FURBEARER WINTER TRACK SURVEY SUMMARY, 2020

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INTRODUCTION

Monitoring the distribution and abundance of carnivores can be important for documenting the effects of harvest, habitat change, and environmental variability on their 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 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 fishers (*Pekania pennanti*) and martens (*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. Formal recording of gray fox (*Urocyon cinereoargenteus*) detections did not commence until 2008.

METHODS

Presently, 57 track survey routes are operational across the northern portion of the state (Figure 1); for various reasons, not all are surveyed each year. Each route is 10 miles long and follows secondary roads or trails. Most routes are continuous 10-mile stretches of road or trail, but a few are composed of multiple discontinuous segments. Route locations were subjectively determined based on availability of suitable roads or trails, but were chosen when 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 recorded only 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 these '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. For standardization, routes are to be surveyed one day after the conclusion of a snowfall (ending by ~ 6:00 pm). However, in most years a few routes are completed two nights following snowfall; track counts on those routes are divided by the number of days post-snowfall.

Because most species of interest 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 the 2015 report, all past marten indices were re-calculated using only those routes that fall within a liberal delineation of marten range (hereafter, the 'marten zone'). However, in general there were minimal differences in temporal patterns observed in this subset versus the full sample of routes.

Currently, I present three summary statistics 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 red fox (*Vulpes vulpes*) clearly traverses two adjacent 0.5-mile segments of the road, and it was the only 'new' red fox 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 computed after removing any obvious duplicate tracks across segments. For wolves (*Canis lupus*) traveling through adjacent segments, I use the maximum number of pack members recorded in any one of those segments 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 (percent of segments occupied and number of 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 foxes 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, I include both indices on the same graph. Because snowshoe hares are tallied only as present or absent, the two 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'). I compute this measure to help assess whether any notable changes in the above-described track indices are a result of larger-scale changes in distribution (i.e., more or less routes with presence) or finer-scale changes in density along routes.

Using a bootstrapping approach (percentile method; Thompson et al. 1998), 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 50^{th} and 950^{th} values constitute the lower and upper bounds of the confidence interval. Although the survey is intended to document long-term trends in populations, confidence intervals (CI) improve interpretation of the significance of any annual changes. However, I refrain from formal significance testing (e.g., determination of whether a CI on the difference between means overlaps 0) and instead use an informal approach (i.e., degree of CI overlap; Cumming and Finch 2005) to highlight changes from last year that likely represent significant differences.

RESULTS AND DISCUSSION

This winter, 28 of the 57 routes were completed (Figures 1 and 2), the fewest since 1995. Survey routes took an average of 2.3 hours to complete. Snow depths averaged 10" along completed routes, similar to the long-term mean (Figure 3). Mean overnight low temperature the night preceding the surveys was 6°F, also near the long-term average (Figure 3). Survey routes were completed between October 17th and March 12th, with the mean survey date of January 20th (Figure 3).

Reliable interpretation of changes in 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. Index point estimates increased for most species this winter. However, based on degree of confidence interval overlap, the only significant changes this winter were increases in the percentage of segments and routes where bobcats were detected, and an increase in the number of routes where red foxes were detected (Figure 4).

Fishers were detected on 5.3% of the route segments and along 75% of the routes (Figure 4), both similar to last winter. 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 indicative of population trends in only the northern 'core' of fisher range. Fisher indices have remained below their long-term average for the past 12 years, and far below the long-term peak around 2002; at their peak, fishers were detected on 14% of route segments.

Within the 'marten zone', martens were detected on 8.6% of the route segments and 56% of the survey routes (Figure 4), both non-significant increases from the previous winter. At their peak in 1999, martens were detected on 13% of the 'marten zone' route segments and 83% of the 'marten zone' survey routes. Similar to results for fishers, marten indices have declined over the long-term. Although low and without trend over the last 14 years, marten indices during this period do show indications of 3-5 year cycles, consistent in timing with cyclic fluctuations of some of their rodent prey species in Minnesota (e.g., Berg et al. 2017, Oestricher 2018).

