



CARNIVORE SCENT STATION SURVEY SUMMARY, 2024

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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 (Johnson 1998, 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 49th 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 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, had 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 or 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 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.

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 more informal methods (i.e., degree of CI overlap; Cumming and Finch 2005) to highlight changes from last year that likely represent significant differences.

RESULTS AND DISCUSSION

A total of 217 routes and 1,988 stations were surveyed this year, similar to the past 7 years but below levels in previous decades. Route density varied from 1 route per 633 km² in the Forest Zone to 1 route per 1,840 km² in the Farmland Zone (Figure 1).

Statewide, route visitation rates (% of routes with detection), in order of increasing magnitude, were opossums (5%), bobcats (12%), domestic dogs (16%), wolves (18%), skunks (24%), domestic cats (25%), coyotes (29%), red foxes (32%), and raccoons (32%). Regionally, species-specific route visitation rates (% of routes with detection) were as follows:

	Red fox	Coyote	Striped skunk	Raccoon	Opossum	Wolf	Bobcat	Dog	Cat
Farmland	24	59	24	76	11	0	0	19	46
Transition	33	35	45	49	12	12	10	37	39
Forest	34	19	16	14	1	25	16	9	15

Figures 2-5 show station visitation indices (% of stations visited) from the survey's inception through the current year. Although a couple changes this year approached statistical significance (i.e., decline in red fox and increase in wolf in Forest Zone), none in fact represent statistically significant changes from the previous year.

In the Farmland Zone (Figure 2), red fox indices continue to remain stable but well below their long-term average, as they have been for over 20 years. Conversely, coyote and raccoon indices continue to be near record levels. Low red fox indices are likely related in part to increased coyote abundance (Levi and Wilmers 2012). No consistent long-term trends are evident for other species in the Farmland Zone, though domestic dog detections have remained below the long-term average for over a decade.

As in the Farmland, red fox and coyote indices have generally exhibited inverse patterns in the Transition Zone, with red fox indices remaining below average for nearly 2 decades and coyote indices generally increasing during that same time (Figure 3). No consistent long-term trends are evident for other species in the Transition Zone. Wolves and bobcats continue to occur in the Transition Zone (Figure 5), but at lower levels and sometimes with erratic fluctuations compared to the Forest Zone. Although not a significant change from the previous year, the point estimate for wolves in the Transition Zone was the highest yet recorded.

Unlike in the Farmland and Transition Zones, the Forest Zone coyote index has not increased over time and was below the long-term average for 2 decades (Figure 4), likely due to the presence and long-term increase of wolves in the Forest Zone (Levi and Wilmers 2012). Coyote point indices, however, have increased above the long-term average the last 6 years.

Red fox, raccoon, and striped skunk indices have not exhibited consistent or notable trends in the Forest Zone over the past 20 years; indices were near (raccoon) or moderately below (skunk and red fox) their long-term averages this year (Figure 4). After remaining low for an extended period (1976 – 2000), bobcat indices increased for over a decade (~ 2000 – 2012) and have since been relatively stable at levels above, often notably so, the long-term average (Figure 4).

