CARNIVORE SCENT STATION SURVEY
AND
WINTER TRACK INDICES

NOTE: This survey is organized and coordinated by the Forest Wildlife Populations and Research Group, 1201 E. Hwy 2, Grand Rapids, MN 55744. Results are presented at this location in the book because of the statewide nature of the data.

CARNIVORE SCENT STATION SURVEY SUMMARY, 2015

John Erb, Minnesota, Forest Wildlife and Populations Research Group

INTRODUCTION

Monitoring the distribution and abundance of carnivores can be important for understanding the effects of harvest, habitat change, and environmental variability on these populations. However, many carnivores are highly secretive, difficult to repeatedly capture, and naturally occur at low to moderate densities, making it difficult to annually estimate abundance over large areas using traditional methods (e.g., mark-recapture, distance sampling, etc.). Hence, indices of relative abundance are often used to monitor such populations over time (Sargeant et al. 1998, 2003, Hochachka et al. 2000, Wilson and Delahay 2001, Conn et al. 2004, Levi and Wilmers 2012).

In the early 1970's, the U.S. Fish and Wildlife Service initiated a carnivore survey designed primarily to monitor trends in coyote populations in the western U.S. (Linhart and Knowlton 1975). In 1975, the Minnesota DNR began to utilize similar survey methodology to monitor population trends for numerous terrestrial carnivores within the state. This year marks the 39th year of the carnivore scent station survey.

METHODS

Scent station survey routes are composed of tracking stations (0.9 m diameter circle) of sifted soil with a fatty-acid scent tablet placed in the middle. Scent stations are spaced at 0.5 km intervals on alternating sides of a road or trail. During the initial years (1975-82), survey routes were 23.7 km long, with 50 stations per route. Stations were checked for presence/absence of tracks on 4 consecutive nights (old tracks removed each night), and the mean number of station visits per night was the basis for subsequent analysis. Starting in 1983, following suggestions by Roughton and Sweeny (1982), design changes were made whereby routes were shortened to 4.3 km, 10 stations/route (still with 0.5 km spacing between stations), and routes were surveyed only once on the day following route placement. The shorter routes and fewer checks allowed for an increase in the number and geographic distribution of survey routes. In either case, the design can be considered two-stage cluster sampling.

Survey routes were selected non-randomly, but with the intent of maintaining a minimum 5 km separation between routes, and encompassing the variety of habitat conditions within the work area of each survey participant. Most survey routes are placed on secondary (unpaved) roads/trails, and are completed from September through October. Survey results are currently stratified based on 3 'habitat zones' within the state (forest (FO), transition (TR), and farmland (FA); Figure 1).

Track presence/absence is recorded at each station and track indices are computed as the percentage of scent stations visited by each species. Confidence intervals (95%) are computed using bootstrap methods (percentile method; Thompson et al. 1998). For each of 1000 replicates, survey routes are randomly re-sampled according to observed zone-specific route sample sizes, and station visitation rates are computed for each replicate sample of routes.

Replicates are ranked according to the magnitude of the calculated index, and the 25th and 975th values constitute the lower and upper bounds of the confidence interval.

RESULTS AND DISCUSSION

A total of 268 routes were completed this year. There were 2,449 operable scent stations examined on the 268 routes. Route density varied from 1 route per 564 km^2 in the Forest Zone to 1 route per 1,216 km^2 in the Farmland Zone (Figure 1).

Statewide, route visitation rates (% of routes with detection), in order of increasing magnitude, were opossum (3%), domestic dogs (10%), wolves (10%), bobcats (13%), domestic cats (27%), skunks (29%), coyotes (30%), raccoons (30%), and red foxes (31%). Regionally, route visitation rates were as follows: red fox – FA 27%, FO 31%; TR 35%; coyote – FO 19%, TR 40%, FA 46%; skunk – FO 18%, TR 38%, FA 45%; raccoon – FO 12%, TR 42%, FA 66%; domestic cat – FO 12%, TR 40%, FA 52%; domestic dog – FO 5%, FA 14%, TR 20%; opossum - FO 0%, TR 3%, FA 9%; wolf - FA 0%, TR 6%, FO 16%; and bobcat - FA 0%, TR 11%, FO 19%.

Figures 2-5 show station visitation indices (% of stations visited) from the survey's inception through the current year. Although the survey is largely intended to document long- term trends in populations, confidence intervals improve interpretation of the significance of annual changes. Based strictly on the presence/absence of confidence interval overlap, there were no significant changes in indices compared to last year. However, several changes approached significance, including coyote increases in both the Farmland and Forest Zones and declines in skunk and raccoon indices in the Forest Zone (Figures 2 and 4).

In the Farmland Zone (Figure 2), red fox indices remain well below the long-term average, whereas raccoon and coyote indices remain above average. Indices for most other species remain near their long-term averages. The index for domestic dog detections in the Farmland Zone has recently undergone a decline to a record low.

In the Transition Zone (Figure 3), red fox indices have undergone a 'cyclic' fluctuation over the last 10 years but remain below the long-term average. Conversely, the Transition Zone coyote index remains above the long-term average. Indices for most other species are near their long-term average, though similar to the Farmland Zone, domestic dog detections are currently near a low point.

In the Forest Zone (Figures 4 and 5), most indices this year were near or moderately below their long-term averages. The primary exception is the bobcat index which remains well above its long-term average. Overall, there have been no long-term trends in forest indices except for the long-term increase in wolf indices and the recent 10-year increase in bobcat indices.

