negundo), black willow (Salix nigra), bur oak (Quercus macrocarpa), hackberry (Celtis occidentalis), and silver maple (Acer saccharinum). The Cottonwood River is a third-order tributary, and the South Fork of the Cottonwood River is a second-order tributary (Horton 1945; Strahler 1952). The South Fork is a Value Class I stream (Kansas Fish and Game Commission 1981). The Cottonwood River is impounded upstream of the study area by Marion Dam and Reservoir. At conservation flow, the Cottonwood is characterized by long, slow-moving stretches of deep water interspersed with shallow riffles. Some pools may be five meters in depth, although one-two meter depths are probably more

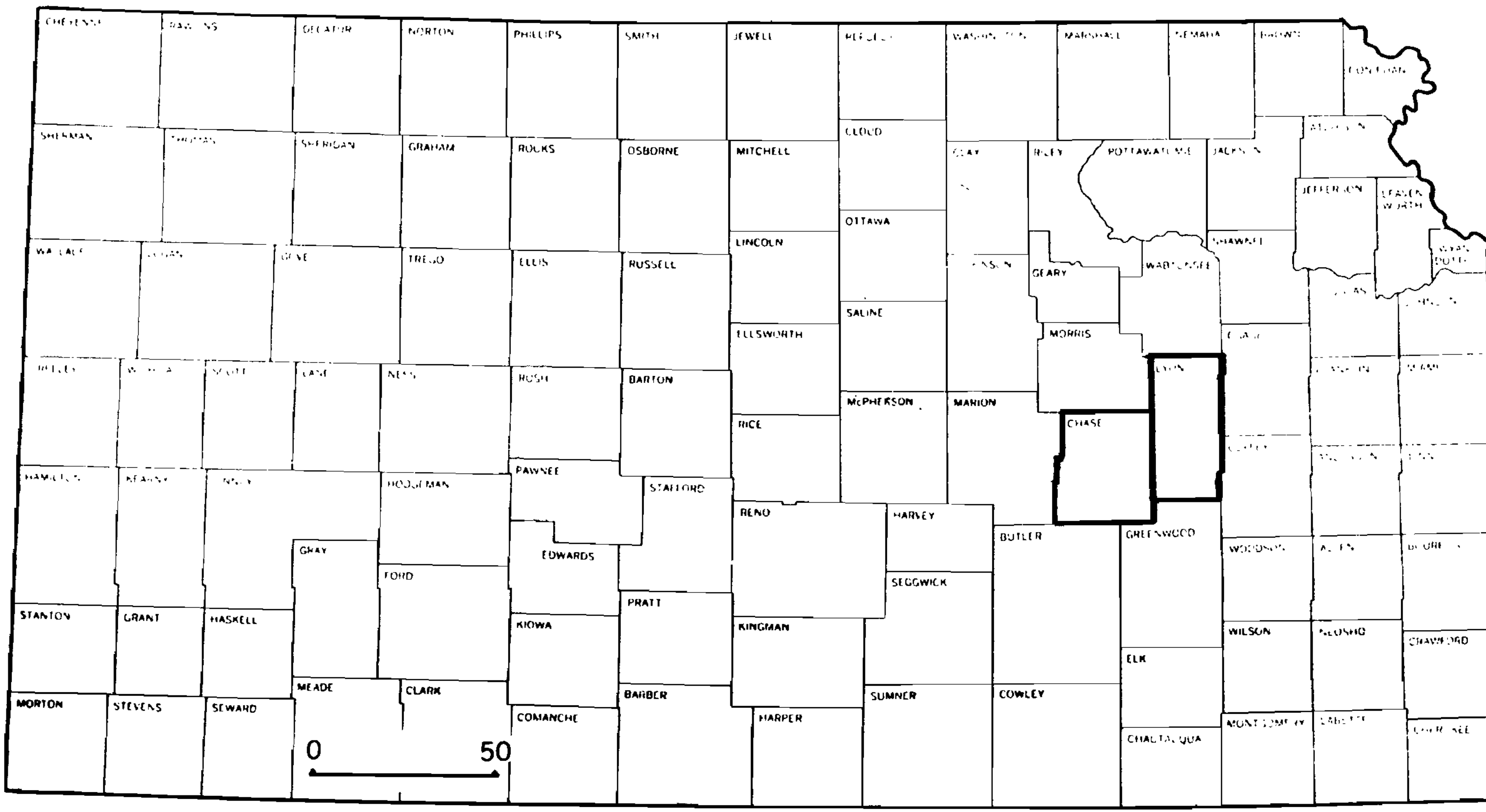

Figure 3. Location of Chase and Lyon counties, Kansas.

