EVALUATION OF SPECIFIC SCENT STATION VARIABLES IN NORTHCENTRAL LOUISIANA

DAVID W. MORRISON, Louisiana Department of Wildlife and Fisheries, Opelousas, LA 70570
ROBERT M. EDMUNDS, Louisiana Department of Wildlife and Fisheries, New Iberia, LA 70560
GREG LINSCOMBE, Louisiana Department of Wildlife and Fisheries, New Iberia, LA 70560
JOHN W. GOERTZ, Department of Zoology, Louisiana Tech University, Ruston, LA 71272

Abstract: In an attempt to determine a more effective means of utilizing scent station data to evaluate furbearer population trends, 3 scent types, 2 tracking surfaces and 3 habitat types were analyzed in northcentral Louisiana. Observations at 775 stations on 2 successive days during the fall of 1979, summer of 1980 and fall of 1980, resulted in 574 visits by 13 different groups of mammals. Bobcat *(Felis rufus)* urine produced the highest visitation rates for coyotes *(Canis latrans)* when compared to fatty acid scent and rhodium ($P < 0.05$). However, there was no significant difference ($P > 0.05$) in bobcat visits when the 3 scent types were compared. The use of agricultural lime, when compared to natural soil, as a tracking surface increased bobcat visits significantly ($P < 0.001$). Visitations by other mammals were not adversely affected by the use of lime.

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During the 1970's, increased consumer demand for natural fur led to increased harvest pressure on certain furbearers, especially carnivores. Because of this demand, pelt prices and trapping activity increased. Controversies arose between the trapping industry and protectionist groups concerning limits to which furbearers should be harvested. As a result of federal interpretations of regulations related to the Convention on International Trade in Endangered Species, states were required to provide biological data on bobcat and river otter *(Lutra canadensis)* in order to be granted export permits for these species. In Louisiana, where the fur resource is a multi-million dollar industry, this has led to an increased demand for better methods to evaluate population trends.

A number of methods are available by which furbearers may be monitored to evaluate population trends. Among others, these include use of bounty records (Richards and Hines 1953, Wolfe 1973); track and scat counts (Wolfe 1973); catch per unit of trapping effort (Wood 1959); mark, release and recapture (Clark 1972); siren elicited vocalization (Alcorn 1946, Wenger and Cringan 1978); and scent post surveys (Wood 1959, Linhart and Knowlton 1975, Hill and Sumner 1980).

In the scent post survey, a perforated scent bearing capsule is placed within the center of a prepared tracking surface. The posts are established at predetermined distance intervals and then rechecked subsequently to determine if visitations have occurred, as denoted by tracks. According to Wolfe (1973), scent station surveys are one of the most effective means of determining population indices. In comparison to other methods, the scent station survey offers uniformity, repeatability, and

reasonable man-hour expenditures (Linhart and Knowlton 1975, Brady 1979). It is applicable to extensive land areas yields data that can be analyzed statistically, can be uniformly repeated and compared from year to year and is a practical means for determining relative abundance (Brady 1979). Scent station surveys do have limitations. Rain, and to a lesser extent wind, may obliterate tracks and necessitate the re-establishment of entire lines (Linhart and Knowlton 1975). Since visitation rates are usually low, misidentification of tracks could lend bias to index values with the end result being a biased population trend (Andrews 1979). This problem can be minimized by careful scrutiny of tracks by competent observers.

Among state wildlife departments conducting mammalian predator surveys, widespread interest has arisen for the use of scent station techniques as used by the United States Fish and Wildlife Service (USFWS) (1978) in its annual survey of 400 localities in 19 western states during September. Each USFWS line consisted of 50 stations situated at 0.48 km intervals with each line having been interpreted for tracks for 1 day (Roughton 1979). The initial work with scent station surveys in the southeastern United States was conducted by Wood (1959) for foxes in 25 Georgia counties. In recent years, southeastern states, including Florida (Brady 1979) and Georgia (Hon 1979) have initiated scent station surveys. Summer and Hill (1980) conducted surveys in Alabama, but this study was of a research nature and not a statewide management program. In addition, a scent station survey was initiated in Louisiana during the fall of 1978, and will continue through the fall of 1982.

