Iowa Spring Spotlight Survey: 2025 Summary

Dan J. Kaminski, Iowa Dept. of Natural Resources, Boone Wildlife Research Station, 1436 255th St., Boone, Iowa 50036
Tyler M. Harms, Iowa Dept. of Natural Resources, Boone Wildlife Research Station, 1436 255th St., Boone, Iowa 50036
Vince D. Evelsizer, Iowa Dept. of Natural Resources, Clear Lake Research Station, 1203 N. Shore Dr., Clear Lake, Iowa 50428
Jace R. Elliott, Iowa Dept. of Natural Resources, Boone Wildlife Research Station, 1436 255th St., Boone, Iowa 50036

ABSTRACT
The Iowa Dept. of Natural Resources conducts nocturnal spotlight surveys from mid-March to mid-May, annually. Surveys are completed in all 99 Iowa counties and total ~4,780 mi ($\bar{x}$ = ~50 mi/county) of surveyed rural roads. In 2025, a total of 21,732 wildlife observations were recorded, with white-tailed deer (*n* = 15,445), raccoon (*n* = 5,464), opossum (*n* = 322), striped skunk (*n* = 200), and house cat (*n* = 117) most frequently observed. Counts decreased for all species from the previous year, with declined observations most pronounced for badger and opossum.

INTRODUCTION
Data capable of estimating wildlife abundance are often difficult, expensive, and time consuming to collect, particularly for rare or elusive species, or species that exist across large geographic areas. Standardized sampling methods, however, may provide consistent indices of populations over time. Reliable indices are important for understanding population trends and the factors affecting populations, including environmental conditions (Progulske and Duerre 1964, Fujisaki et al. 2011), regulated harvest (Carrillo et al. 2000), and disease (Gehrt et al. 2006). One common method, the nocturnal spotlight survey, has been used since the mid-20th Century and provides wildlife managers a cost-effective and easily implemented option to sample wildlife populations (SDDGFP 1950; Anderson 1959). Spotlight counts have been used to produce indices for species such as opossum (*Didelphis virginiana*; Gehrt et al. 2006), raccoon (*Procyon lotor*; Gehrt et al. 2002), red fox (*Vulpes vulpes* ; Ruette et al. 2003), and white-tailed deer (*Odocoileus virginianus*; Rybarczyk 1978, Kaminski et al. 2019).

In 1978, the Iowa Dept. of Natural Resources (Iowa DNR; formerly the Iowa Conservation Commission) initiated the Spring Spotlight Survey because of concerns that all-time high raccoon pelt prices threatened an over-harvest and would negatively impact the sustainability of the population (Rybarczyk 1978). Spotlight routes were established along forested areas to survey for raccoon, although white-tailed deer were also included. In general, from 1978–1990, 85 spotlight routes were surveyed across the state, and from 1991–1995, 5 additional routes were added (Appendix A). This survey specifically targeted forested areas in an agriculturally dominated landscape, and given the close association between raccoon (Pedler et al. 1997, Beasley et al. 2007) and deer (Volk et al. 2007, Walter et al. 2009) populations and forest cover, statewide counts may have been biased (McShea et al. 2011). Regardless, the trends resulting from this survey provided key insight into these growing populations since the 1970s (Appendix B to E).

In 2006, a new survey was developed to address deficiencies in the original design. Rather than using survey routes perpendicular to forest cover, routes were oriented longitudinally in an east–west direction to achieve a representative sample of the land cover types across the state. Several species were added to the survey, including badger (*Taxidea taxus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), gray (*Urocyon cinereoargenteus*) and red fox, mink (*Mustela vison*), opossum, river otter (*Lontra canadensis*), and striped (*Mephitis mephitis*) and spotted skunk (*Spilogale putorius*). The new method was tested concurrently with the original survey and found to result in similar trends with less variability (Iowa DNR, unpublished data). Therefore, in 2012, the new survey routes were adopted in all 99 Iowa counties. The new survey design results in relatively large counts of deer, raccoon, opossum, striped skunk, coyote, and red fox. Observations of other species (e.g., gray fox, bobcat, river otter, mink), however, are more variable because of the secretive nature, low density, or low visibility of animals. Thus, a low count of these species does not necessarily imply low population abundance.

The goal of the Spring Spotlight Survey is to collect reliable, standardized, and long-term counts for select wildlife species that can be used to inform science-based management decisions in Iowa. The objectives of the survey are to 1) collect systematic observations for deer, raccoon, and select furbearer species as independent indices for populations or as supplements to harvest and other survey data collected by the Iowa DNR and 2) monitor the long-term distribution and relative abundance of select wildlife species for population management and conservation efforts.

STUDY AREA

The Spring Spotlight Survey is conducted in each of 99 counties in the 56,239-mi^2 state of Iowa (Figure 1). The climate is humid continental, characterized by hot, humid summers and cold winters. Average annual precipitation ranges from 24.4 inches in the northwest to 37.2 inches in the southeast (NOAA 2002a). Average annual temperature ranges from 45.5° F in the northwest to 50.7° F in the southeast (NOAA 2002b). Land cover consists of agriculture (63%), grass and pastureland (22%), forest (10%), urban and other developed lands (2%), and wetlands, shallow lakes, and open water (2%; IA DNR 2015).