ACKNOWLEDGEMENTS

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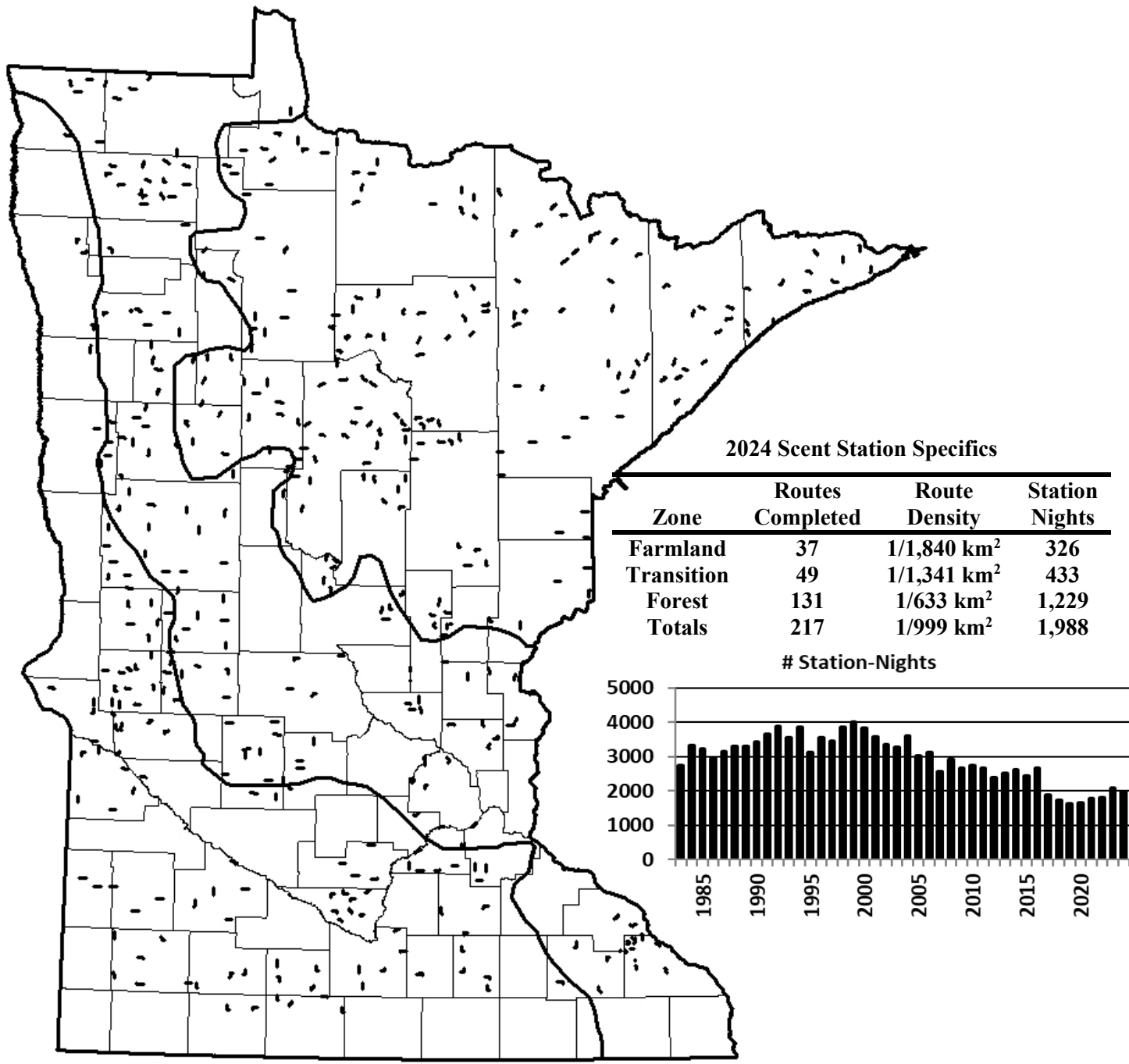


Figure 1. Locations of existing scent station routes (not all completed every year). Insets show 2024 route specifics and the number of station-nights per year since 1983.