As an integral part of the Louisiana program concerning visitation rates by bobcats, coyotes *(Canis latrans)* and other mammals, the objectives of this study were 3-fold: to determine if a tracking surface of agricultural lime would change visitations when compared to natural soil; to find which of 3 attractants, bobcat urine, rhodium or fatty acid scent (FAS) would produce the highest visitation rate; to evaluate visitation rates among 3 different habitats.

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METHODS

Study Area

The data were collected in the northcentral Louisiana parishes of Lincoln, Jackson, Ouachita, Winn, Natchitoches and Bienville. Three separate, linearly arranged lines, were established with 88, 88, and 60 stations per line. A 4th group of stations was established, but the number and locations varied from season to season in order to obtain an equal number of stations in each of 3 habitat types evaluated. Scent stations were established in the following 3 habitats in order to determine if there were differences in visitation rates (1) mixed pine and hardwoods; (2) predominately pine; (3) clear-cut.

A mixed pine-hardwood association was one in which pines *(Pinus spp.)* and hardwoods *(Quercus* spp., *Carya* spp., *Liquidambar* sp. and others) were rather evenly intermixed in the overstory, along with characteristic brushy species in the sub-canopy. The predominately pine stations were located in areas where 70-75%

or more of the overstory, was pine *(Pinus taeda, P. echinata* and *P. elliotti)* mixed with scattered hardwoods and understory shrubs. Clear-cut areas included areas where the majority of trees had been cut for pulp or timber. These areas differed from one location to another depending on the state of succession reached, but usually included a wide variety of pioneering species characteristic of old field including: greenbriar *(Smilar* spp.), dew berry *(Rubus* spp.), boneset *(Eupatorium* spp.), and bush clover *(Lespedeza* spp.). Some areas supported more woody invaders such as pine-hardwood reproduction, sumac *(Rhus* spp.), bayberry *(Myrica* spp.), salt bush *(Baccharis* spp.), and elderberry *(Sambucus canadensis).*

Tracking Surface and Scent Type

This study was designed to compare 2 tracking surfaces and 3 scent types in order to determine the most effective attractant combination. The tracking surfaces were sifted agricultural lime ($CaCo_3$) and sifted natural soil. The 3 scent types were rhodium, FAS and bobcat urine. Lime was purchased in 22.7 kg bags at a cost of $1.50/bag. Coloration of the lime was a grayish-white and consisted of 38-40% calcium. The second tracking surface used was natural soil obtained at or near each station. Rhodium, a thick, clear substance, orginally derived from the roots of *Convolvulus scoparius,* was once used as a lure for rats (Cook and Lawall 1936). It is now produced synthetically and is used as a base in many bobcat lures. It was purchased in 30 ml bottles from Deer Creek Co., P.O. Box 508, Bel Air, Maryland, at an approximate cost of $2.25/30 ml.

FAS was developed by the Denver Wildlife Research Center for use as a coyote attractant. Ten fatty acids found in fermented egg powder were isolated and then combined in specific proportions to produce a liquid that carries the same odor as the original fermented egg powder (Roughton 1979). Components of FAS were mixed by personnel of the Louisiana Department of Wildlife and Fisheries (LDWF). Bobcat urine was purchased from Trapper Supplies and Sporting Goods, Route 3, Box 503, Bassett, Virginia, at a cost of $44.00/3.8 l. Enough urine was purchased at the outset of the study to ensure uniformity of the scent as used throughout the study.

Scent Station Placement

Gravel and secondary roads were the sites of scent post transect lines during placed at intervals of 1.6 km. If a house or another obstacle was encountered at the proposed 1.6 km mark, the interval was increased or decreased by 0.16 km in order to avoid possible interference. A total of 270 stations was established, 90 in each of the 3 habitat types.

The day before the lines became functionally established, perforated, plastic, scent capsules (10 × 38 mm) were prepared. A sponge containing about 1 ml of the attractant to be tested was placed in the capsule. In order to promote better dispersion of the scent, a 6D common nail was passed through the capsule so that, upon placement, the capsule would be maintained at an elevated position at the head end of the nail with the tip of the nail inserted into the ground. Each scent station consisted of a 1 m circle cleared of all debris. All stations were adjacent to the sides of roads in order to promote more efficient use of time, and because

many furbearers utilize roads as travel lanes. The stations were located approximately 2 m from the road. All stations were set on the same side of the road. Due to the meanderings of the roads, the effect of wind direction was eliminated. After the station was cleared of debris, agricultural lime or soil was sifted onto the 1 m surface to a depth of approximately ½ inch. When setting a series of stations, the use of lime or soil was alternated to assure the proper ratio of 1 lime to 1 soil station. Once the surface was prepared, the capsule was placed in the center of the station.