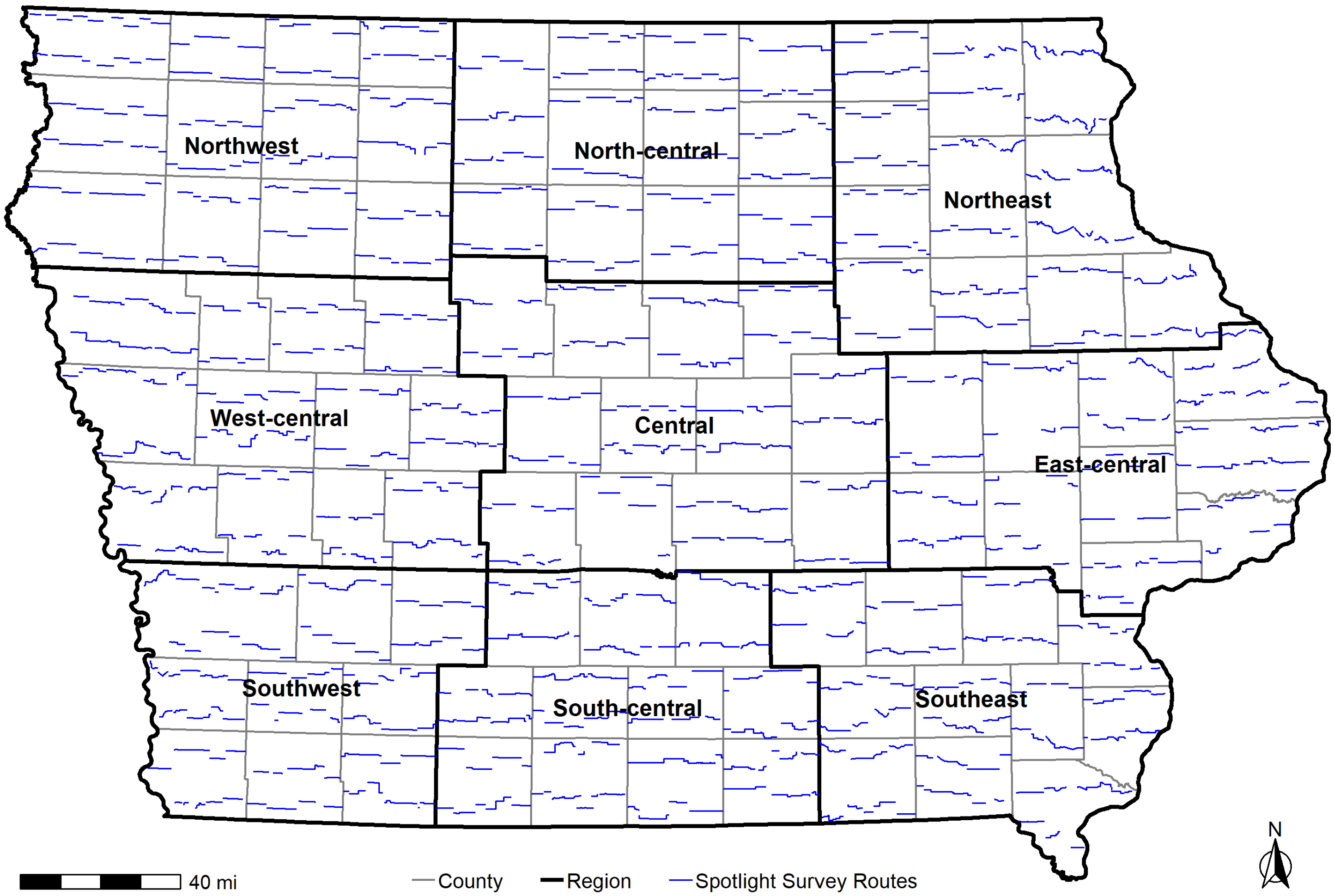


Figure 1. Spring Spotlight Survey routes (*n* = 199) in each county of Iowa and 9 regions of the state used for summarizing spotlight count data.

METHODS

The Spring Spotlight Survey is conducted each year, usually after snow-melt and before spring green-up occurs, between mid-March and mid-May with the date of surveys dependent on local weather conditions and the latitudinal timing of vegetation leaf-out across the state. Surveys are standardized according to weather conditions (Rybarczyk 1978) and conducted during periods of no precipitation, wind speed <15 mph, relative humidity ≥40%, and temperature >32° F. Surveys consist of 2 east–west driving routes, one across the north half and one across the south half of each county (except Kossuth County which has 3 routes; *n* = 199). Routes follow along rural unpaved roads totaling ~4,780 mi statewide ($\bar{x}$= 24.0 mi/route, 13.0–41.9 mi; SD=4.3 mi) and are sampled once each spring. Surveys begin 1 hour after sunset and are conducted at speeds ≤20 mi/hr. Surveys are conducted by 2 observers (1 driver and 1 passenger), both of whom search for wildlife using a spotlight along their respective side of the road. From 2006–2018, the number and location of animals was recorded at the observer location using a Global Positioning System (GPS) device. For deer, the distance and bearing to each group of deer (≥1 individual) were also recorded for estimating deer density across the state. Beginning in 2019, observations were recorded digitally (e.g., smart phones, tablets) in a geospatial database (ArcGIS Field Maps; Environmental Systems Research Institute, Redlands, CA) which allowed for collection of more precise wildlife locations and increased survey efficiency.