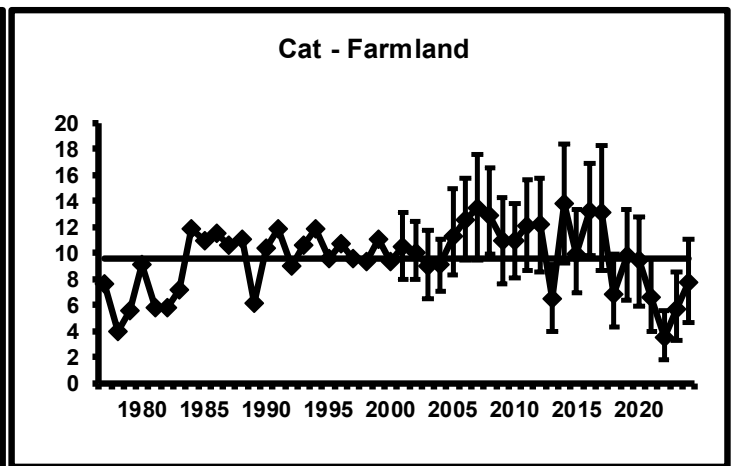
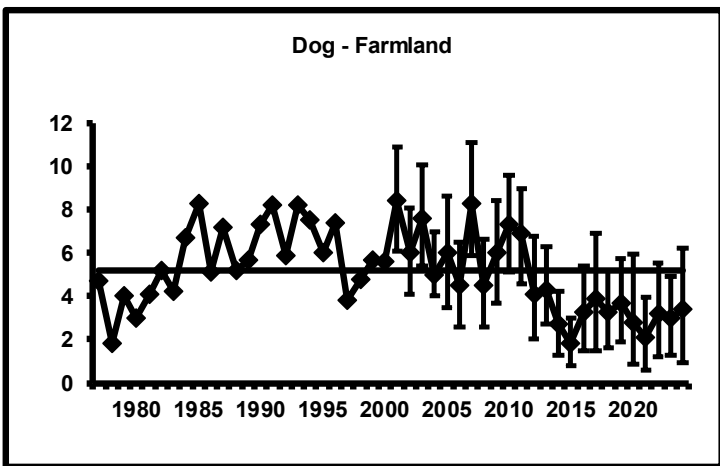
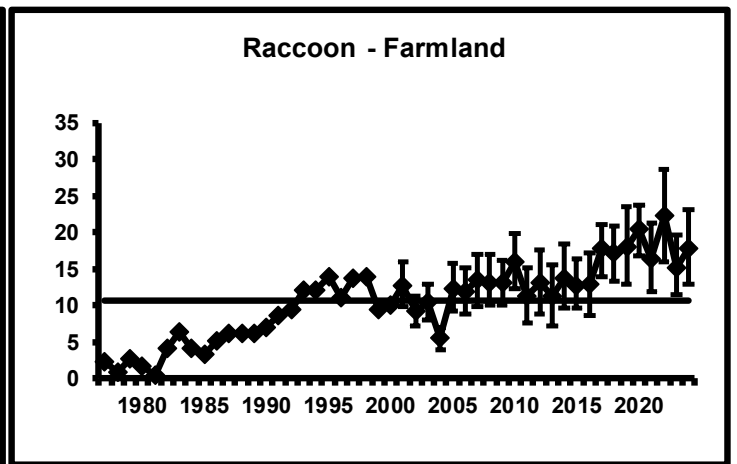
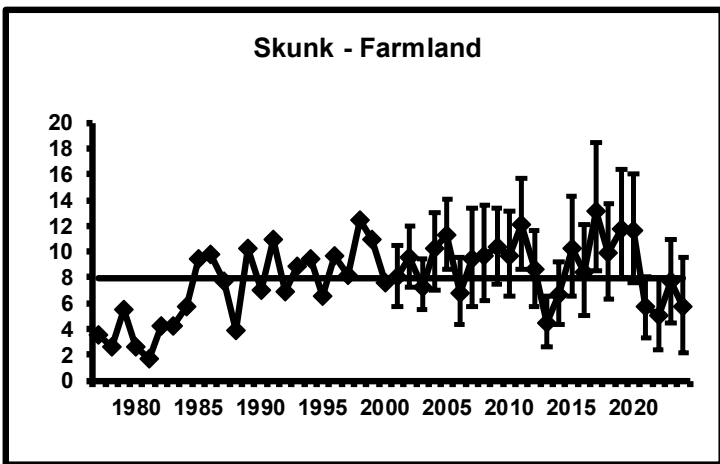
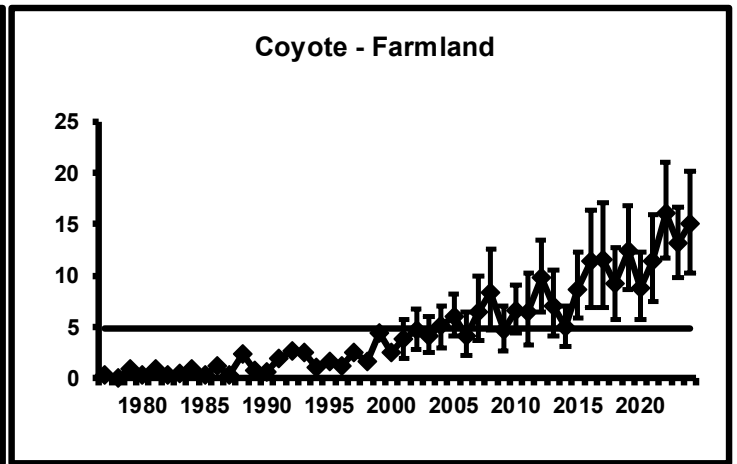
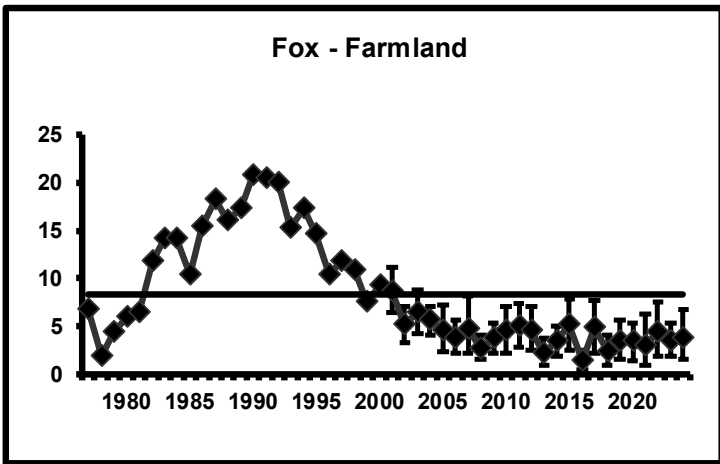