In the distribution of the 3 attractants, a soil station was followed by a lime station with the same attractant. Once all 3 attractants had been used, a total of 6 stations, the procedure was repeated. On each of the 2 days following placement of the scent capsule, the stations were revisited. During the first revisit, tracks were identified and recorded, after which the tracks were brushed away. During the second revisit, all new tracks were identified and recorded and the scent capsules were removed and the station destroyed.

A total of 810 scent stations was established during the fall of 1979, summer of 1980 and fall of 1980. Each station was checked for 2 consecutive nights for a total of 1620 observations. This total was divided into 18 equal units with scent type, habitat and tracking surface considered uniformly.

RESULTS AND DISCUSSION

Due to destruction or interference by humans, a total of 1550 observations was functional. A statistical test of independence was performed on the data which revealed the 2 consecutive nightly samplings at each station were not acting independently ($P < 0.05$). Visits by the same species on 2 consecutive nights were considered to have been too great to have occurred strictly by chance. For this reason, the 2 samples at each station were pooled. This resulted in a total of 775 pooled samples, excluding stations disturbed by humans. Statistical analysis for visitation rates was based on analysis of variance (Steel and Torrie 1960).

Values between the present study and those reported earlier in the literature are difficult to compare because of inconsistencies in sampling techniques. Spatial distribution of scent stations in earlier studies were at 0.32 or 0.48 km intervals, whereas this study established stations at 1.6 km (1 mile) to correspond with the statewide survey. The scent type used in earlier studies also differed. FAS was used exclusively in the western surveys and urine based attractants were utilized in the southeast. The present study utilized lime as one of the tracking surfaces, whereas other studies used natural soil. In this study, the 775 pooled stations were visited 574 times for an average rate of 74.1 visitations/100 pooled samples by 14 different categories of vertebrates (Table 1).

Bobcats

The bobcat visitation rate in the present study was 6.5 visits/100 pooled stations (Table 2), thus differing from higher rates of 18.6/100 in Florida (Brady 1979) and 9.3/100 stations in Georgia (Hon 1979), and a lower rate of 0.04/100 in both Alabama (Hill and Sumner 1980) and a western survey (Knowlton and Tzilkowski 1979). The Georgia and Florida surveys may have yielded high

Table 1. Scent station visitation rates for bobcats, coyotes and other categories of vertebrates in North Central Louisiana, 1979 - 80.

Categories	Visits/775 pooled stations	Visitation rate (*N*/100 pooled stations)
Bobcat	50	6.45
Coyote	76	9.81
Other Carnivores		
Dog *(Canis familiaris)*	69	8.90
Fox *(Vulpes vulpes* and *Urocyon cinereoargenteus)*	14	1.81
Raccoon *(Procyon lotor)*	22	2.84
Mink *(Mustela vison)*	5	0.65
Striped skunk *(Mephitis mephitis)*	14	1.81
House cat *(Felis catus)*	37	4.77
Other Categories		
Opossum *(Didelphis virginiana)*	22	2.84
Armadillo *(Dasypus novemcinctus)*	34	4.39
Rabbit *(Sylvilagus floridanus* and *S. aquaticus)*	146	18.84
Squirrel *(Sciurus niger* and *S. carolinensis)*	15	1.94
White-tailed deer *(Odocoileus virginianus)*	17	2.19
Birds (unidentified)	53	6.84
Totals	574	74.08

visitation rates due to the spacing of their stations. Since stations were set at 0.32 km intervals, multiple visits by the same bobcat may have occurred. In the present study, the chance of multiple visits was reduced by spacing the stations at 1.6 km intervals. In addition, by pooling our data, we reduced the possible error incurred by multiple visits, since 1 station that had 2 bobcat visits on successive nights was represented as only one 1 visit. The visitation rate of bobcats in Alabama was considerably lower than the present rate considering that the sampling and spacing were similar to Georgia and Florida. The survey of 17 western states was designed for coyotes (Knowlton and Tzilkowski 1979). For this reason, bobcat visits may have been minimized due to sampling procedures, including the use of fermented eggs as the only attractant.