Bobcat indices had increased for approximately 15 years through 2014, and then declined to their (now elevated) long-term average by 2016. Indices from 2016-18 then showed a rebound, followed by a significant decline again 2 winter's ago. However, the percentage of route segments with bobcat detection significantly increased this winter to the highest yet recorded, though not significantly higher than the previous peak in 2014. Bobcats were detected on 6.7% of the segments and 54% of the routes.

Wolves were detected on 11.6% of the route segments and 79% of the survey routes, both near peak levels since the survey began, but neither representing a significant change from the previous winter (Figure 4). The average number of wolves detected per route was 4.3, the second largest since the survey began. Coyotes were detected on 3.7% of the route segments and 36% of the routes. The long-term trend in coyote indices has been stable, but as with martens and weasels (see below), coyote winter indices appear to exhibit 3 - 5 year cycles consistent in timing with fluctuations in some rodent populations in MN. Long-term red fox indices display a 'stair-step' decline over time, being lowest and comparatively stable since 2013. Red foxes were detected on approximately 12% of the segments and 93% of the routes (Figure 4), the latter representing a significant increase from last winter. Although it is premature to characterize longer patterns in gray fox detections, data from the past 13 years suggests that, similar to coyotes, martens, and weasels, they may fluctuate in concert with cyclic rodent populations. Gray foxes were detected on 2% of the route segments and on 21% of the routes.

Following a significant increase the previous year, this winter's weasel (*Mustela* spp.) indices remained similar to last winter. However, fluctuations continue to be characterized by 4 to 5 year cycles or 'irruptions' superimposed on a long-term declining trend (Figure 4). Weasels were detected on 14% of the route segments (peak of 31% in 1995) and on 68% of the routes (peak of 88% in 1999).

There were no significant changes in the percentage of routes or route segments with snowshoe hare detections. Both spring and winter hare indices steadily increased from 1994 - 2010, then generally declined for five years and are near their post-1994 averages (Figure 4). The moderate albeit non-significant increase in the track index this winter may suggest a potential cyclic increase, though it is premature to conclude. Historic data (pre-1994; not presented here) for the spring snowshoe hare index clearly exhibited 10-year cycles. Since then, only subtle signs of a cycle are apparent in both surveys during the first few years of each decade.