Figure 2. Percentage of scent stations visited by selected species in the Farmland Zone of Minnesota, 1977-2024. Horizontal lines represent long-term means.

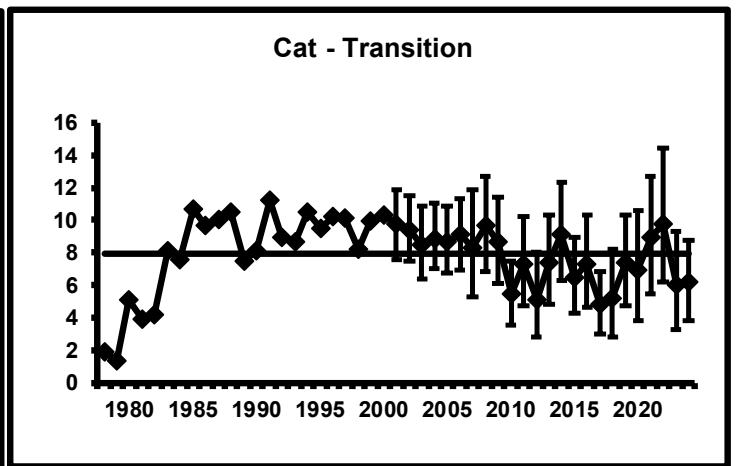
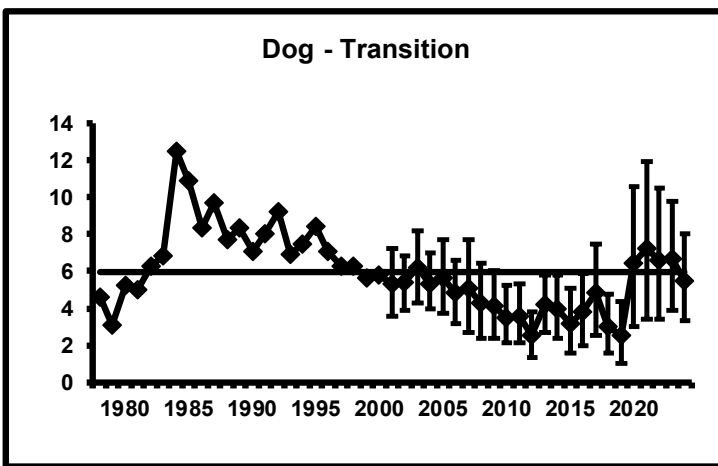
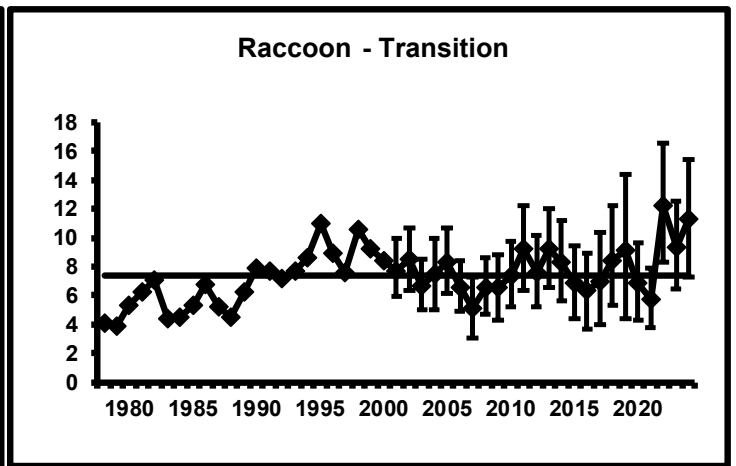