common. The substrate along the Cottonwood consists of stretches of hardpan clay and limestone with occasional gravelly, riffle areas and gravel bars. The South Fork of the Cottonwood River is similar to the Cottonwood but on a smaller scale. Riffle areas are more prevalent on the South Fork. Numerous springs feed into the South Fork maintaining minimal flow even in times of drought and creating pockets of cool spring water. The substrate along the South Fork and the smaller feeder streams is increasingly limestone and gravel as one advances upstream. Common stream fishes include channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), black bullhead (*Ictalurus melas*), carp (*Cyprinus carpio*), buffalo (*Ictiobus* spp.), gar (*Lepisosteus* spp.), largemouth bass (*Micropterus salmoides*), crappie (*Pomoxis* spp.), and green sunfish (*Lepomis cyanellus*). Crayfish (*Procambarus* spp.) and bullfrogs (*Rana catesbeiana*) also occur and are seasonally important prey species for river otters.

Fishing and canoeing are popular recreational activities on the South Fork and Cottonwood rivers. These activities are pursued mainly by area residents, and because the human population density is relatively low in the area, recreational use is not considered to be heavy. The South Fork and the smaller creeks in the area can be considered relatively pristine.

METHODS AND MATERIALS

Twenty-five bridge sites were randomly selected from 46 bridge sites located within the study area (Figure 4). Two scent stations were constructed at each bridge site. One was constructed approximately 50 m upstream from the bridge and one approximately 50 m downstream from the bridge. When possible, scent stations were constructed on opposite sides of the stream.

Twenty 1.6 km stream segments were selected within the study area (Figure 5). These segments were chosen because otters were likely to be present (Eccles 1984). Five scent stations were constructed at 0.4 km intervals along each stream segment. When possible, scent stations were constructed on alternate sides of the stream.

A suitable site for a scent station was defined as an area of at least 1 m in diameter which had substrate that would allow tracks of any animal walking through that area to be recorded as impressions in the substrate. Wetting and smoothing of the substrate was sometimes necessary to provide a suitable track impression matrix and to eliminate any tracks already present. A 10-20 cm long, dry stick which had been dipped in otter lure (S.S. Hawbaker and Sons, Fort Loudon, PA), was set upright in the center of the 1 m diameter circle (Figure 6). Scent stations were marked with surveyor's ribbon that was tied to a nearby branch to aid in relocation.

All scent stations were checked for evidence of visitation approximately 24 hours after they were constructed. Identifiable tracks of selected species of furbearers were recorded if present