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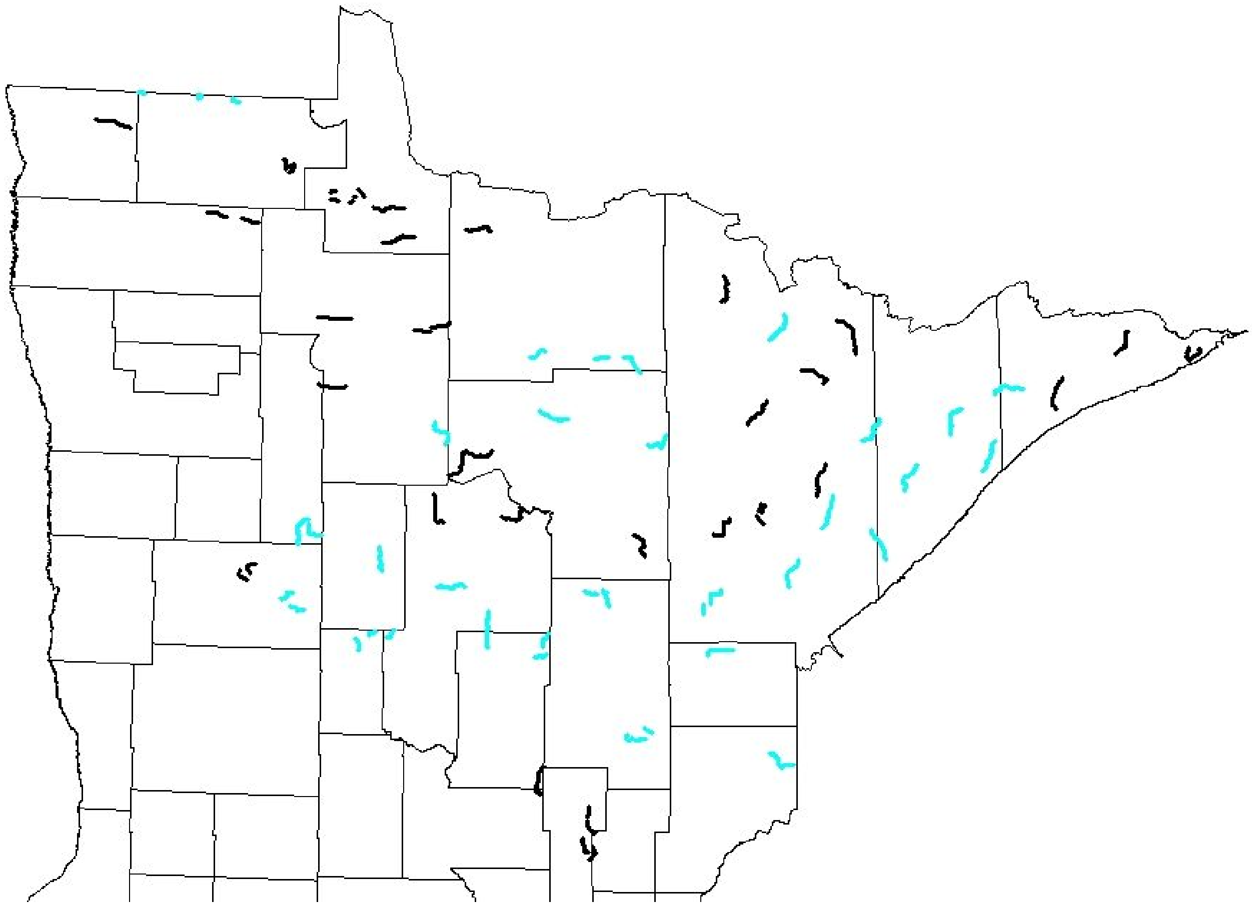

Figure 1. Locations of furbearer winter track survey routes in northern Minnesota. Blue routes are those completed during winter 2020-21.

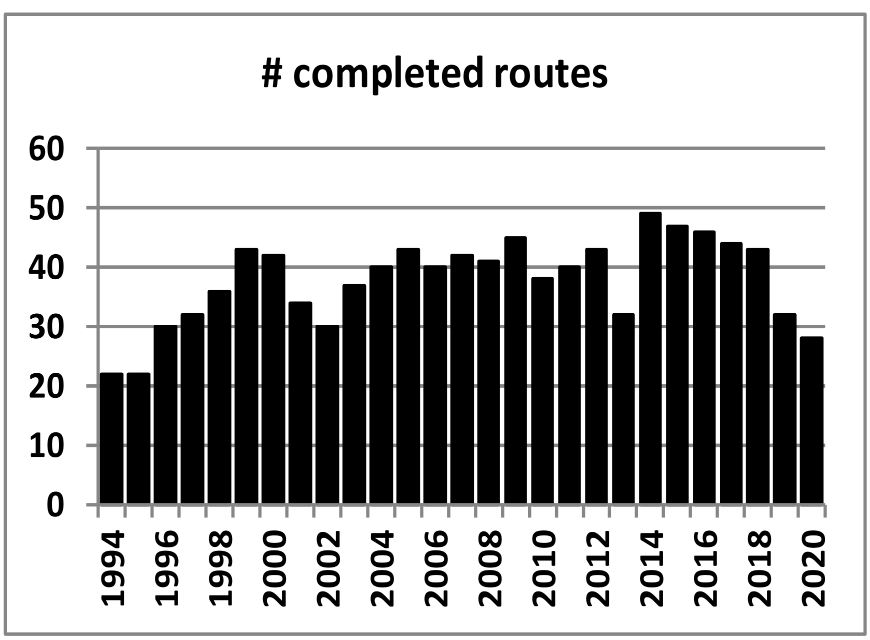

Figure 2. Number of snow track routes surveyed in Minnesota, 1994-2020.