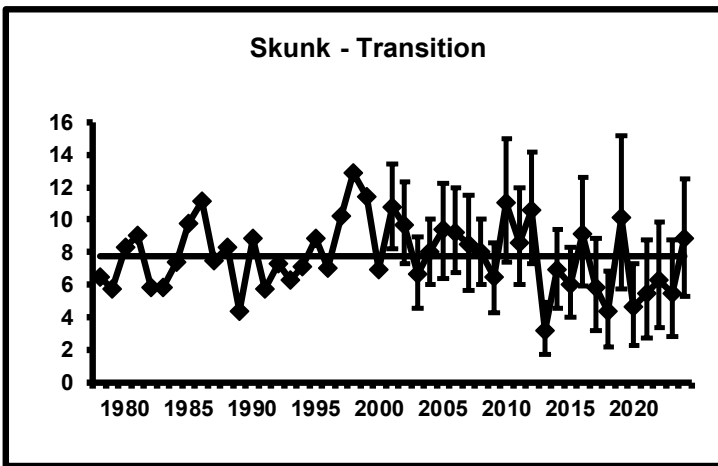
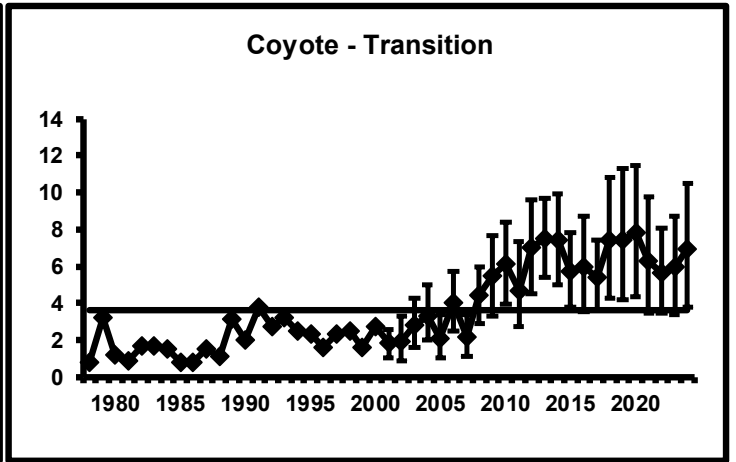
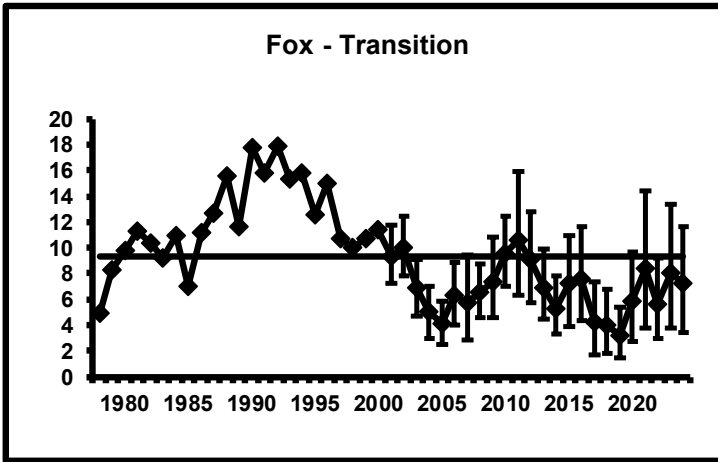


Figure 3. Percentage of scent stations visited by selected species in the Transition Zone of Minnesota, 1978-2024. Horizontal lines represent long-term means.