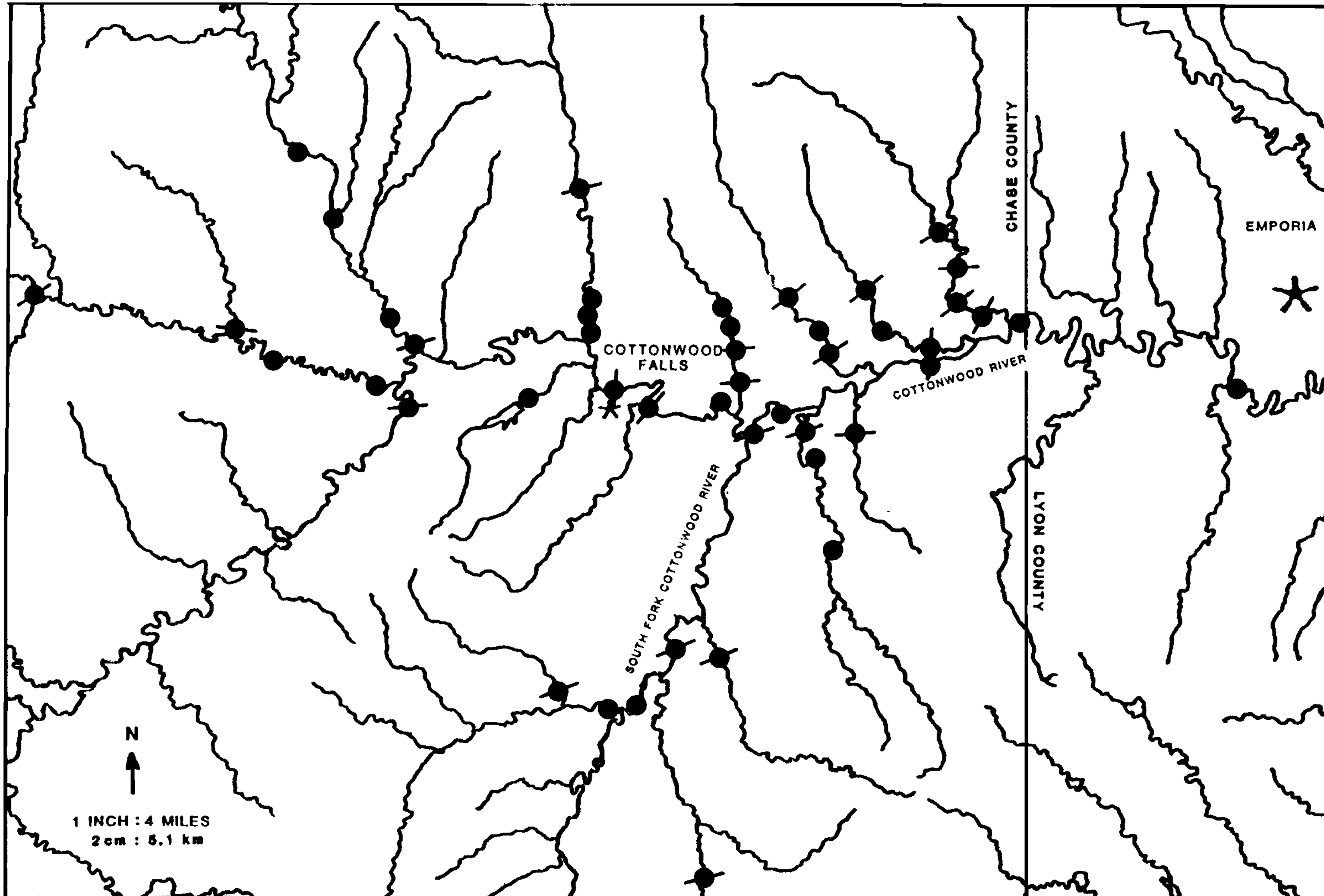

Figure 4. Locations of bridge sites within the study area. Dots with lines (perpendicular to the stream) through them represent bridge sites surveyed.