Table 1. Survey year, number of miles surveyed, and total number of animals observed for select species during the Spring Spotlight Survey in Iowa, 2006-present.

Year	Miles	Deer	Badger	Bobcat	Coyote	Mink	Opossum	Raccoon	Red fox	Skunk	House cat
2006[a]	4,290	9,279	9	4	56	9	136	2,417	41	133	15
2007	4,795	11,284	23	2	49	6	164	2,817	32	144	383
2008	4,793	13,329	22	5	51	13	118	3,143	46	148	511
2009	4,784	12,935	15	4	66	11	136	3,219	32	174	405
2010	4,787	10,888	16	4	53	10	86	3,621	43	217	392
2011	4,780	11,054	9	4	64	6	85	4,197	55	211	490
2012	4,764	9,322	9	3	92	11	114	3,282	37	171	599
2013	4,738	13,053	15	2	94	6	172	3,347	42	140	479
2014	4,800	11,401	12	3	65	3	88	3,793	28	116	391
2015	4,752	12,354	12	2	66	1	162	3,537	29	155	337
2016	4,607	12,522	16	1	110	13	273	3,672	27	144	252
2017	4,793	13,017	16	4	108	5	297	3,695	38	138	200
2018	4,755	15,102	18	0	99	2	295	4,683	46	181	209
2019	4,772	16,164	28	4	88	11	149	5,314	58	193	230
2020	4,781	15,746	26	8	86	8	179	4,454	24	173	161
2021	4,781	13,765	27	6	103	8	142	5,284	47	169	118
2022	4,783	17,103	27	4	119	7	268	6,486	48	270	143
2023	4,752	15,550	19	3	104	3	249	5,526	54	246	122
2024	4,783	16,920	36	2	122	4	442	5,601	43	252	155
2025	4,783	15,445	14	2	109	2	322	5,464	41	200	117

[a]In 2006, species other than white-tailed deer and northern raccoon, particularly house cat, were not recorded in all counties and species counts may not be comparable to subsequent years.

We summarized long-term trends for spotlight counts across 9 regions of Iowa (Figure 1) and statewide for the most commonly observed species each year. We standardized counts as the number of animals observed per 100 miles surveyed to account for annual differences in the number of miles surveyed (e.g., road closures). Because animal counts may vary annually, we further estimated the 5-year average relative distribution of counts to contextualize annual observations with recent trends and to map the relative distribution of species across the state. We interpolated the average distribution of counts for the most recent 5 years using inverse distance weighting (IDW; function gstat in Program R 4.5.0; R Core Team 2025) and 9 nearest neighbors. To determine the IDW power used to weight nearest neighbors for each species, we iteratively tested power values from 0.2–5.0 in 0.2 increments and estimated the root mean square error (RMSE) for each IDW estimate. We selected the power value from the IDW estimate with the lowest RMSE for producing the final IDW map. We further averaged the final IDW map using a focal analysis (function focal in Program R) and a 29.8-mi moving window to produce a smoother and more readily interpretable trend surface across Iowa.

RESULTS

In 2025, 4,783 mi of rural roads were surveyed across all 99 Iowa counties. A total of 21,732 animals were reported, marking a decrease of 1,859 animals observed (8.6%) compared with 2024. Observations for all regularly reported species decreased from the previous year (Table 1; Figure 2–39).

A total of 15,445 deer were observed and was consistent with counts since 2018 (Figure 2). Deer were observed at a rate of 3.2 deer/mi statewide, with the highest numbers across south-central and eastern regions (Figure 4). Deer counts decreased in all regions of the state except the southeast. Long-term deer observations have been relatively stable to increasing in all regions, except the south-central and western regions, where counts have declined the past 3 or more years.

Raccoon observations were similar to the previous two years and remained above their long-term average ($\bar{x}$ = 4,178; Figure 24; Table 1). The statewide trend increased by an average of 4.2% per year since 2006 (R^2 = 0.83, P < 0.001), although counts have been relatively stable around an average of 5,447 animals since 2019 (Figure 24). Regionally, raccoon counts decreased in all regions except central and east-central regions compared with 2024 (Fig 26).