Bobcat visits declined slightly from 20 of 263 (7.6%) stations during the fall of 1979 to 18 of 250 (7.2%) in the fall of 1980. Including 12 of 262 (4.6%) visits during the summer of 1980, visitations between seasons and years did differ significantly ($P > 0.05$). Bobcat visits declined throughout Louisiana during the same period, from 3.4 to 2.3%, but the decline does not appear to be significant. Other studies have also shown that steady declines in bobcat visits have occurred, including: a steady decline in bobcat visits from 1972 through 1978 in 17 western states; and from 1977 through 1979 in Georgia (Hon 1980). In the western study,

Table 2. A comparison between years and seasons for bobcat visits with scent types, tracking surfaces, and habitat types.

Variables tested	Total visits	Visits/station nights		
		Fall 1979	Summer 1980	Fall 1980
Scent type				
Bobcat urine	22/260	7/88	6/88	9/84
Rhodium	15/255	8/86	3/87	4/82
FAS	13/260	5/89	3/87	5/84
Tracking surface				
Lime	40/392	16/134[a]	12/133[a]	12/125
Natural soil	10/383	4/129	0/129	6/125
Habitat type				
Clear-cut	19/259	8/86	5/87	6/86
Pine-hardwood	17/254	3/88	5/87	9/79
Pine	14/262	9/89	2/88	3/85

[a] Lime was significantly different from natural soil ($P < 0.001$).

Knowlton and Tzilkowski (1979) felt that the decline was due, in part, to 1 or more of the following reasons: increased fur prices, changes in prey availability, competition from other carnivores and habitat loss. The decline in visitation rates during the present study is believed to have been due to the long, hot, arid summer, but the actual impact is unknown. The drought, especially, could have had an impact on bobcat distribution and movement. This factor, in addition to decreased prey availability may have played a role in the reduction of bobcat visits. Although cotton rats ranked first, rabbits constitute a large portion of a bobcat's diet (Hall 1973, Miller and Speake 1978) and rabbit visits declined significantly ($P < 0.01$) over the same time period. This may have been associated with a decline in bobcat visitations.

Bobcat visits ($N = 50$) were highest at stations where bobcat urine ($N = 22$) was the attractant, but attraction was not significantly ($P > 0.05$) greater than at stations with rhodium ($N = 15$) and FAS ($N = 13$) (Table 2). In the statewide Louisiana survey FAS was used exclusively and the overall visitation rate for 1979 and 1980 was 2.9 visits/100 non-pooled stations, which is lower than this unit (6.5) of the study. Sumner and Hill (1980) compared bobcat urine, FAS, red fox urine and a 1:1 mixture of bobcat-fox urine in Alabama. The Alabama study showed that bobcat urine stations produced 62.0% of total visitations by bobcat whereas FAS stations produced 0.9% of the total visitations. FAS and rhodium were relatively equal as attractants during our study.

The highest visitation rate for bobcats would be expected to occur in areas where prey species were most abundant. This occurred in the present study in clear-cut areas ($N = 19$) where bobcat and rabbit visits were highest. However, this was not significantly ($P > 0.05$) higher than visitation in pine-hardwoods ($N = 17$) and pines ($N = 14$). During the fall of 1979, bobcat visits were highest in areas dominated by pines. Visitations probably occurred as bobcats wandered through these areas on their sojourns between more desirable habitat types.

According to Sumner and Hill (1980), bobcats are not noted for their keen sense of smell when compared with sight and hearing. They felt that bobcat visits could have been increased in their studies if some form of visual clue had been used. Handbooks on trapping also indicate bobcats are attracted to visual lures (Hawbaker 1974). In the present study, bobcat responses were significantly higher ($P < 0.001$) at stations were lime ($N = 40$), in comparison to soil ($N = 10$), was used as the tracking surface (Table 2). A statewide Louisiana survey indicates similar responses to lime stations. Bobcats may have responded to visual (lime) as well as aromatic stimuli during the present study. A seasonal difference was also noted for the 2 tracking surfaces (Table 2). The grayish-white coloration of the lime may be more apparent against the green backdrop of summer compared with the lack of contrast coloration of fall.