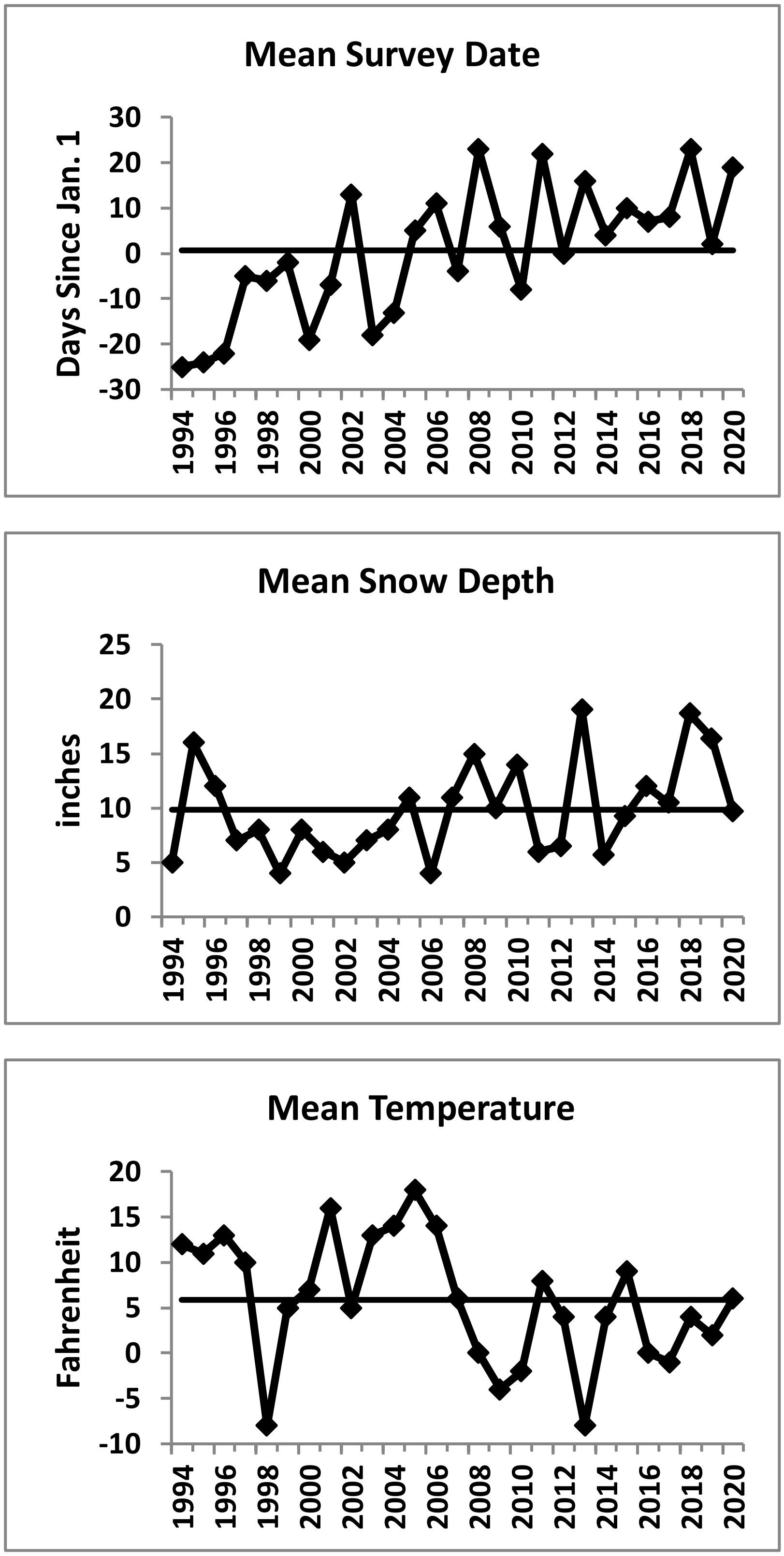

Figure 3. Average survey date, snow depth, and temperature for snow track routes completed in Minnesota, 1994-2020. Horizontal line represents long-term mean.