ACKNOWLEDGEMENTS

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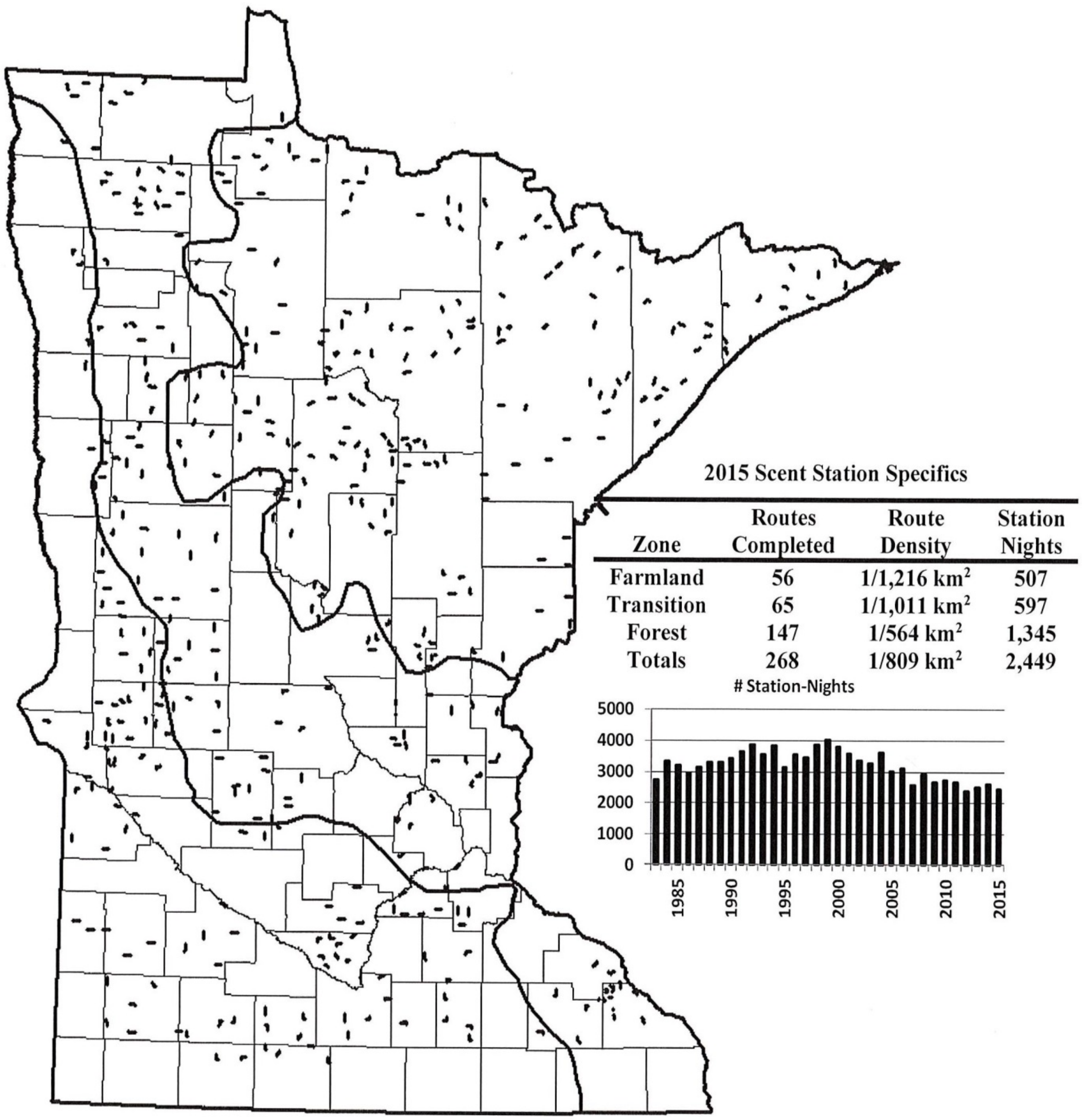

Zone	Routes Completed	Route Density	Station Nights
Farmland	56	1/1,216 km^2	507
Transition	65	1/1,011 km^2	597
Forest	147	1/564 km^2	1,345
Totals	268	1/809 km^2	2,449

Figure 1. Locations of existing scent station routes (not all completed every year). Insets show 2015 route specifics and the number of station-nights per year since 1983.

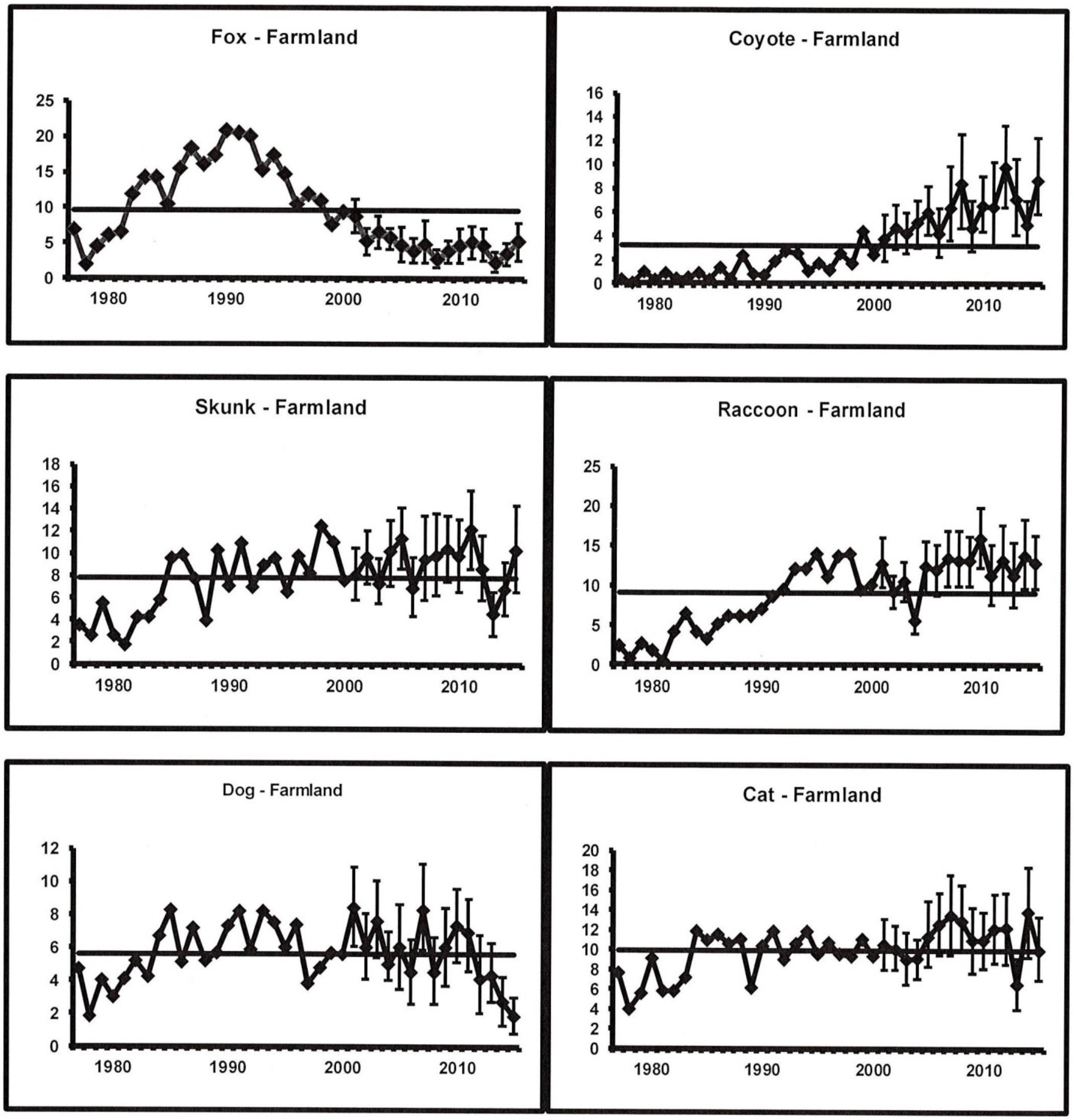

Figure 2. Percentage of scent stations visited by selected species in the Farmland Zone of Minnesota, 1977-2015. Horizontal line represents long-term mean.