Badger (Figure 7–10), opossum (Figure 20–23), skunk (Figure 32–35), and coyote (Figure 13–16) observations decreased 61%, 27%, 20%, and 11%, respectively, following increases for each species in 2024. The badger count was below their long-term average ($\bar{x}$ = 18), whereas the opossum count was consistent with past years and above their long-term average ($\bar{x}$ = 194). Coyote observations have been relatively stable since 2016 and fluctuated around 2 animals per 100 miles surveyed ($\bar{x}$ = 85). Skunk observations were low compared to the past 3 years, although above their long-term average ($\bar{x}$ = 179).

Red fox observations were similar to 2024 and comparable to the previous 4-year average ($\bar{x}$ = 48; Figure 28–31). Red fox counts were stable or decreased in all regions except the east-central region, where counts increased from 1 in 2024 to 9 this year.

Observations for additional species tend to be more opportunistically collected due to biological or behavioral constraints of the species. Bobcat observations were below their long-term average ($\bar{x}$ = 3.4) and generally low for this survey (Figure 11–12). Mink observations continued a 7-year decline and matched the 10-year low of 2 animals observed in 2018 ($\bar{x}$ = 6.9; Figure 17–19). Three otters were reported, whereas no gray fox, jackrabbit, weasel, or woodchuck were reported.

DISCUSSION

Statewide deer counts increased in 2018 and have since remained stable with minor fluctuations. Regionally, long-term counts have increased in the northeast, north-central, central, east-central, and southeast regions (Fig 4.). Although counts have decreased in south-central Iowa during the past 6 years, the region maintains some of the highest deer densities in Iowa (Figure 5). Alternatively, counts in western regions have declined or remained relatively low despite harvest regulations designed to reduce doe (female) harvest and allow increased reproduction in these counties. Spotlight observations support local staff and public accounts that deer populations in western Iowa remain low. As part of the Western Iowa Deer Initiative, the DNR recently held 11 public meetings across the region to gather feedback on potential antlerless deer harvest strategies for coming years.

Raccoon observations increased between 2016 and 2022, which coincided with low raccoon pelt values in international fur markets and subsequent reduced harvest during the past decade (Evelsizer 2022). Statewide counts have exceeded an average of 1 raccoon per mile during 6 of the past 7 years, although counts were stable the past 3 years. Regionally, counts have increased most in the lower two-thirds of the state, particularly in west-central, east-central, southwest, and south-central regions. However, during the past few years, counts have declined slightly in all regions except the east-central region, where counts have increased since 2006.

Badger observations peaked 25 individuals per year in 5 of the previous 6 years. The number of badgers observed is positively related to the number of precipitation events ≥1 inch in the 28 days prior to surveys and humidity during survey nights (R^2 = 0.57, $P \leq$ 0.001; Appendix F). Precipitation in March and April was below long-term normals, particularly in western Iowa where models indicate the majority of suitable habitat exists in the state (Glisan 2025*a*, *b*, Iowa DNR, unpublished data). Although badger observations vary based on many coinciding factors, dry spring conditions likely decreased detectability of badgers in 2025.

Canids are difficult to survey using spotlighting and coyote and red fox observations are likely highly variable according to factors such as nighttime humidity, terrain, and road-avoidance behavior. As a result, some inherent variability exists in canid spotlight counts. For red fox, spotlight observations are further challenging to collect due to their small size and evasive behavior (Ruette et al. 2003). Although observations regularly fluctuate, statewide red fox counts have remained stable since 2006, with slightly greater numbers observed in central and eastern regions. Alternatively, archery hunter counts (as reported in the Iowa DNR bow hunter observation survey; Harms et al. 2022) show a steady statewide decline since 2005, which tracks with declining reported harvest. Archery hunter counts likely provide a more reliable annual population index for red fox (and coyote) compared with raw spring spotlight counts, suggesting a stable to declining population statewide.

Reported coyote harvest in Iowa decreased 305% in 2021 (from 15,087 to 3,724) but it is unknown if this represents a true decrease in harvest or whether harvesters chose not to sell pelts into fur markets due to a 50% drop in average pelt values. The population-level effect of decreased reported harvest is unclear. However, statewide spotlight counts for coyotes have remained relatively stable around 2 individuals per 100 miles surveyed since 2016. Long-term counts have increased in western Iowa and fluctuated in central and eastern regions. Recent trends in northeast and east-central regions have tended to decline during the past decade, although archery hunter observations indicate more stable counts.

Opossums are sensitive to winter temperatures (Gillette 1980, Gehrt et al. 2006) and spotlight counts are negatively correlated with winter weather severity in Iowa (r = -0.69; Boustead et al. 2015). The 2025 count was the second highest in survey history (following 2024) and lower than last year likely due to colder than normal February temperatures (average 3.2° F below statewide normal). Opossum populations have the ability to rebound quickly following severe winters because females can produce two litters per year consisting of a large number of young (up to 13 joeys/litter; Gipson and Kamler 2001). February 2014, 2019, and 2021 all ranked within the top 16 coldest February's in recorded history and opossum counts subsequently declined 49%, 48%, and 21%, respectively, in the following springs (Glisan 2019, Glisan 2021, Hillaker 2014). Alternatively, opossum counts increased 65%, 16%, and 78% in 2016, 2020, and 2024, respectively, following mild winters. Overall, reported harvest for opossums has been below the 25-year average for the past decade; therefore, statewide population trends will likely be driven by winter severity, among other non-harvest related factors, in the coming years.