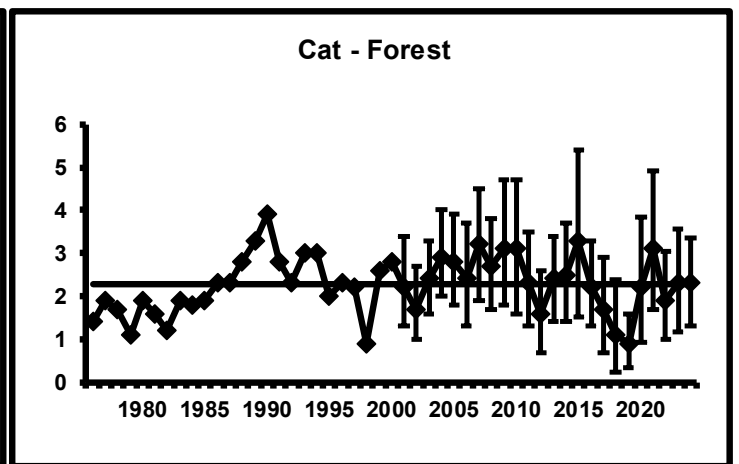
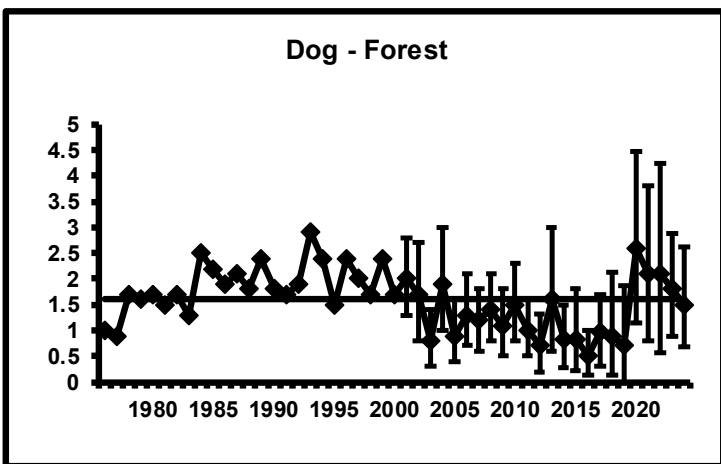
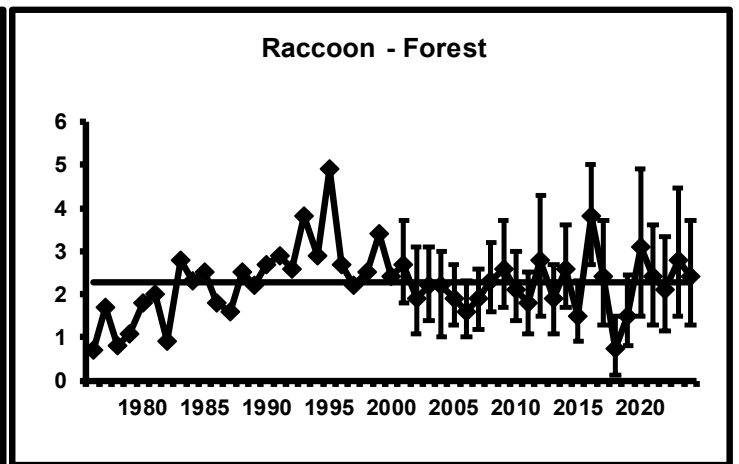