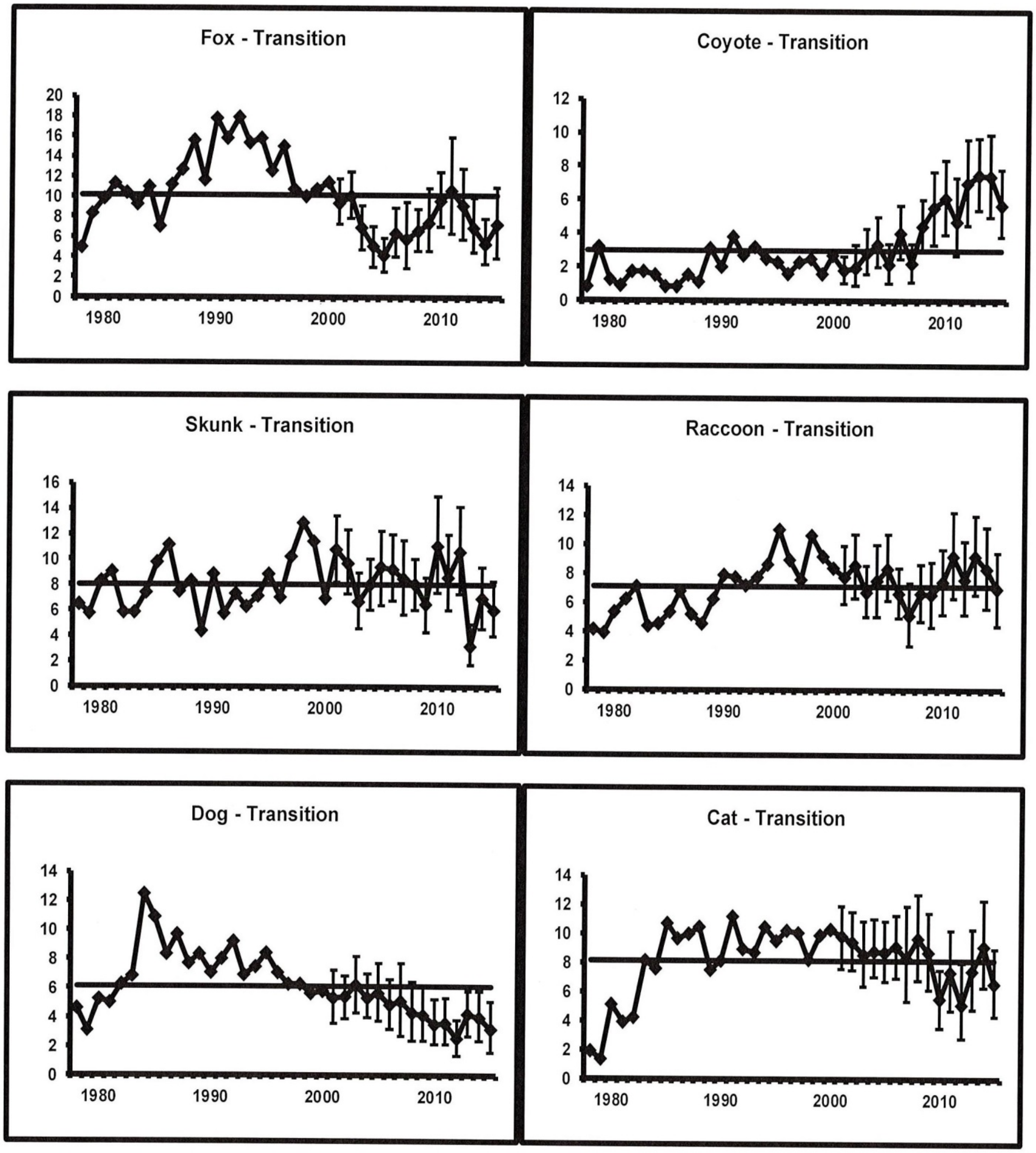

Figure 3. Percentage of scent stations visited by selected species in the Transition Zone of Minnesota, 1978-2015. Horizontal line represents long-term mean.

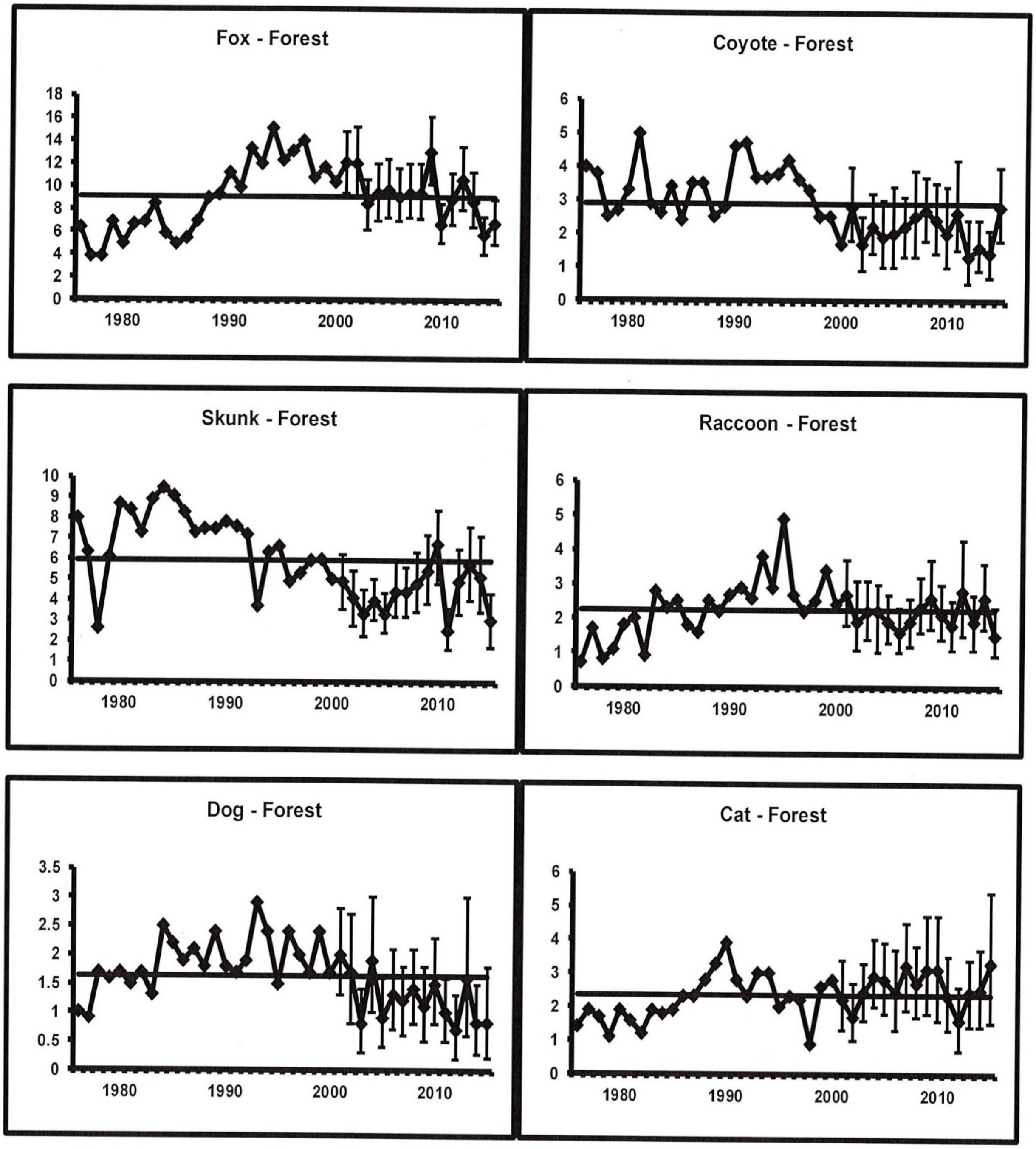

Figure 4. Percentage of scent stations visited by selected species in the Forest Zone of Minnesota, 1976-2015. Horizontal line represents long-term mean.