Skunk observations declined in 2025 but remained above the long-term average. Skunk observations are distributed around the state, except the southeast region where counts are consistently low. Counts for skunks tend to fluctuate every 3–10 years similar to archery hunter observations (Harms et al. 2022). Spotlight surveys for skunks (as well as mustelids) are challenging because spotlighting is most effective for species that are readily detectable by eye shine (e.g., deer, raccoon). Skunks are rarely identified by eye shine and must be close to the observer for detection (Gehrt et al. 2006). Regardless, spotlighting likely works well for skunks in Iowa because of their tendency to be viewed in open areas at night, slower movements, and distinct black and white coloration.

The spotlight survey provides one of the only indices for mink in Iowa and indicates that counts typically fluctuate every 3 or more years. Mink observations have declined since 2019, reaching a 10-year low in 2025. Regionally, the most consistent mink observations occur in northeast Iowa, with frequent observations occurring in north-central, northwest, and east-central regions. Mink observations are rare because surveys are not focused on riparian or wetland areas typical of mink use. Reliable population trends for mink are possible using spotlight observations; however, annual counts may be highly variable (Waller 2010) and are typically low for our survey ($\bar{x}$ = 7.0). Weather indices accounted for 32% of annual variability in mink observations (Appendix F), indicating that other environmental or population factors contribute to observed counts in Iowa as well.

Spotlight observations for bobcats are collected incidentally as spotlighting is less likely to detect forest obligates. However, the distribution of bobcat observations is consistent with other population indices in Iowa and suggests a population distributed primarily in the southern half of the state.

For this survey house cats are defined as free-ranging domestic cats located in rural areas unconfined and away from farmsteads and human developments (e.g., feral cats). Observations for house cats have declined 80% since 2012. A similar pattern was observed for archery hunter observations, although the reason for these declines is unclear and may be related to several interacting factors (e.g., disease, predation, or declining rural human populations; Warner 1985). Predation by house cats on native fauna poses a serious conservation concern in North America, particularly for birds and small mammals (Dauphine and Cooper 2009). The effect of potentially declining rural cat populations on native fauna remains unknown, although declining cat populations is likely beneficial for several wildlife taxa across the state.

MANAGEMENT IMPLICATIONS

The Spring Spotlight Survey provides consistent long-term population indices for several wildlife species in Iowa. Population trends derived from the survey are critical for monitoring populations and informing science-based management decisions. When paired with long-term harvest and other survey data, the development of population abundance or growth models may be possible and provide more robust metrics for evaluating populations in the future.

ACKNOWLEDGMENTS

We thank all current and past Iowa DNR staff and volunteers who traveled thousands of miles of gravel roads across the state, often until early morning hours, to complete the Spring Spotlight Survey each year. We appreciate the opportunity to present these data on their behalf. W. J. Suchy developed the current study design for the Spring Spotlight Survey; we appreciate his efforts to expand the survey statewide and across multiple taxa to improve the quality of the data collected. J. M. Coffey compiled and maintained data for many years of the survey.

LITERATURE CITED

Anderson, CF, Jr. 1959. Nocturnal activities of the Columbia black-tailed deer (*Odocoileus heminous columbianus Richardson*) affecting spotlight census results in the Oregon coast range. Thesis, Oregon State College, Corvallis, USA.

Beasley, JC, TL Devault, OE Rhodes, Jr. 2007. Home-range attributes for raccoons in a fragmented agricultural region of northern Indiana. J of Wildl Manag 71:844–850.

Boustead, BEM, SD Hilberg, MD Shulski, and KG Hubbard. 2015. The accumulated winter season severity index (AWSSI). J of Appl Meteor and Climat 54:1693–1712.

Dauphine, N, and RJ Cooper. 2009. Impacts of free-ranging domestic cats (*Felis catus*) on birds in the United States: A review of recent research with conservation and Manag recommendations. Proceedings of the Fourth International Partners in Flight conference: Tundra to Tropics 205–219.

Evelsizer, V. 2022. Furbearers. Pages 62–116 in P. Fritzell, editor. Trends in Iowa wildlife populations and harvest 2021–2022. Iowa Dept of Nat Resour, Boone Wildlife Research Station, Boone, USA.

Fujisaki, I, FJ Mazzotti, RM Dorazio, KG Rice, M Cherkiss, and B Jeffery. 2011. Estimating trends in alligator populations from nightlight survey data. Wetlands 31:147–155.

Gehrt, SD, GF Hubert, Jr., and JA Ellis. 2002. Long-term population trends of raccoons in Illinois. Wildl Soc Bull 30:457–463.

Gehrt, SD, GF Hubert, Jr., and JA Ellis. 2006. Extrinsic effects on long-term population trends of Virginia opossums and striped skunks at large spatial scales. American Midland Natist 155:168–180.