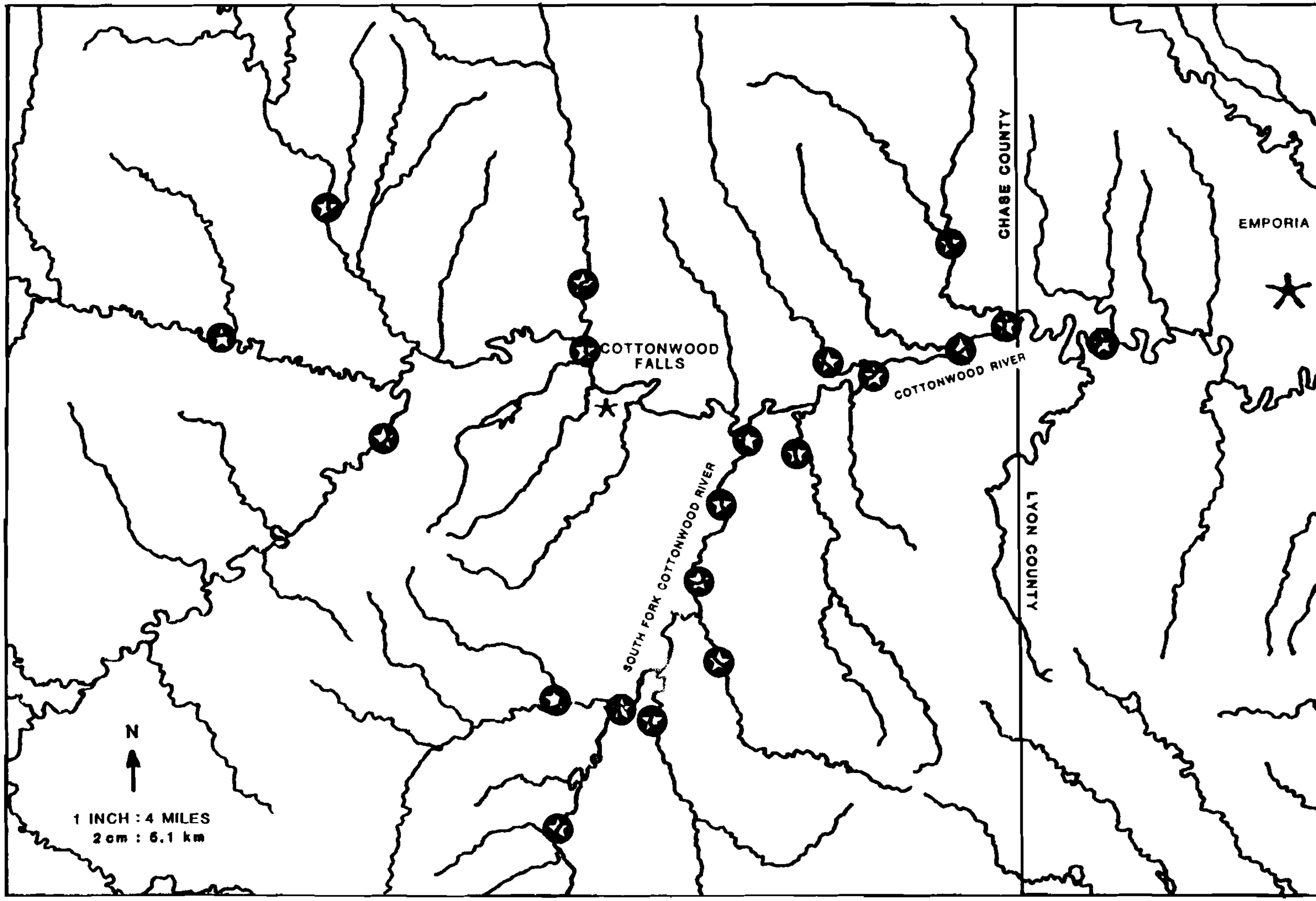

Figure 5. Locations of stream segment survey lines.

Figure 6. A recently constructed scent station.

within the 1 m diameter area of the scent station (Figure 7). Visitation at either one or both of the scent stations at each bridge site was recorded as one visit per one scent station-night. This procedure is similar to that followed by Clark (1982).

Sign surveys were conducted in conjunction with both stream segment and bridge site scent station surveys. Stretches of stream banks were checked for presence or absence of sign (usually tracks). In the sign survey done in conjunction with the stream segment scent station survey, the stream bank was checked for sign both 50 m upstream and 50 m downstream from each scent station, excluding the 1 m diameter area of the scent station and any area between the scent station and the water's edge. Both sides of streams were checked for sign when stream width was less than 5 m.

In the sign survey carried out in conjunction with the bridge site scent station survey, the stream bank between the upstream and downstream scent stations was checked for sign. Both sides of the stream were checked when possible.

On the day the scent stations were constructed, all identifiable sign in the survey area was recorded regardless of age. On the following day, only sign left within the previous 24 hours was noted. Sign survey area visitation was represented by data collected the second day.

Two replicates of the stream segment surveys were completed. The first replicate occurred between 3 May 1986 and 13 September 1986 with 17 of 20 segments surveyed in May and June. The second replicate

Figure 7. A scent station with evidence of visitation.

occurred between 19 July 1986 and 1 November 1986 with 13 of 20 segments surveyed in August (Table 1).

Four replicates of the bridge site surveys were completed. The first replicate occurred between 22 March 1986 and 2 August 1986 with 20 of 25 sites surveyed in March and April. The second replicate occurred between 4 July 1986 and 6 September 1986 with 20 of 25 sites surveyed in July and August. The third replicate occurred between 6 September 1986 and 18 September 1986. The fourth replicate occurred between 13 September 1986 and 20 September 1986 (Table 1). All bridge site survey data were pooled as were all stream segment survey data. Mean visitation rates per scent station and sign survey area were compared among stream segments using analysis of variance. The relationship between scent station visitation and sign survey area visitation was tested using the chi-square test on visitation rates for paired scent stations and sign survey areas. Survey indices were derived by dividing the number of visits by the number of survey-nights, then multiplying by 10 [(number of visits/number of survey-nights)x10]. This method was used to calculate visitation indices for reference data so direct comparisons between the results of this study and the results of other studies were possible. These calculated indices appear in parentheses.