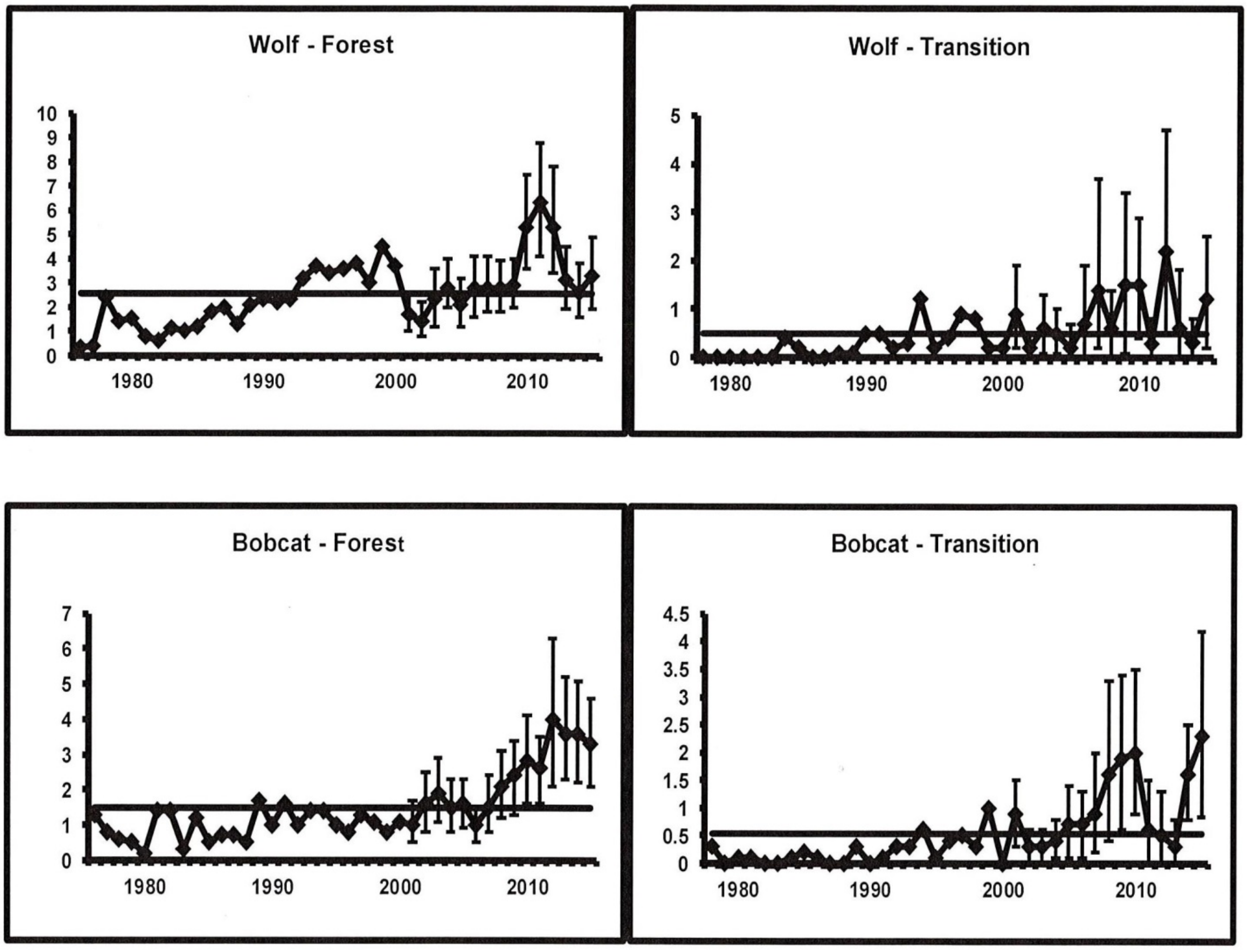

Figure 5. Percentage of scent stations visited by wolves and bobcat in the Forest and Transition Zones of Minnesota, 1976-2015. Horizontal line represents long-term mean.

FURBEARER WINTER TRACK SURVEY SUMMARY, 2015

John Erb, Minnesota, Forest Wildlife and Populations Research Group

INTRODUCTION

Monitoring the distribution and abundance of carnivores can be important for documenting the effects of harvest, habitat change, and environmental variability on these populations. However, many carnivores are highly secretive, difficult to repeatedly capture, and naturally occur at low to moderate densities, making it difficult to estimate abundance over large areas using traditional methods (e.g., mark-recapture, distance sampling, etc.). Hence, indices presumed to reflect relative abundance are often used to monitor such populations over time (Hochachka et al. 2000, Wilson and Delahay 2001, Conn et al. 2004).

In winter, tracks of carnivores are readily observable following snowfall. Starting in 1991, Minnesota initiated a carnivore snow track survey in the northern portion of the State. The survey's primary objective is to use a harvest-independent method to monitor distribution and population trends of fisher (*Martes pennanti*) and marten (*Martes americana*), two species for which no other survey data is available. Because sign of other carnivores is readily detectable in snow, participants also record tracks for other selected species. After three years of evaluating survey logistics, the survey became operational in 1994.

METHODS

Presently, 57 track survey routes are operational across the northern portion of the state (Figure 1). Each route is a total of 10 miles long and follows secondary roads or trails. A majority of routes are continuous 10-mile stretches of road/trail but a few are composed of multiple discontinuous segments. Route locations were subjectively determined based on availability of suitable roads/trails but were chosen where possible to represent the varying forest habitat conditions in northern Minnesota. For data recording, each 10-mile route is divided into 20 0.5-mile segments.

Each route is surveyed once following a fresh snow typically from December through mid-February, and track counts are recorded for each 0.5-mile segment. When it is obvious the same animal crossed the road multiple times *within* a 0.5-mile segment, the animal is only recorded once. If it is obvious that an animal ran along the road and entered multiple 0.5 mile segments, which often occurs with canids, its tracks are recorded in all segments but circled to denote it was the same animal. Though duplicate tracks are not included in calculation of track indices (see below), recording data in this manner allows for future analysis of animal activity in relation to survey 'plot' size and habitat. Snowshoe hares (*Lepus americanus*) are recorded only as present or absent in the first 0.1 miles of each 0.5-mile segment. Although most routes are surveyed one day after the conclusion of a snowfall (ending by ~ 6:00 pm), thereby allowing one night for tracks to be left, a few routes are usually completed two nights following snowfall. In such cases, track counts on those routes are divided by the number of days post-snowfall.

Because most targeted species occur throughout the area where survey routes are located, calculated indices for all species prior to 2015 utilize data from all surveyed routes. Starting with this report, all past marten indices were re-calculated using only those routes that fall within a liberal delineation of marten range. However, in general there were minimal differences in temporal patterns observed in this subset versus the full sample of routes.