Gillette, LN. 1980. Movement patterns of radio-tagged opossums in Wisconsin. The American Midland Natist 140:1–12.

Gipson, PS, and JF Kamler. 2001. Survival and home ranges of opossums in northeastern Kansas. The Southwestern Natist 46:178–182.

Glisan, J. 2019. Iowa monthly weather summary – February 2019. Iowa Dept of Agric & Land Steward, Des Moines, USA.

Glisan, J. 2021. Iowa monthly weather summary – February 2020. Iowa Dept of Agric & Land Steward, Des Moines, USA.

Glisan, J. 2025*a*. Iowa monthly weather summary – March 2025. Iowa Dept of Agric & Land Steward, Des Moines, USA.

Glisan, J. 2025*b*. Iowa monthly weather summary – April 2025. Iowa Dept of Agric & Land Steward, Des Moines, USA.

Glisan, J. 2025*c*. Iowa monthly weather summary – February 2025. Iowa Dept of Agric & Land Steward, Des Moines, USA.

Harms, TM, JM Coffey, VD Evelsizer, and DK Kaminski. Iowa Bow Hunter Observation Survey: 2022 summary. Iowa Dept of Nat Resour, Boone, USA.

Hillaker, HJ. 2012. Iowa weather summary – April 2012. Iowa Dept of Agric & Land Steward, Des Moines, USA.

Hillaker, HJ. 2014. Iowa annual weather summary – 2014. Iowa Dept of Agric & Land Steward, Des Moines, USA.

IA DNR [Iowa Dept of Nat Resour]. 2015. Iowa wildlife action plan: securing a future for fish and Wildlife. Iowa Dept of Nat Resour, Des Moines, USA.

Johnson, CJ, SE Nielsen, EH Merrill, TL McDonald, and MS Boyce. 2006. Resource selection functions based on use-availability data: theoretical motivation and evaluation methods. J of Wildl Manag 70:347–357.

Kaminski, DJ, TM Harms, and JM Coffey. 2019. Using spotlight observations to predict resource selection and abundance for white-tailed deer. J of Wildl Manag 83:1565–1580.

Kaminski, DJ, TM Harms, and VD Evelsizer. 2021. Iowa Spring Spotlight Survey: 2021 Summary. Iowa Dept of Nat Resour, Boone, USA.

McShea, WJ, CM Stewart, L Kearns, and S Bates. 2011. Road bias for deer density estimates at 2 national parks in Maryland. Wildl Soc Bull 35:177–184.

NOAA [National Oceanic and Atmospheric Administration]. 2002a. Section 2: Precipitation. National Oceanic and Atmospheric Administration, National Climatic Data Center, Climatography of the United States No. 85:1–71.

NOAA [National Oceanic and Atmospheric Administration]. 2002b. Section 1: Temperature. National Oceanic and Atmospheric Administration, National Climatic Data Center, Climatography of the United States No. 85:1–69.

Pedler, JH, L Fahrig, and HG Merriam. 1997. Raccoon habitat use at 2 spatial scales. J of Wildl Manag 61:102–112.

Progulske, DR, and DC Duerre. 1964. Factors influencing spotlighting counts of deer. J of Wildl Manag 28:27–34.

R Core Team. 2019. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Ruette, S, S Philippe, and M Albaret. 2003. Applying distance-sampling methods to spotlight counts of red fox. J of Appl Ecol 40:32–43.

Rybarczyk, WB. 1979. Evaluation of a spotlight survey technique as an index to Iowa white-tailed deer (*Odocoileus virginianus*) and raccoon (*Procyon lotor*) populations. Thesis, Iowa State University, Ames, USA.

SDDGFP [South Dakota Dept of Game, Fish and Parks]. 1950. 1949 Spotlight Observations in the Black Hills. South Dakota Game Report. Project 12-R-7. Div of Wildl, South Dakota Dept of Game, Fish and Parks, Pierre, USA.

Volk, MD, DW Kaufman, and GA Kaufman. 2007. Diurnal activity and habitat associations of white-tailed deer in tallgrass prairie of eastern Kansas. Transactions of the Kansas Acad of Sci 110:145–154.

Waller, M. 2010. Evaluation of spotlight surveys for monitoring mink populations in coastal South Carolina. Thesis, Clemson University, South Carolina, USA.

Walter, WD, KC VerCauteren, H Campa III, WR Clark, JW Fischer, SE Hygnstrom, NE Mathews, CK Nielsen, EM Schauber, TR Van Deelen, and SR Winterstein. 2009. Regional assessment on influence of landscape configuration and connectivity on range size of white-tailed deer. Landsc Ecol 24:1405–1420.

Warner, RE. 1985. Demography and movements of free-ranging domestic cats in rural Illinois. J of Wildl Manag 49:340–346.