Coyotes

The 76 coyote visits at 775 pooled stations yielded 9.8 visits/100 stations. Lower rates were reported in Iowa where 4.7/100 non-pooled visits occurred (Andrews 1979). An average of 10.8 stations was visited by coyotes from 1972 through 1973 in 17 western states (Linhart and Knowlton 1975), and during a similar study of 20 western and midwestern states, 10.1/100 non-pooled visits were reported (Roughton 1979). Rate differences might be expected due to variability in population densities and sampling procedures that were used in the studies.

Bobcat urine (47.4%, $N = 37$) had significantly greater ($P < 0.05$) attraction for coyotes when compared to rhodium ($N = 20$) and FAS ($N = 19$) (Table 3). Thus, bobcat urine, when used as an attractant, is not entirely species specific since coyotes and other mammals are also attracted (Roughton 1979).

The data suggest a significant difference ($P < 0.01$) in visitation rates occurred between years as well as seasons. Coyote visits were significantly higher ($P < 0.05$) during the fall of 1980 (15.2%, $N = 38$) than the summer of 1980 (7.3%) and fall (7.2%) of 1979 (Table 3), indicating an apparent increase in the numbers of coyotes. It has been suggested that as coyote numbers increase, fox numbers decrease (Roughton, Biologist, USFWS, Pers. Commun. This relationship was also suggested by our data. During 1979, 11 fox visits occurred in comparison to 19 coyote visits, whereas in 1980, 1 fox and 32 coyote visits occurred. Coyotes may have a competitive advantage over foxes for available food and cover.

Another relationship associated with an increased number of coyotes could have been related to the reduction of rabbit visits. In a previous study, from 1963 through 1967 (Wagner and Stoddart 1972), coyotes were believed to have been a contributing factor in a decline of jackrabbit numbers. In turn, fluctuations in rabbit densities may have also affected coyote numbers in Utah (Clark 1972). In this study, no clear conclusions can be drawn concerning a predator-prey relationship due to the short duration and limited sample size. Tendencies similar to earlier studies were noted however.

No significant difference ($P > 0.05$) was noted for coyote visits in the 3 habitat types, but 43.4% of the total coyote visits occured in clear-cuts. Had sample sizes been larger, a significant difference may have been indicated. Coyote preference for a particular habitat, in part, is dependent on prey availability. During all

Table 3. Coyote and rabbit visitation rates between years and seasons in comparison with scent types, tracking surfaces, and habitat types.

Tested	Tested	Visits	Visits/station nights		
			Fall 1979	Summer 1980	Fall 1980
Scent type					
Bobcat urine	Coyote	36/260	7/88	11/88 [a]	18/84
	Rabbit	47/260	23/88	11/88	13/84
Rhodium	Coyote	21/255	7/86	3/87	11/82
	Rabbit	52/255	30/86	10/87	12/82
FAS	Coyote	19/260	5/89	5/87	9/84
	Rabbit	47/260	23/89	9/87	15/84
Tracking surface					
Natural soil	Coyote	38/383	11/129	10/129	17/125
	Rabbit	73/383	40/129	9/129	24/125
Lime	Coyote	38/392	8/134	9/133	21/125
	Rabbit	73/392	36/134	21/133[b]	16/125
Habitat type					
Clear-cut	Coyote	34/259	10/86	10/87	14/86
	Rabbit	76/259	35/86 [c]	16/87 [d]	25/86 [c]
Pine	Coyote	23/262	5/89	5/88	13/85
	Rabbit	36/262	18/89	6/87	10/85
Pine-hardwood	Coyote	20/254	5/88	4/87	11/79
	Rabbit	34/254	23/88	8/88	5/79

[a] Bobcat urine is used significantly more than rhodium and FAS ($P < .05$).
[b] Visitation rates were significantly higher ($P < .05$) at lime stations.
[c] Clear-cuts produced higher visitation rates ($P < .01$) than the other habitat types.
[d] Clear-cut areas had significantly ($P < .05$) more use than pine areas, but not in comparison to mixed pine-hardwood regions ($P < 0.05$).

sampling periods, 52.1% of the rabbit visits occurred in clear-cuts (Table 3). Rabbits and rodents are a large portion of a coyote's diet in Louisiana (Michaelson and Goertz 1977), so visits would be expected to be higher in those areas with dense ground cover (clear-cuts) where rabbits, rodents, and other available terrestrial prey species are most abundant.