Currently, three summary statistics are presented for each species. First, I compute the percentage of 0.5-mile segments with species presence after removing any duplicates (e.g., if the same fox clearly traverses two adjacent 0.5-mile segments along the road, and it was the only 'new' red fox (*Vulpes vulpes*) in the second segment, only one of the two segments is considered independently occupied). In addition to this metric, but on the same graph, the average number of tracks per 10-mile route is presented after removing any obvious duplicate tracks across segments. For wolves (*Canis lupus*) traveling through adjacent segments, the maximum number of pack members recorded in any one of those segments is used as the track total for that particular group, though this is likely an underestimate of true pack size. Because individuals from many of the species surveyed tend to be solitary, these two indices (% segments occupied and # tracks per route) will often yield mathematically equivalent results; on average, one tends to differ from the other by a constant factor. In the case of wolf packs, and to a lesser extent red fox and coyotes (*Canis latrans*) which may still associate with previous offspring or start traveling as breeding pairs in winter, the approximate equivalence of these two indices will still be true if average (detected) group sizes are similar across years. However, the solitary tendencies in some species are not absolute, potential abundance (in relation to survey plot size) varies across species, and for wolves, pack size may vary annually. For these reasons, as well as to provide an intuitive count metric, both indices are currently presented. Because snowshoe hares are tallied only as present/absent, the 2 indices are by definition equivalent. Dating back to 1974, hare survey data has also been obtained via counts of hares observed on ruffed grouse drumming count surveys conducted in spring. Post-1993 data for both the spring and winter hare indices are presented for comparison in this report.

In the second graph for each species, I illustrate the percentage of *routes* where each species was detected (hereafter, the 'distribution index'). This measure is computed to help assess whether any notable changes in the above-described track indices are a result of larger-scale changes in distribution (more/less routes with presence) or finer-scale changes in density along routes.

Using bootstrap methods, I compute confidence intervals (90%) for the percent of segments with species presence and the percent of routes with species presence. For each of 1000 replicates, survey routes are randomly re-sampled with replacement according to the observed route sample size. Replicates are ranked according to the magnitude of the calculated index, and the 50th and 950th values constitute the lower and upper bounds of the confidence interval.

RESULTS

This winter, 47 of the 57 routes were completed, the second most since the survey began (Figure 2). Survey routes took an average of 2.1 hours to complete. Total snow depths averaged 9.3" along completed routes, very close to the long-term average (Figure 3). Mean overnight low temperature the night preceding the surveys was 9°F, slightly above the long-term average (Figure 3). Survey routes were completed between December 2nd and February 24th, with a mean survey date of January 11th (Figure 3).

Considering presence or degree of confidence interval overlap, fisher and bobcat indices (% segments with detection) exhibited significant declines from last year (Figure 4). However, there is no apparent trend over the last 4 years for fishers, though indices remain well below the long-term average. The decline in the bobcat index is the first significant annual decline since confidence intervals have been generated, but the current bobcat index is near the long-term average (Figure 4). Both marten and weasel indices exhibited marginally significant declines and remain below their long-term averages. There were no significant changes in indices for red foxes, coyotes, wolves, or the winter index for snowshoe hares (Figure 4).

Fishers were detected on ~ 6% of the route segments and along 33% of the routes (Figure 4), the latter being the lowest since the survey began. Numerous sources of information indicate that over the past decade fishers have expanded in distribution and abundance along the southern and western edge of their Minnesota range, an area currently with few or no track survey routes. Hence, fisher indices in this report are presumed indicative of fisher population trends only in the previous 'core' of fisher range. This year's decline, particularly in the percentage of routes where they were detected, suggests that fisher detections have become patchier in the previous core areas of their range. At their peak (2004), fishers were detected on 78% of the survey routes.

Within the 'marten zone', martens were detected on 3.5% of the route segments and 50% of the survey routes (Figure 4). The latter is the second lowest point estimate since the survey began, suggesting as with fisher that marten distribution is reduced or patchier compared to the peak year (1999) when they were detected on 83% of the 'marten zone' routes. Marten fluctuations, particularly in recent years, show indications of 4-5 year cycles consistent in timing with data for some rodent species in MN.

Wolf indices were near their long-term average, largely unchanged from last winter. Wolves were detected on ~ 6.5% of the route segments and 67% of the survey routes (Figure 4). The average number of wolves detected per route was 2.3. Coyotes were detected on 4.4% of the route segments and 44% of the routes. Although there was no significant change in coyote indices from last year, the point estimate for the percentage of segments with a detection was near an all-time high. However, like with marten and weasels (see below), coyote indices appear to exhibit 4 to 5 year cycles consistent in timing with data for some rodent species in MN. Although red fox indices have been comparatively stable in recent years, indices have remained below the long-term average since 2006. They were detected on ~ 11% of the segments and 73% of the routes.

Weasel (*Mustela erminea* and *Mustela frenata*) indices did not change significantly from last year and their fluctuations continue to be characterized by 3 to 5 year cycles or 'irruptions' superimposed on a declining trend (Figure 4). No significant change was observed in winter snowshoe hare indices. Since the winter track survey began in 1994, hare indices have steadily increased, with some leveling off in the past 4 years (Figure 4). Although confidence intervals are not currently computed on the spring hare index, a large decline in the point estimate was observed in spring 2015 (Figure 4). Historic data (pre-1994; not presented here) for the spring index of snowshoe hares clearly exhibited 10-year cycles. In recent times, only faint hints of a cycle are apparent in both surveys during the first few years of each decade; the large decline observed in the 2015 spring index would nevertheless be consistent with the expected timing of a cyclic decline.

DISCUSSION

Reliable interpretation of changes in these track survey results is dependent on the assumption that the probability of detecting animals remains relatively constant across years (Gibbs 2000, MacKenzie et al. 2004). Because this remains an untested assumption, caution is warranted when interpreting changes, particularly annual changes of low to moderate magnitude or short-term trends. Overall, the timing and average ambient conditions during this winter's survey were near their post-1994 averages, suggesting that there were no obvious conditions that might bias track counts low or high compared to previous years. Nevertheless, other factors can influence animal movement and detection rates and results must be interpreted cautiously. Acknowledging this caveat, indices for fishers and bobcats, and to lesser degree martens and weasels, all declined; no significant changes were observed for other species. Fisher, marten, red fox, and weasel indices all remain below their long-term averages, whereas wolf, bobcat, and hare indices are near their long-term averages. Only the coyote index was above its long-term average in 2015.

ACKNOWLEDGEMENTS

I wish to thank all those who participated in this year's survey, including staff with the Minnesota DNR, Superior National Forest (Cook, Ely, and Grand Marais offices), Leech Lake, Fond-du-Lac, Grand Portage, and Red Lake Bands of Ojibwe, and the 1854 Treaty Authority. This project was funded in part by the Wildlife Restoration Program (Pittman-Robertson).