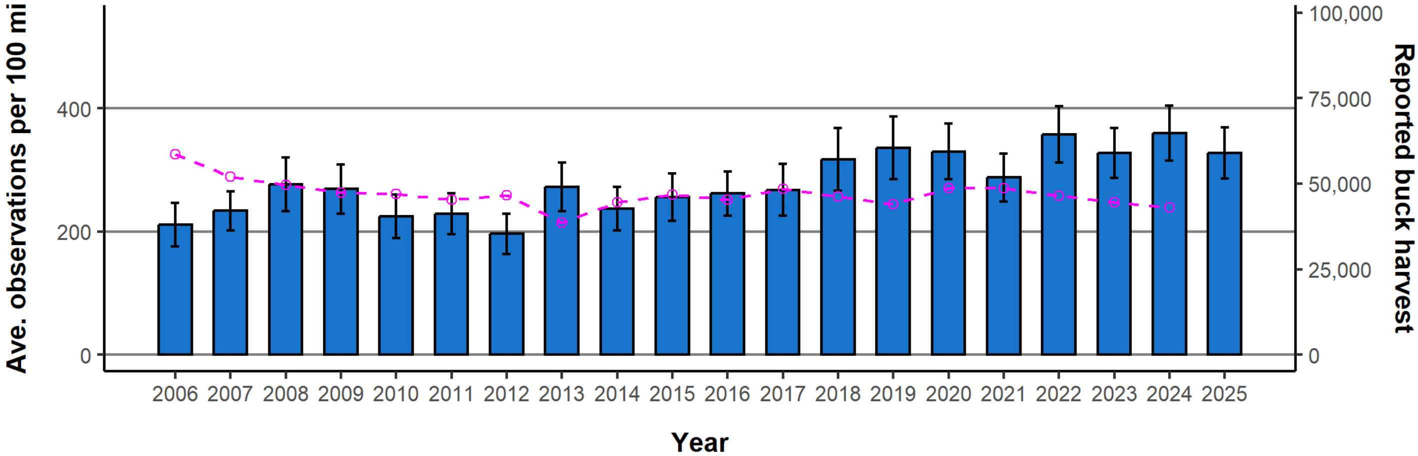


Figure 2. Average white-tailed deer observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Dashed line indicates the reported statewide buck deer harvest.