Table 1. Temporal distribution of 1986 survey replicates, number of bridge sites and stream segments surveyed by month. [Specific time periods of replicates: bridge rep. 1 (22 Mar - 2 Aug), bridge rep. 2 (4 Jul - 6 Sep), bridge rep. 3 (6 Sep - 18 Sep), bridge rep. 4 (13 Sep - 20 Sep), segment rep. 1 (3 May - 13 Sep), segment rep. 2 (19 Jul - 1 Nov)].

	BRIDGE SITES				STREAM SEGMENTS	
	bridge rep. 1	bridge rep. 2	bridge rep. 3	bridge rep. 4	segment rep. 1	segment rep. 2
MAR	10	0	0	0	0	0
APR	10	0	0	0	0	0
MAY	0	0	0	0	9	0
JUN	0	0	0	0	8	0
JUL	2	12	0	0	1	4
AUG	3	8	0	0	0	13
SEP	0	5	25	25	2	1
OCT	0	0	0	0	0	0
NOV	0	0	0	0	0	2

RESULTS AND DISCUSSION

River Otters

Survey data collected on river otters from 22 March 1986 to 13 July 1986 were considered invalid due to initial difficulty with identifying river otter tracks. For this reason, only data from bridge site survey replicates 3 and 4 and stream segment survey replicate 2 were evaluated for otters.

Survey indices for river otters were highest at bridge sites with indices of 4.20 and 4.40 for the scent station survey and the sign survey, respectively (Tables 2 and 3). Stream segment indices were 0.80 for the scent station survey and 0.90 for the sign survey. Otters visited the sign survey areas each time otters were recorded at the corresponding scent stations and only one visitation occurred at a sign survey area without a corresponding visit to the scent station in either the stream segment survey and the bridge site survey. This suggests that otters were attracted to the scent stations. For the duration of the study, when otters were detected by the sign survey (31 visits), they visited the scent station at that sign survey area 29 of 31 times.

Clark (1982) compared the results of his bridge crossing survey with the results of his stream segment survey and decided to use the bridge crossing survey for the remainder of his study. He also compared scent stations with a sifted sand substrate to scent stations utilizing a Masonite trackboard coated with blue marking chalk dust.

Table 2. Number of visits per number of scent station-nights and calculated survey indices.

	Stream Segments	Survey Index	Bridge Sites	Survey Index
Otter	8/100	0.80	21/50	4.20
Raccoon	101/200	5.05	70/100	7.00
Mink	4/200	0.20	5/100	0.50
Beaver	1/200	0.05	1/100	0.10

Table 3. Number of visits per number of sign survey-nights and calculated survey indices.

	Stream Segments	Survey Index	Bridge Sites	Survey Index
Otter	9/100	0.90	22/50	4.40
Raccoon	140/200	7.00	90/100	9.00
Mink	7/200	0.35	15/100	1.50
Beaver	34/200	1.70	8/100	0.80

These two substrates yielded visitation rates of 17 visits per 193 station-nights (index = 0.88) and two visits per 282 station-nights (index = 0.07), respectively, prompting him to use the sand substrate for the remainder of his study and to recommend it as the preferred track recording medium.

Masonite trackboards were used by Humphrey and Zinn (1982) in a Florida study to survey river otters and Everglades mink. They found the trackboards to be appropriate because natural or sand substrate stations would have been difficult to construct and maintain in their frequently-flooded study area.

By utilizing in this study the natural substrate as the track recording medium, the possibility of the animal avoiding or being attracted to the scent station because of an unnatural appearing substrate was negated. Also the amount of material one needed to carry from station to station was greatly minimized. One problem resulted from the variability in streamside substrate. At areas where rock or gravel was prevalent, it was sometimes necessary to prepare a muddy area by bringing in dirt and wetting it.

Humphrey and Zinn (1982) also found seasonal variation in river otter visitation rates with highest rates occurring during autumn and lowest rates during spring. In a study done along the Texas Coast, Foy (1984) found otter sign at a high percentage of 64 stations during winter and a low percentage during summer.

Because most data on otters were collected during the summer in this study, no seasonal comparisons were possible. The surveys could not be done during the winter by utilizing the natural mud track matrix because of the high probability that the mud would be frozen.