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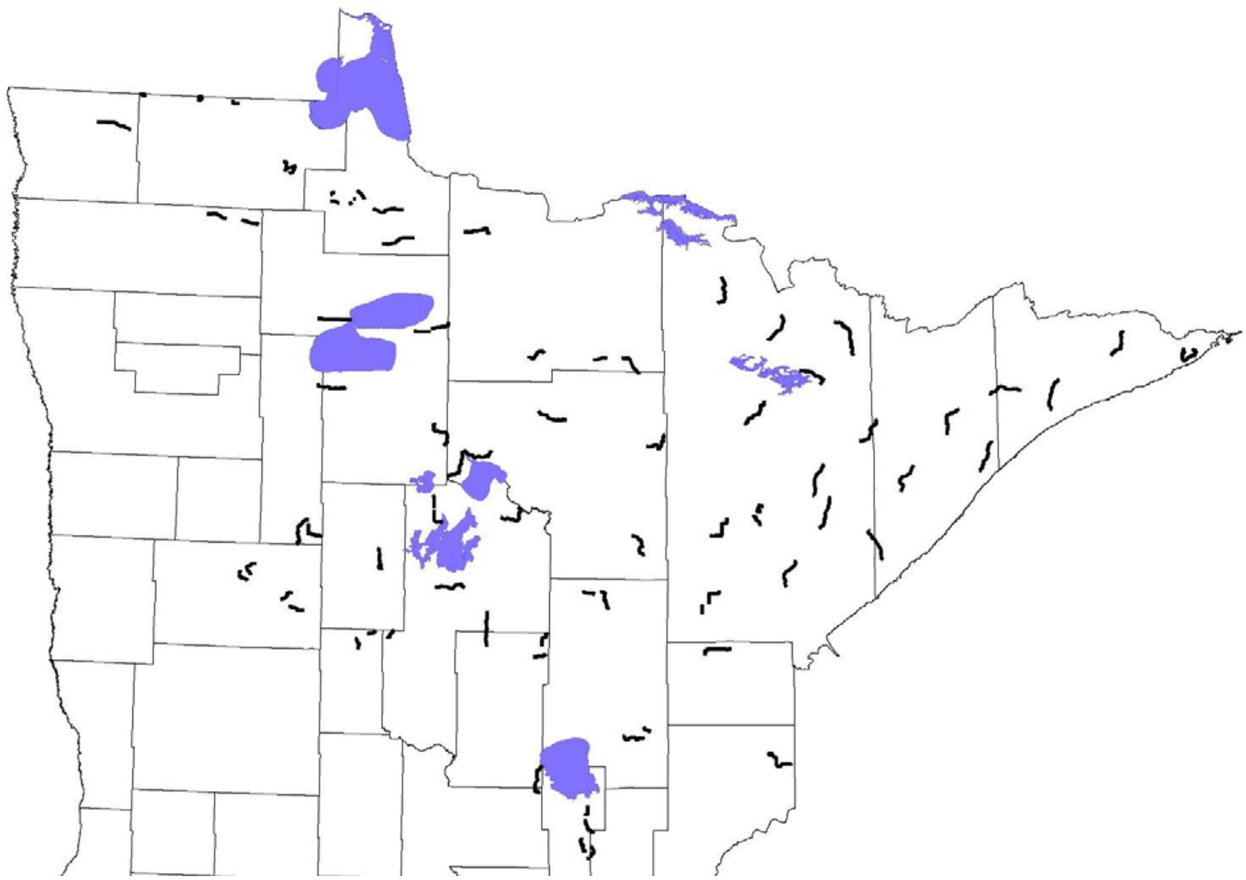


Figure 1. Locations of furbearer winter track survey routes in northern Minnesota.

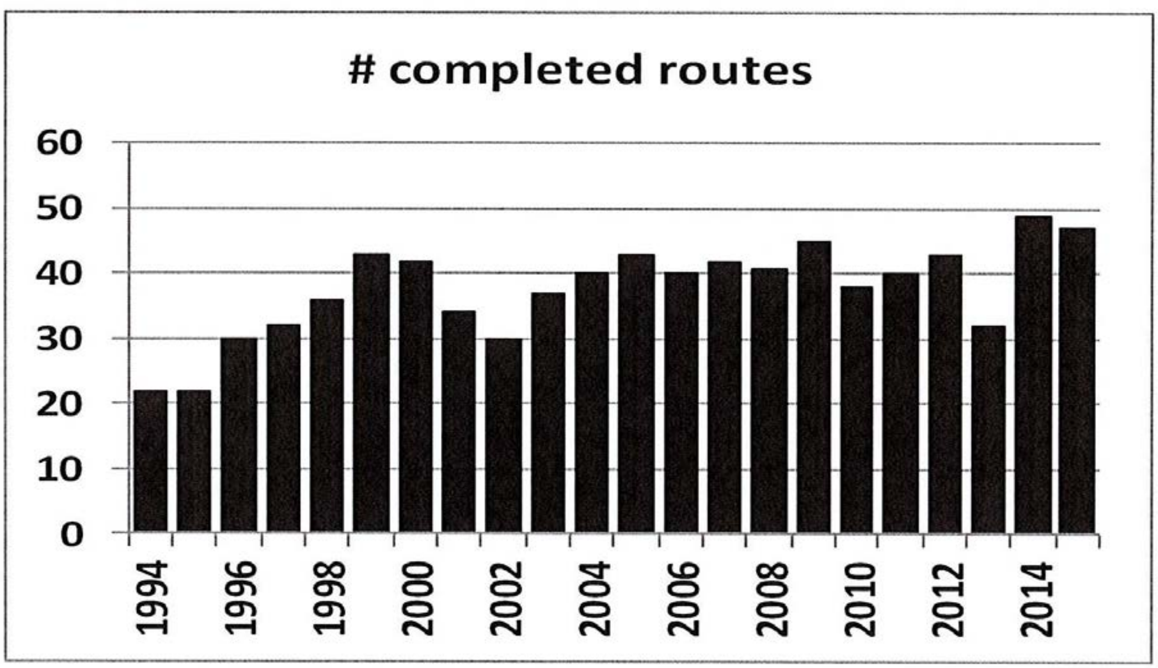


Figure 2. Number of snow track routes surveyed in Minnesota, 1994-2015.