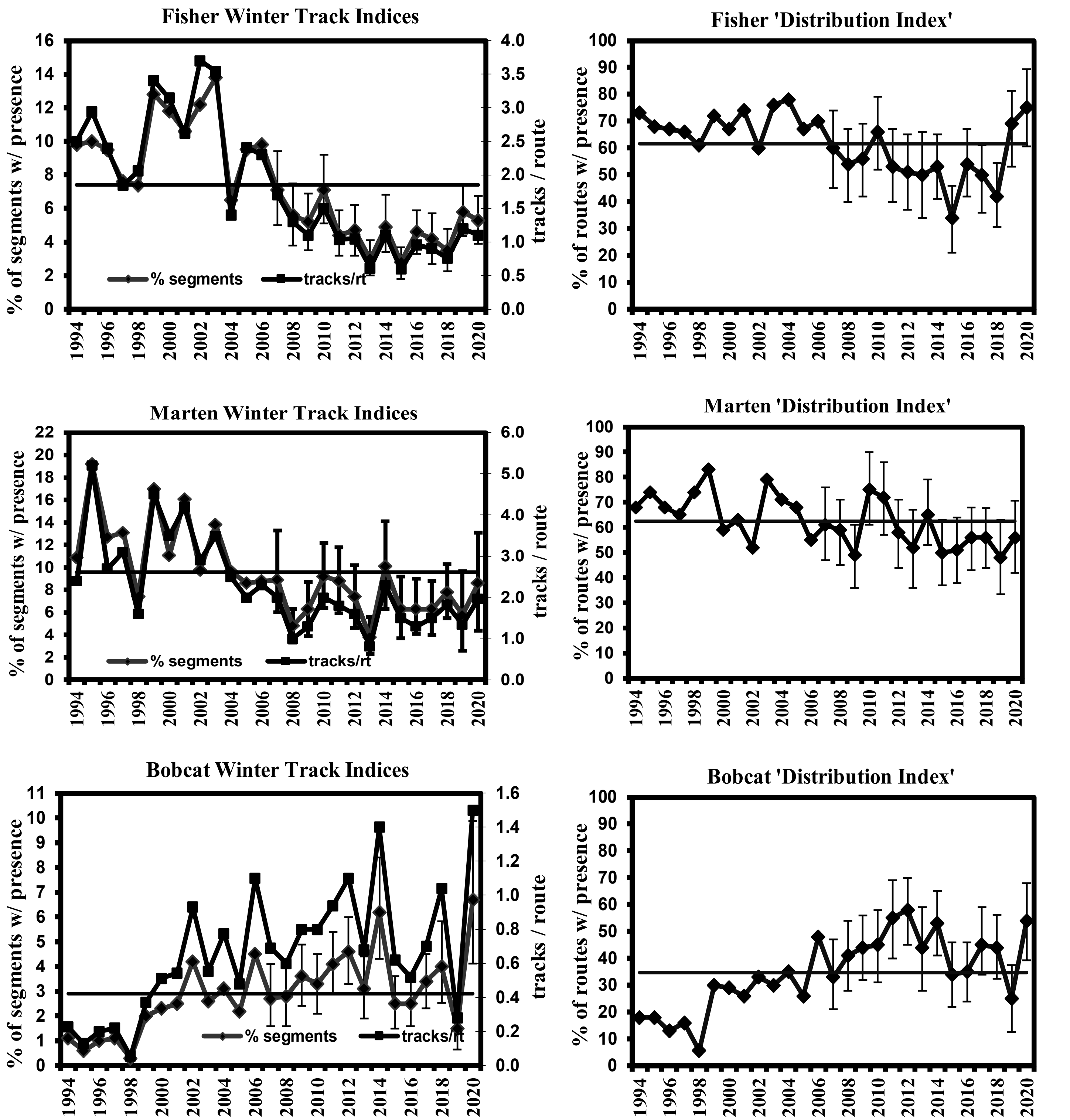

Figure 4. Winter track indices for selected species in Minnesota, 1994-2020. Confidence intervals are presented only for % segments and % routes with track presence; horizontal lines represent their long-term averages.