Tracking surface seemed to play no role in coyote visitation rates, since 50% of the coyote visits occurred at each tracking surface (Table 3). The use of lime did have an advantage over natural soil in that tracks were more distinct and were identified more easily at lime stations.

Rabbits

At a visitation rate of 18.8 visits/100 pooled stations (Table 3), rabbits visited scent stations more than any other mammal. Most scent station surveys have not

reported rabbit visitation rates, but we feel that rabbit trends are an important factor to consider because of their value as a prey species. Relationships between predator and prey have been reported by Clark (1972) and by Wagner and Stoddart (1972). A predator-prey relationship might be suggested by a scent station survey if fluctuations in numbers of rabbit visits and visits by large carnivores could be correlated.

Visitations by rabbits may be attributed to what is termed tree blazes or "chinning". This response occurs as a means of marking territory (Mykytowycz 1968),whereby subcutaneous glands located on the underside of the chin secrete a scent that is rubbed on foliage to mark a rabbit's home range (Goodrich and Mykytowycz 1972). Rabbits are probably attracted to various scent types and investigate to determine the significance of the scent. Stations where rhodium was the attractant had the highest visitation rate, but no significant difference ($P > 0.05$) was noted between the 3 scent types.

Rabbit visits declined significantly ($P < 0.01$) from the fall of 1979 (28.6%) in comparison to the summer (11.5%) and fall (16.0%) of 1980 (Table 3). This decline coincides with a significant increase in coyote visits (Table 3). Whether coyote visits were directly related to the decrease in rabbit visitations is not known.

The visitation rate by rabbits was significantly higher ($P < 0.05$) amid clear-cuts (52.1%) during all sampling periods (Table 3) in comparison to pine hardwood (24.7%) and pine (23.3%).

Overall, tracking surfaces seemed to have no effect on rabbit visitations since 50.0% of the total of all visits occurred on each surface (Table 3). The summer sampling period produced a different response, however. Visitations were significantly higher ($P < 0.05$) at lime stations (Table 3). The higher visitation rate at lime stations during the summer months, as was noted for bobcats, may have been a result of the visual stimulus created by the coloration of lime.

Other Mammals

Ten other groups of mammals were noted during this survey (Table 1). Of these, dogs and house cats had the highest visitation rates, 8.9 and 4.7%, respectively. Dog visitations were similar to coyote visits when comparing tracking surfaces, with natural soil and lime selected equally. House cat visitations were similar to bobcats where tracking surfaces were concerned, with visitations to lime stations greater than visits to soil.

Eight other groups were identified during the present survey, but either the attraction ratio between the varables was not significantly different or the sample sizes were too small to make judgements. Nevertheless, a distinction may be made regarding the use of lime. Lime appeared to have been a key factor associated with visits by foxes (11 of 14), skunks (12 of 14), armadillos (21 of 34) and deer (11 of 17), but no significant differences were seen.

CONCLUSIONS

In this study, attractability rates between scent types were difficult to ascertain, but bobcat urine induced greater numbers of visits by bobcats, foxes, and skunks, but not significantly different ($P < 0.05$) in comparison to FAS and rhodium. A

statistically significant difference ($P < 0.05$) was noted in the use of bobcat urine by coyotes. However, a problem may arise when bobcat urine is used since it is subjected to inadequate quality control. Rhodium and FAS are both manufactured and showed similar attractability. The "best" scent type is probably FAS since it has been proven to be an effective attractant in most studies and quality control is not a problem.

The primary objective of this study was to determine if agriculture lime would increase bobcat visits. The results showed that use of lime increased bobcat visitation rates significantly ($P < 0.001$). Visitations by other species were favored by or not affected adversely by the use of lime. Lime does have another advantage over natural soil. Tracks in lime are more easily identified.

Scent station in clear-cut regions yielded the highest visitation for bobcats and coyotes, but all habitat types should be evaluated. Changes in furbearer populations may be more likely to occur and thus be observed in marginal habitat as compared to preferred habitat.

Summer visitation rates were lower than those during the fall. In order to obtain more reliable indications of relative abundance trends, surveys should be conducted during the fall of the year.

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