A scent station survey of otters in Montana (Zackheim 1982) utilized a variety of substrates (mud, snow, and a prepared ash and chalk dust matrix) and yielded three visits per 248 scent post-nights (index = 0.12). That compares with eight visits per 100 survey-nights (index = 0.80) for the stream segment scent station survey conducted in this study where mud substrate was used for scent stations. Zackheim (1982) constructed two scent stations per kilometer along eight to 28 km lengths of streams. He also did stream bank sign surveys, marked locations of latrine sites and then did follow-up surveys of those latrine sites.

There was no significant difference ($P > 0.05$) between visitation rates at paired scent stations and sign survey areas for river otters in either the stream segment survey or the bridge site survey. Results of the chi-square analyses and the fact that when otters were detected at a sign survey area (31 visits in the entire study), they also visited the corresponding scent station 29 of 31 times suggest that river otters were attracted to the scent stations. A study of river otters in Georgia (Clark 1982) revealed a similar positive correlation between sign survey indices and scent station indices. Clark (1982) surveyed bridge crossings by constructing scent stations 100 m upstream and 100 m downstream of the bridges and checking the streambanks in between for sign. Clark (1982) felt that the scent station indices were a more accurate reflection of the otter population than the sign survey indices. His scent station survey produced a visitation rate of 35 visits per 578 crossing-nights (index = 0.60) for river otters as compared to 21 visits per 50 survey-nights (index = 4.20) for the bridge site scent station survey in this study.

Raccoons

Raccoon survey indices were highest in the bridge site and sign surveys. The bridge site sign survey yielded the highest raccoon visitation index of 9.00 and the stream segment scent station survey yielded the lowest index of 5.05. Stream segment sign surveys and bridge site scent station surveys each yielded indices of 7.00. When all survey data from the study were pooled, the results indicated that when raccoons were detected by a sign survey (230 visits) they visited the scent station at that sign survey area 171 of 230 times. For raccoons, visitation rates were significantly higher ($P < 0.05$) at sign survey areas than at scent stations in both the stream segment survey and the bridge site survey. This suggests that raccoons were not strongly attracted to scent stations with otter lure used as an attractant, and visitation at scent stations by raccoons may have been a result of individuals moving through the scent station area by chance. The results of testing mean raccoon visitation rates for each scent station and sign survey area within stream segments suggest that the position of the scent station or sign survey area within the segment had no effect on the visitation rate ($F = 0.90$ for scent stations and 0.73 for sign survey areas, df = 4, 35; $P > 0.05$).

A Nebraska study (Gersib 1984) involved surveying stream banks at bridge crossings over a five year period. Twenty m of shoreline on both sides of the bridge and on both sides of the stream were surveyed. Statewide, raccoon tracks were present at the following percentages of bridge crossings surveyed: 1979 - 79% of 310 survey sites (index = 7.90), 198 - 80% of 320 survey sites (index = 8.00), 1981 - 77% of 278 survey sites (index = 7.70), 1982 - 83% of 329 survey sites (index = 8.30), 1983 - 88% of 329 survey sites (index = 8.80). These results compare with 90 visits per 100 survey-nights (index = 9.00) for the bridge site sign survey conducted in this study. Clark's 1982 Georgia study had a raccoon visitation rate of 216 visits per 578 station-nights (index = 3.74) in his bridge crossing scent station survey which compares with 70 visits per 100 survey-nights (index = 7.00) for the bridge site scent station survey conducted in this study.

Mink

Survey indices for mink were highest in bridge site surveys with indices of 1.50 and 0.50 for the bridge site sign survey and the bridge site scent station survey, respectively. The stream segment sign survey and the stream segment scent station survey produced indices of 0.35 and 0.20, respectively. When mink visited stream segment sign survey areas (seven visits), the corresponding scent station was visited by mink four of seven times. There was no significant difference ($P > 0.05$) between mink visitation rates at scent stations and sign survey areas in the stream segment survey. The results of the chi-square analysis suggest that mink were attracted to the lure in the stream segment survey. However, the low number of visits by mink in the stream segment survey (four at scent stations and seven at sign survey areas) makes the chi-square analysis and any conclusions drawn from its results inappropriate. The mink visitation rate at sign survey areas (index = 1.50) was significantly higher ($P < 0.05$) than the visitation rate at scent stations (index = 0.50) in the bridge site survey. The mink visitation rate was 34 visits per 578 station-nights (index = 0.59) in Georgia (Clark 1982) using bridge crossing scent stations. A five year track survey in Nebraska (Gersib 1984) found mink tracks present at 8.6% to 18.2% (indexes = 0.86 to 1.82) of bridge sites surveyed. The annual number of survey sites ranged from 278 to 329. Twenty m of shoreline on both sides of the bridge and on both sides of the stream were surveyed for tracks. The results of testing mean mink visitation rates for each scent station and sign survey area within stream segments suggest that the position of the scent station or sign survey area within the segment had no effect on the visitation rate ($F = 1.32$ for scent stations and 0.96 for sign survey areas, $df = 4, 35$; $P > 0.05$).