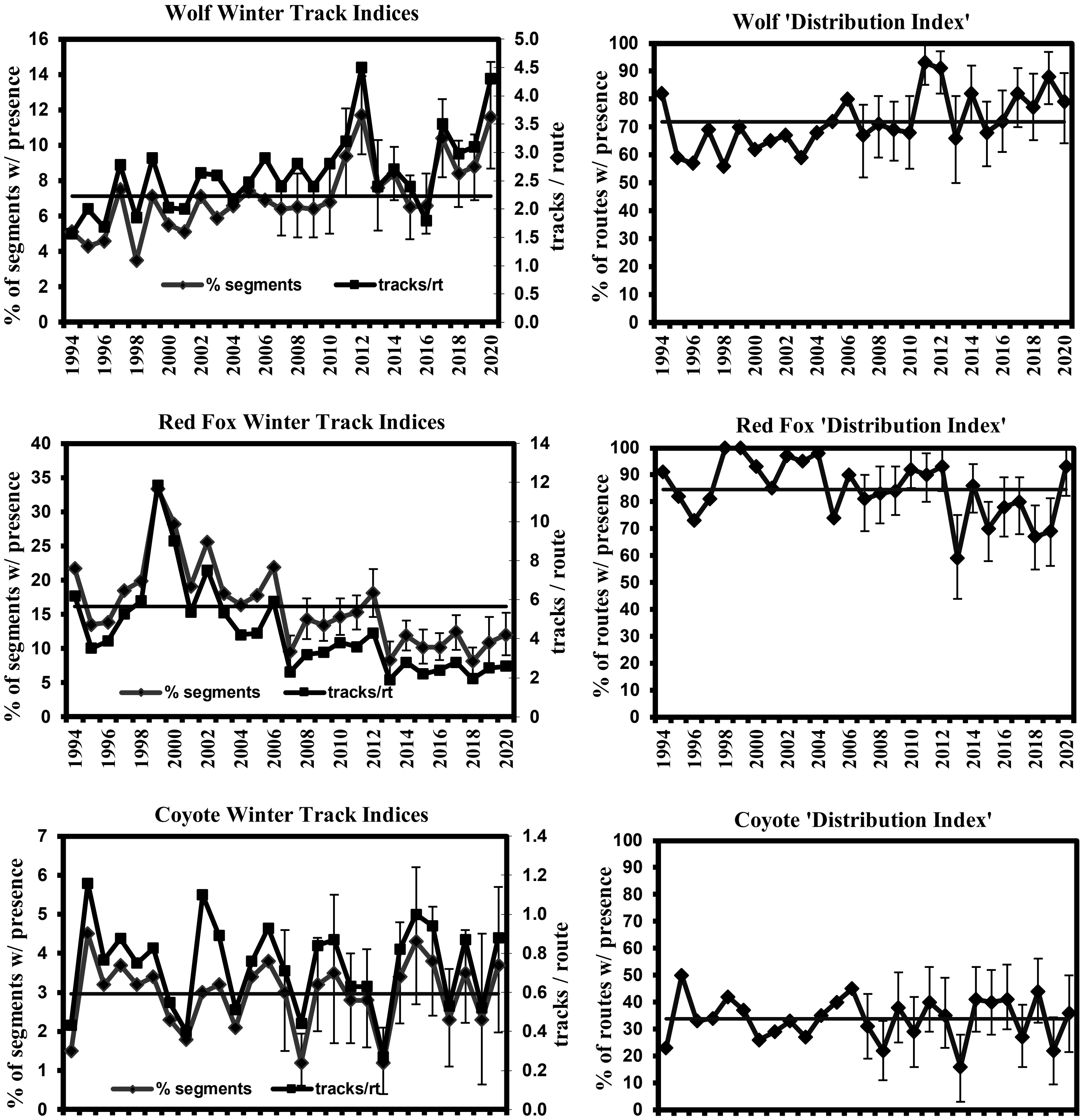

Figure 4 (continued). Winter track indices for selected species in Minnesota, 1994-2020.