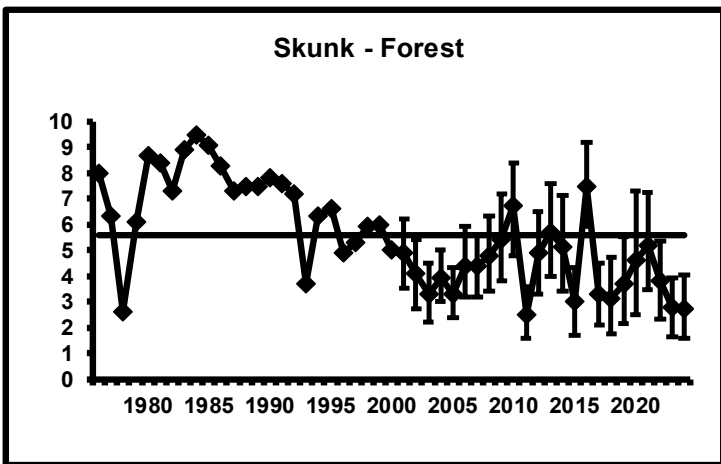
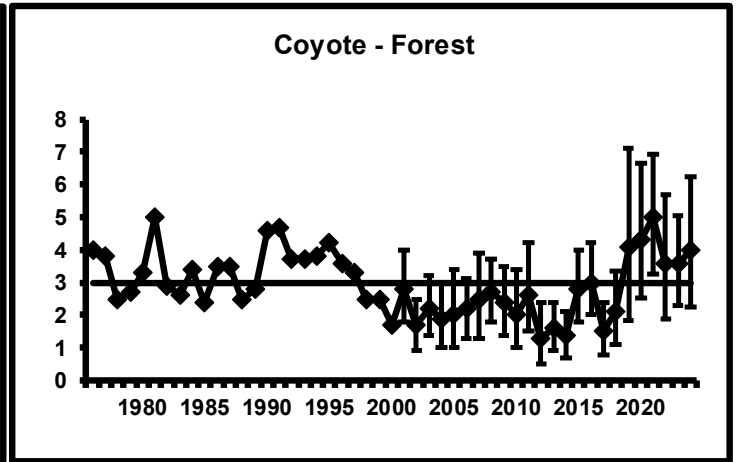
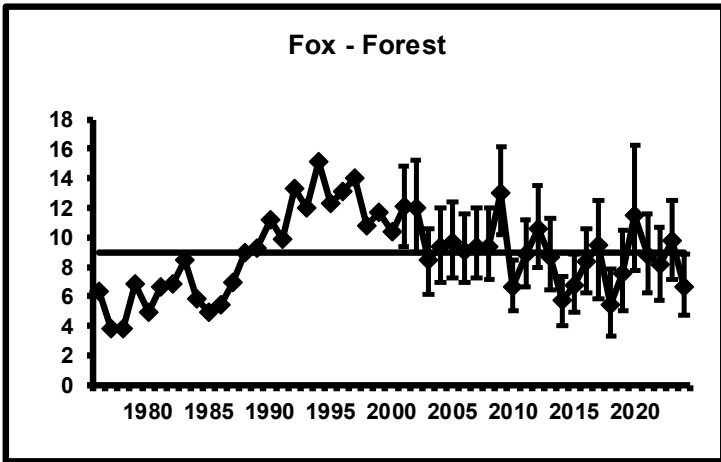