Other Furbearers

The stream segment sign survey yielded a high index of 1.70 for beaver. The bridge site sign survey, the bridge site scent station survey, and the stream segment scent station survey yielded indices of

0.80, 0.10, and 0.05, respectively. Gersib's (1984) five year track survey in Nebraska, found beaver tracks present at 4.0% to 10.9% (indexes = 0.40 to 1.09) of bridge sites surveyed. The annual number of survey sites ranged from 178 to 329. Twenty m of shoreline on both sides of the bridge and on both sides of the stream were surveyed for tracks. Pooled data from the entire study revealed that when beavers were detected by the sign surveys (42 visits) they only visited the scent station at that sign survey area two of 42 times. Beaver visitation rates at sign survey areas were significantly higher ($P < 0.05$) than visitation rates at scent stations in both the stream segment survey and the bridge site survey. These results suggest that beaver were not attracted to the scent stations. The results of testing mean beaver visitation rates for each scent station and sign survey area within stream segments suggest that the position of the scent station or sign survey area within the segment had no effect on the visitation rate ($F = 1.00$ for scent stations and 0.61 for sign survey areas, $df = 4, 35$; $P > 0.05$).

Visitation by other furbearers recorded was infrequent and was not deemed worthy of statistical comparisons (Table 4). Muskrat (<u>Ondatra zibethicus</u>) visitation was 0.3% in the stream segment and bridge site scent station surveys combined and 1.3% in the stream segment and bridge site sign surveys combined. Opossum (<u>Didelphis virginiana</u>) visitation was 0.3% in the stream segment and bridge site scent station surveys combined and 1.0% in the stream segment and bridge site sign surveys combined. During a five year study in Nebraska (Gersib 1984), 20 m of shoreline on both sides of the bridge and on

Table 4. Total number of visits recorded for mammals other than otters, raccoons, mink and beaver by survey method. SSSS = Stream Segment Scent Stations, BSSS = Bridge Site Scent Stations, SSSiSu = Stream Segment Sign Survey, BSSiSu = Bridge Site Sign Survey.

survey	replicate	coyote	bobcat	muskrat	opossum	red fox	domestic dog
SSSS	1	1	0	1	0	0	2
	2	1	0	0	1	0	0
BSSSS	1 and 2	0	0	0	0	1	2
	3 and 4	1	0	0	0	0	3
SSSiSu	1	3	0	1	1	0	1
	2	0	0	3	1	0	1
BSSiSu	1 and 2	0	2	0	1	1	4
	3 and 4	2	0	0	0	0	3

both sides of the stream were surveyed for tracks. The annual number of survey sites ranged from 278 to 329. Muskrat tracks were present at 8.1% to 11.9% of bridge sites surveyed. Gersib (1984) also found skunk (Mephitis mephitis or Spilogale putorius) tracks at 4.3% to 11.2% of bridge sites surveyed. The failure of any surveys in this study to detect the presence of skunks was surprising.

While the data collected on furbearers other than otters are valid, it must be recognized that the scent stations were specifically constructed to attract otters. Scent station visitation rates for other species of furbearers may have been higher if a species-specific lure or a generic attractant like synthetic fermented egg (Bullard et al. 1978) or F. A. S. (Roughton 1980) had been used.

It is important to note that in this study for every visit to a scent station by an otter, raccoon, mink, or beaver, there was a visit to the corresponding sign survey area.

Bridge site surveys required much less time and effort to carry out than stream segment surveys. Time utilized to conduct bridge site surveys was approximately 10 minutes per scent station. Time utilized to conduct stream segment surveys was approximately 40 minutes per scent station. Bridge site surveys were conducted with ease by one person, whereas two persons were required to conduct some of the stream segment surveys, particularly those where canoeing was necessary.