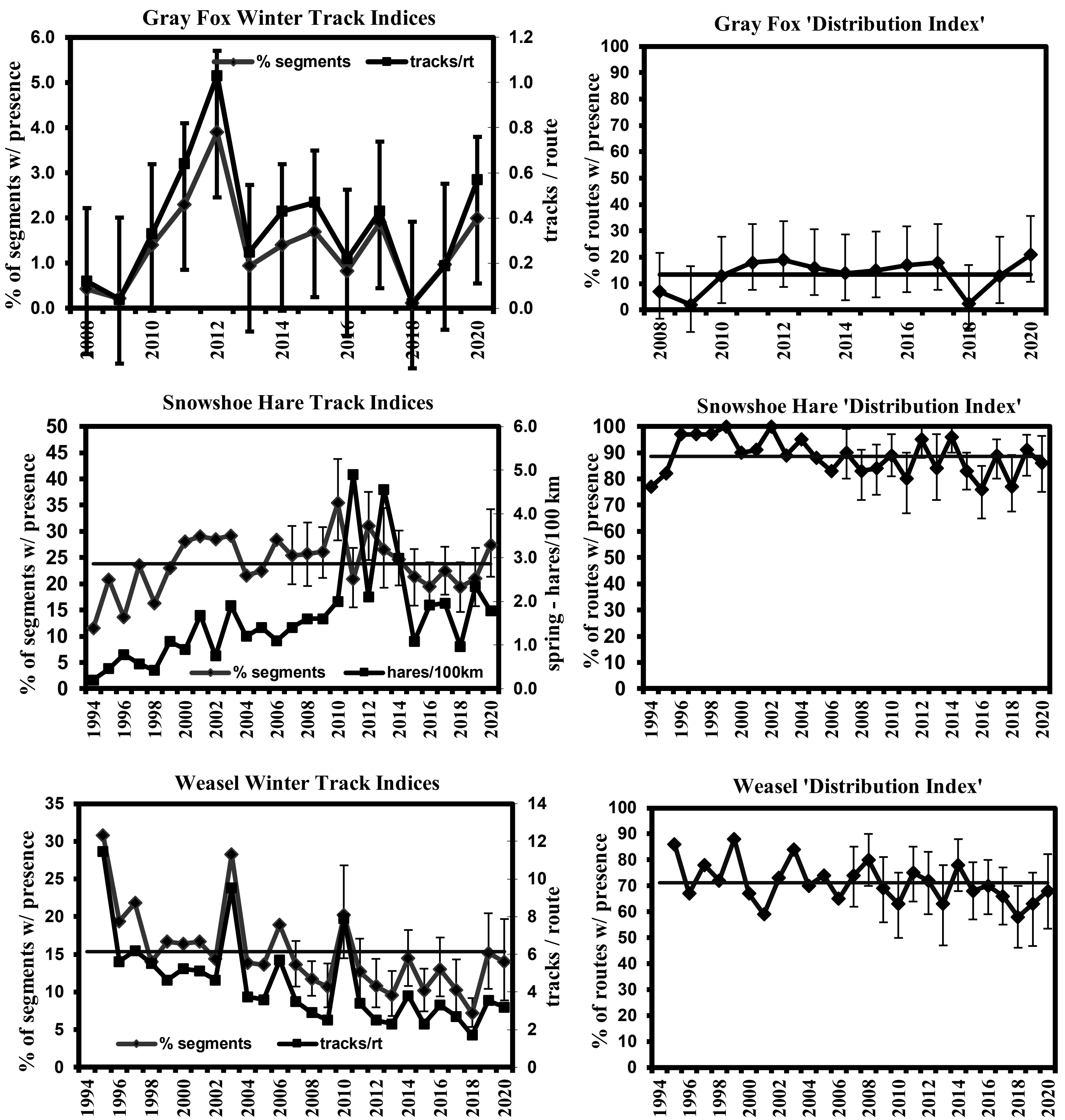

Figure 4 (continued). Winter track indices for selected species in Minnesota, 1994-2020.