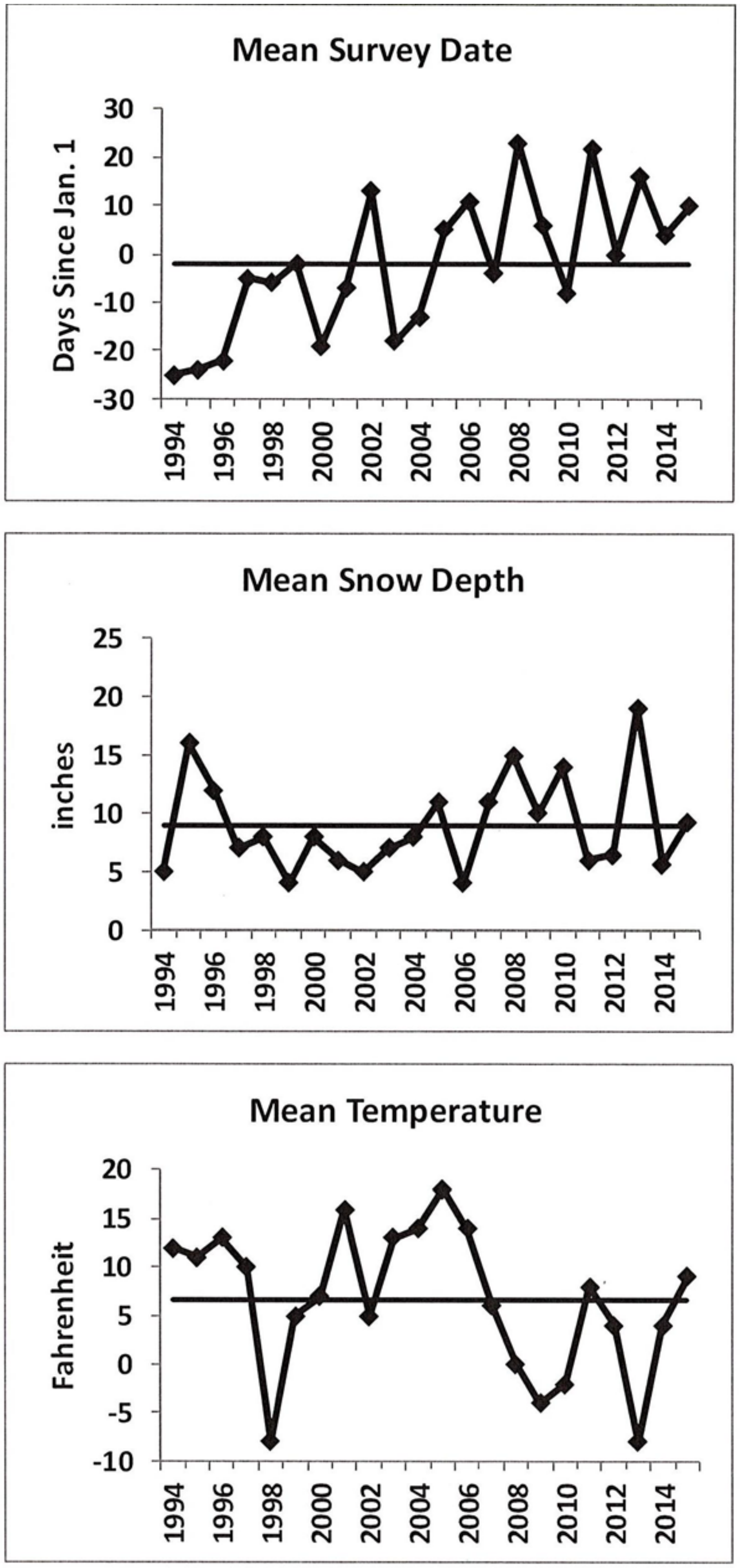


Figure 3. Average survey date, snow depth, and temperature for snow track routes completed in Minnesota, 1994-2015. Horizontal line represents long-tern mean.

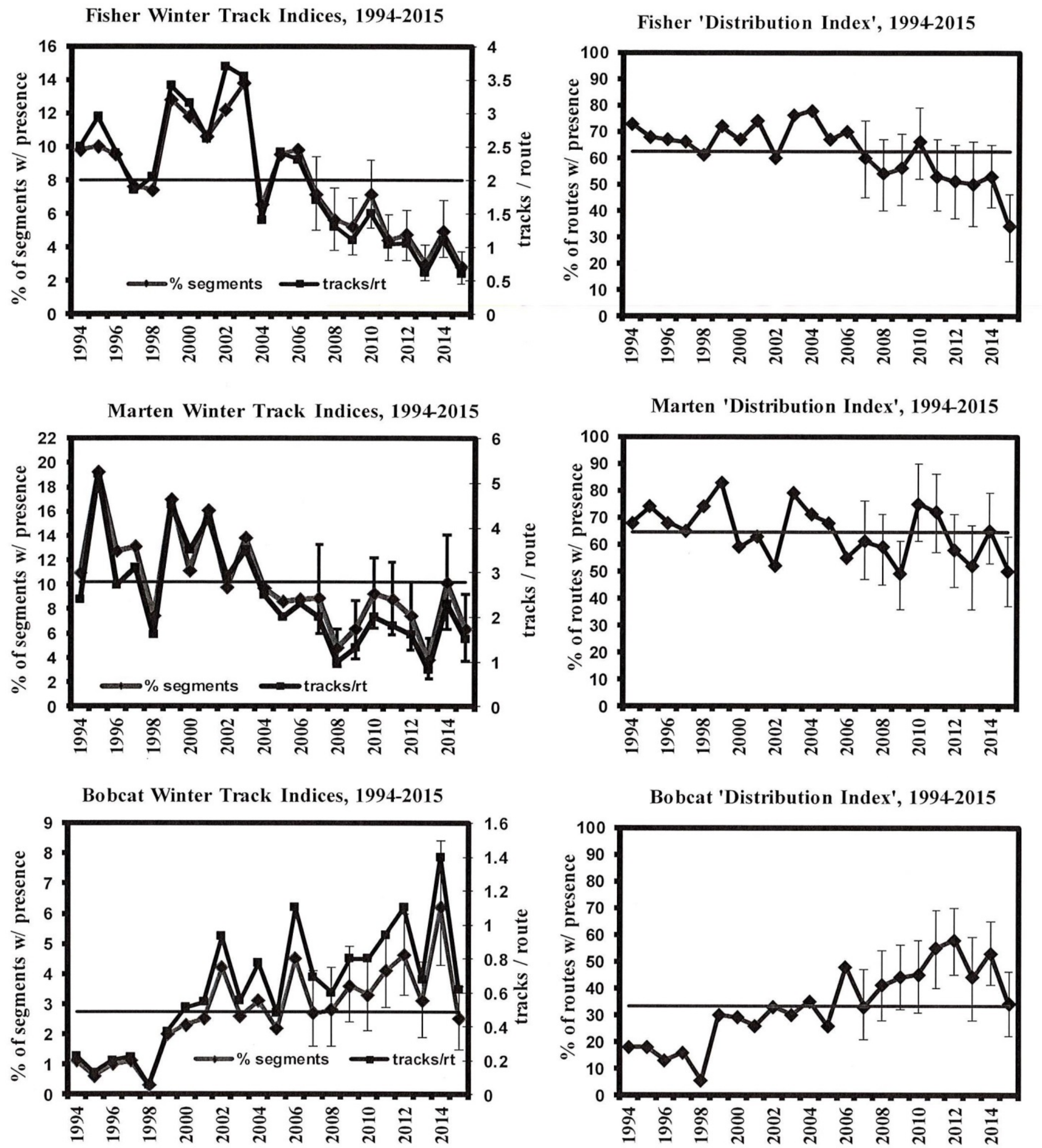
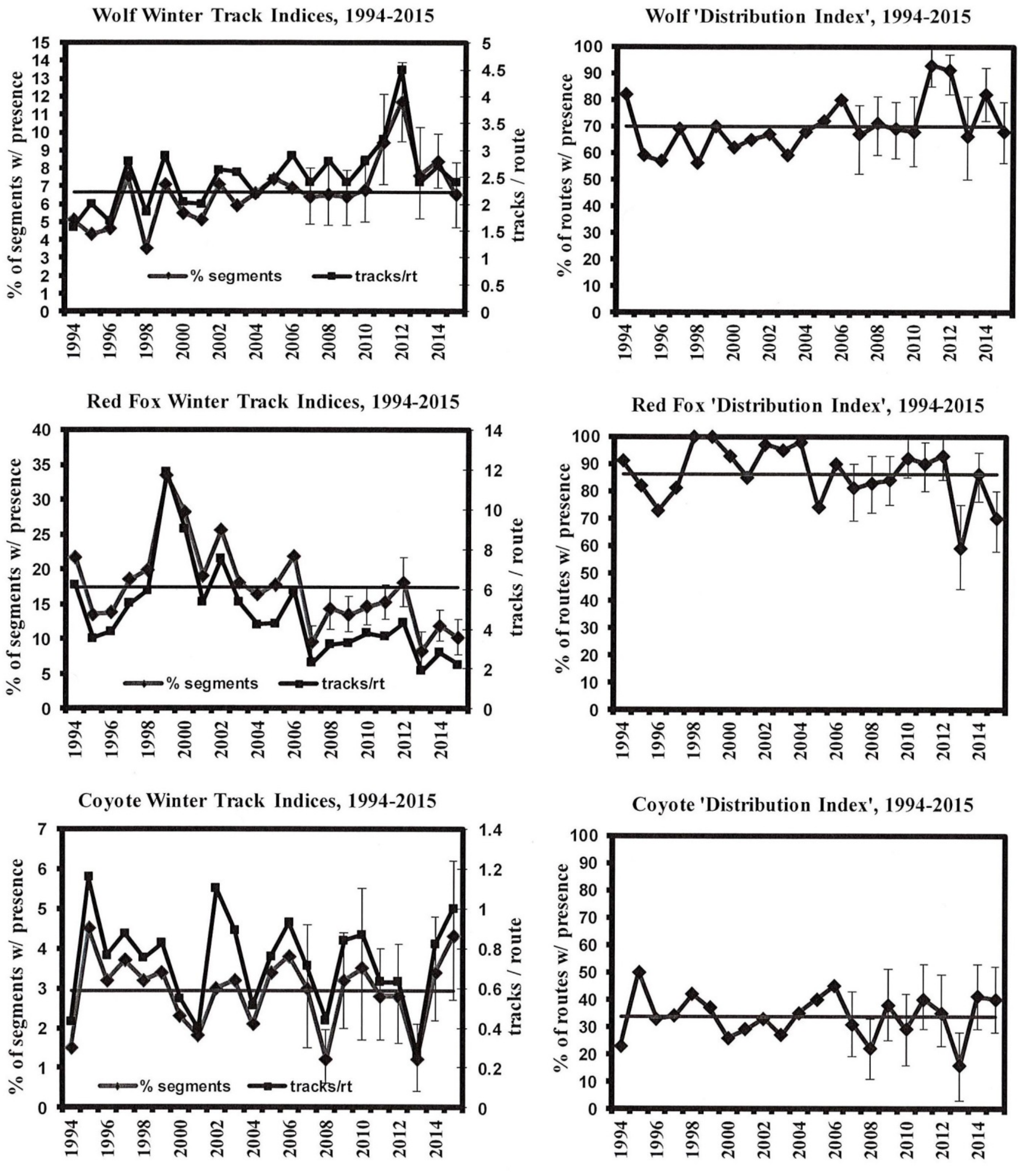