CONCLUSIONS

The results of this study indicate that bridge site surveys are at least as sensitive and perhaps more sensitive than stream segment surveys in detecting the presence of river otters, raccoons, and mink. Stream segment surveys may be more sensitive than bridge site surveys in detecting the presence of beavers. The results of this study also indicate that sign surveys are equal to or more sensitive than scent station surveys in detecting the presence of otters, raccoons, mink, and beaver. Additional research to compare sign surveys and scent station surveys would be worthwhile. Isolating scent station survey sites from sign survey sites would eliminate the possibility of one method biasing the other because of their proximity. Testing the effectiveness of different attractants would also be worthwhile, although the otter lure used in this study was apparently quite effective at attracting river otters.

Bridge site surveys require much less time and effort to carry out than stream segment surveys. Two persons are often required to conduct stream segment surveys, particularly those where canoeing is required, whereas bridge site surveys can be conducted with ease by one person.

The results of this study indicate the potential for bridge crossing sign surveys and bridge crossing scent station surveys to be effective tools for determining relative abundance of river otters and raccoons. I believe they may be effective methods of monitoring the reintroduced river otter population and the established, resident population of raccoons.

It would be advisable for anyone preparing to conduct sign surveys for river otters in the future to go out in the field and study known tracks of otters with someone experienced in the identification of river otter sign. River otter tracks and raccoon tracks can often be quite difficult to differentiate.

SUMMARY

Four survey techniques for determining relative abundance of river otters in east-central Kansas were evaluated in 1986. Scent station surveys and sign surveys were conducted on stream segments and at bridge sites. Survey indices were derived by dividing the number of visits by the number of survey-nights, then multiplying by 10 [(number of visits/number of survey-nights)10]. The numbers of survey-nights for the stream segment scent station survey, the stream segment sign survey, the bridge site scent station survey, and the bridge site sign survey were 200, 100, 200, and 100, respectively. The number of survey-nights for otters was 50% of the total. River otter survey indices were highest at bridge sites with visitation indices of 4.20 and 4.40 for the scent station survey and the sign survey, respectively. There was no significant difference ($P > 0.05$) between visitation rates at paired scent stations and sign survey areas for river otters. Survey indices for raccoons were highest in the bridge site surveys and the sign surveys. The bridge site sign survey produced the highest index of 9.00. Bridge site scent station surveys and stream segment sign surveys each yielded indices of 7.00. There was a significant difference ($P < 0.05$) between visitation rates at paired scent stations and sign survey areas for raccoons. The bridge site sign survey produced the highest index (1.50) for mink, and the stream segment sign survey produced the highest index (1.70) for beaver. The results of this study indicate bridge crossing sign

surveys and bridge crossing scent station surveys may be effective methods for determining relative abundance of river otters and raccoons in eastern Kansas.

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APPENDIX A

Appendix A. Sample survey data form.

location S-2

date 8/29/86 — 8/31/86

time 0750-1920

temp (°F)	high	low	high
	22.8°C	18.7°C	23.1°C
	73	66	73

wind dir. S / S-SW

wind vel. 15 / 11

cloud cover 100% / 100%

scent station location		otter	raccoon	mink	beaver	coyote	bobcat	muskrat	opossum	dog	other
		tracks									
A	stream (day 1)		✓								
	stream (day 2)										none
	scent										none
B	stream (day 1)	✓	✓	✓							
	stream (day 2)										none
	scent										none
C	stream (day 1)		✓		✓						
	stream (day 2)										none
	scent										none
D	stream (day 1)	✓	✓		✓						
	stream (day 2)										none
	scent		✓								
E	stream (day 1)	✓	✓		✓						
	stream (day 2)	✓									
	scent	✓									

8/30/86 - [illegible] otter tracks moving upstream between A + B noted upon returning to truck

8/31/86 - photos #9-#17

APPENDIX B

Appendix B. Photographs of river otter tracks.

Appendix B. Photographs of raccoon tracks.

Donald R. Eccles
Signature of Graduate Student

Dwight L. Spencer
Signature of Major Advisor

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5/4/89
Date

An Evaluation of Survey Techniques for Determining Relative Abundance of River Otters and Selected Other Furbearers
Title of Thesis/Research Report

Jackie Ir Chert
Signature of Graduate Office Staff Member

May 4, 1989
Date Received