Figure 4. Percentage of scent stations visited by selected species in the Forest Zone of Minnesota, 1976-2024. Horizontal lines represent long-term means.

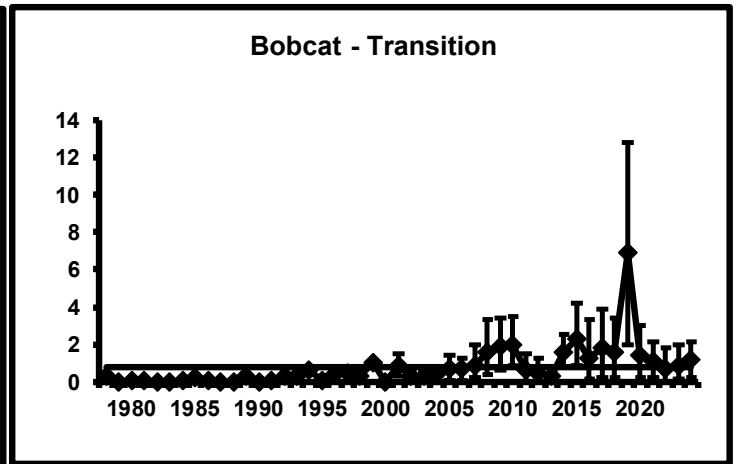
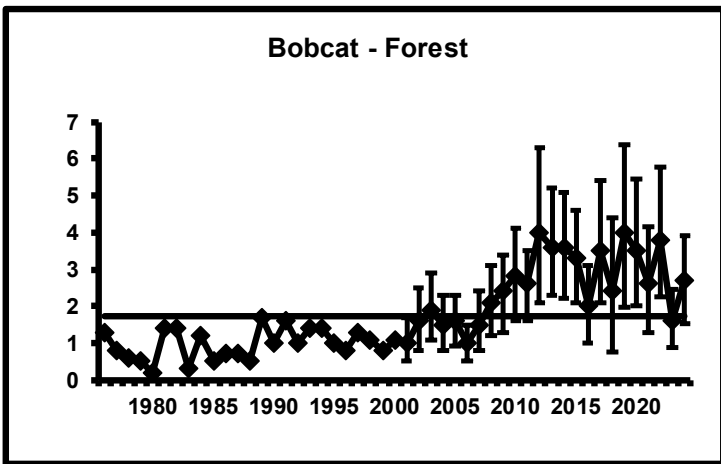
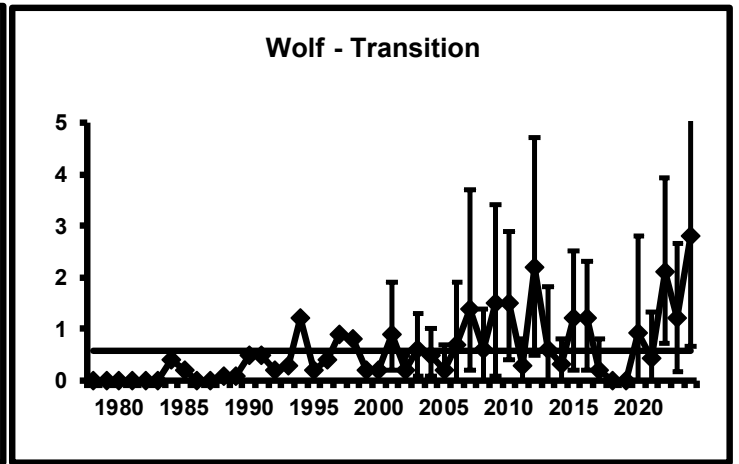
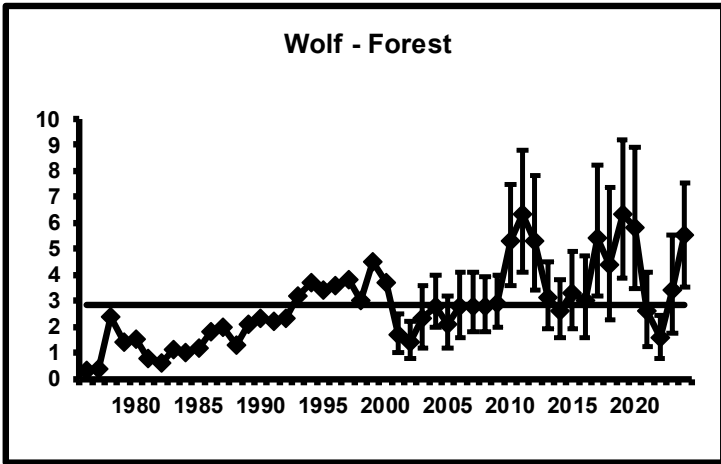


Figure 5. Percentage of scent stations visited by wolves and bobcat in the Forest and Transition Zones of Minnesota, 1976-2024. Horizontal lines represent long-term means.