Figure 4. Winter track indices for selected species in Minnesota, 1994-2015. Confidence intervals are presented only for % segments and % routes with track presence; horizontal lines represent their long-term averages.



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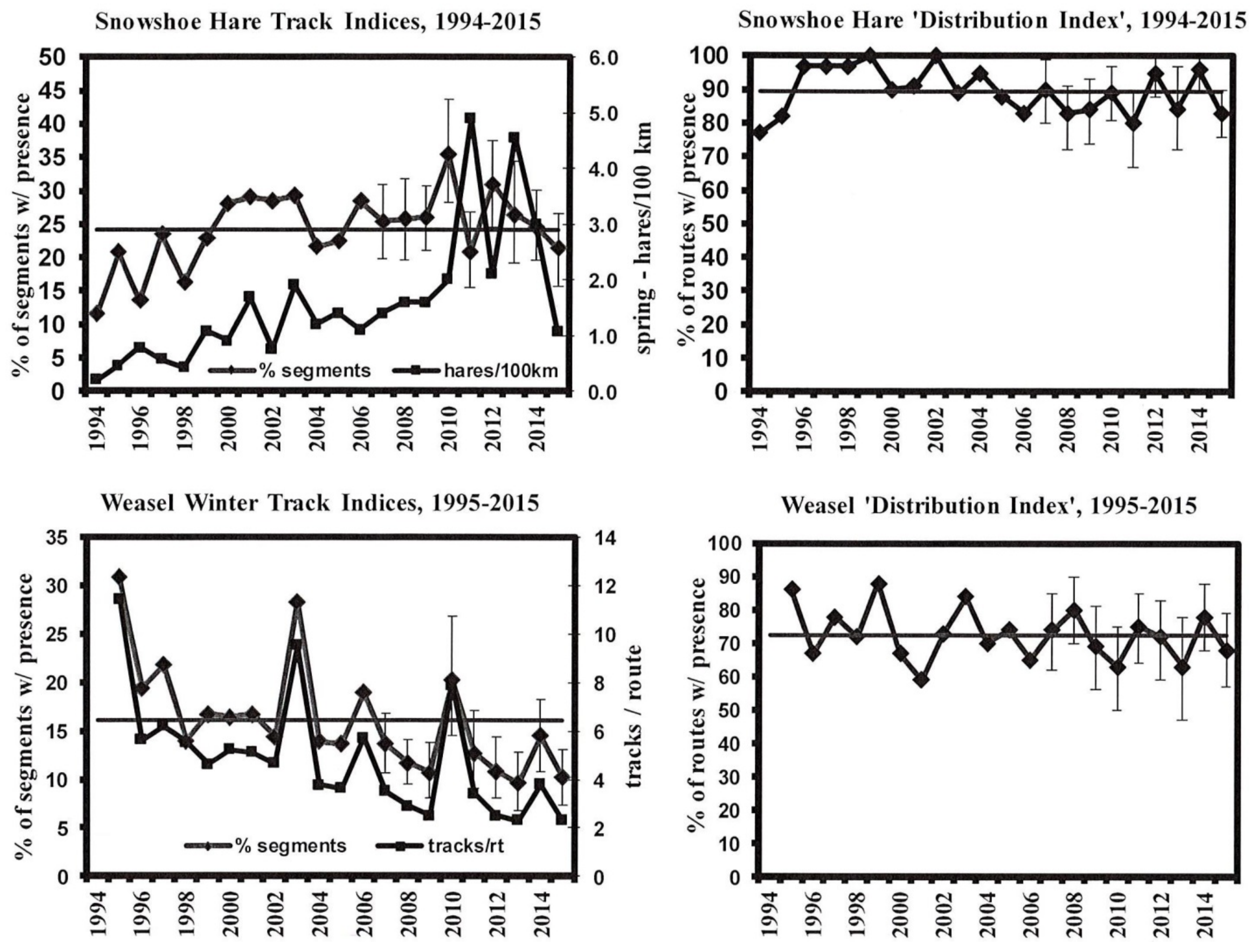

Figure 4 (continued).