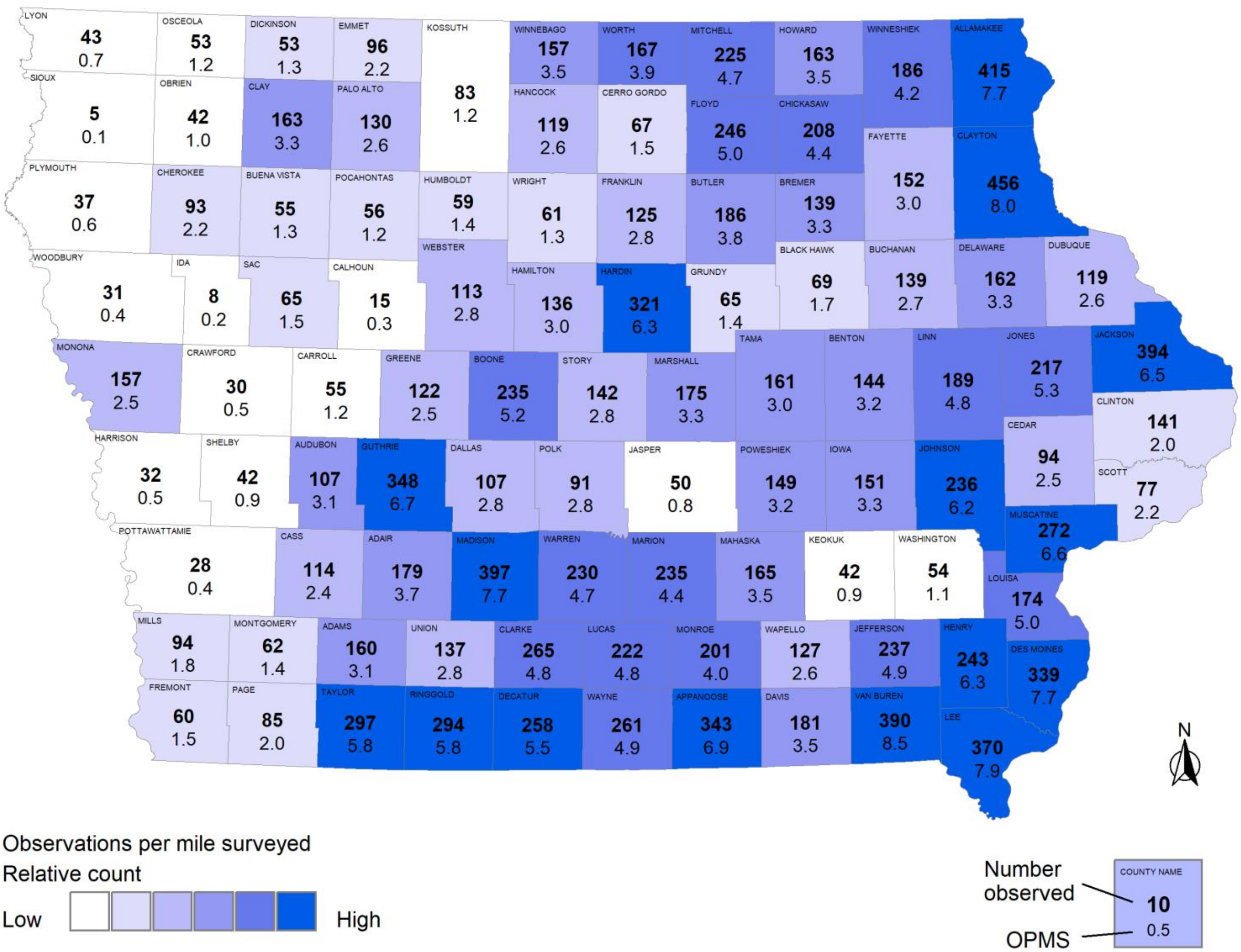


Figure 3. Total number of white-tailed deer observations per county during the Iowa Spring Spotlight Survey, 2025. Color shading indicates the number of animals counted per mile surveyed (OPMS).

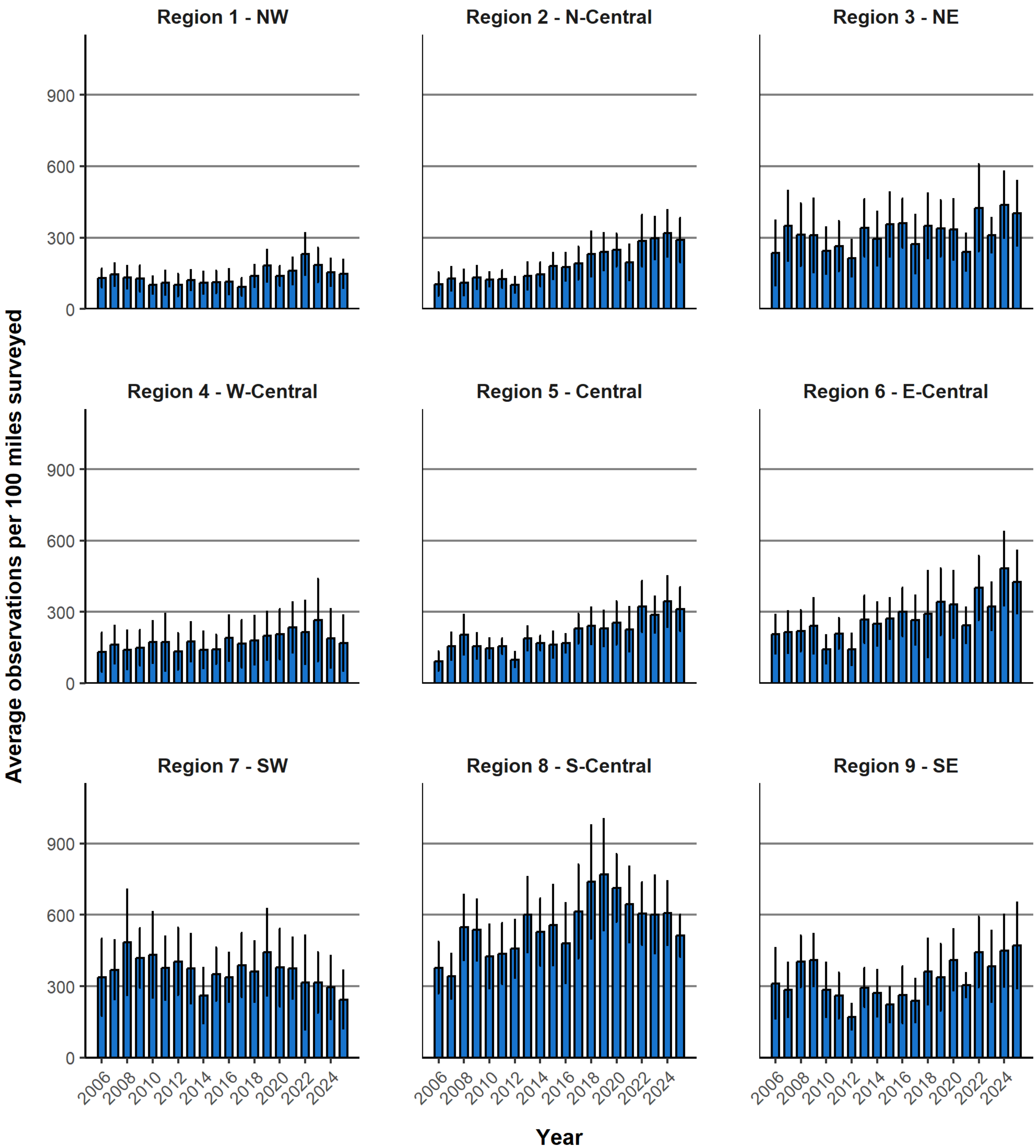


Figure 4. Average white-tailed deer observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals.

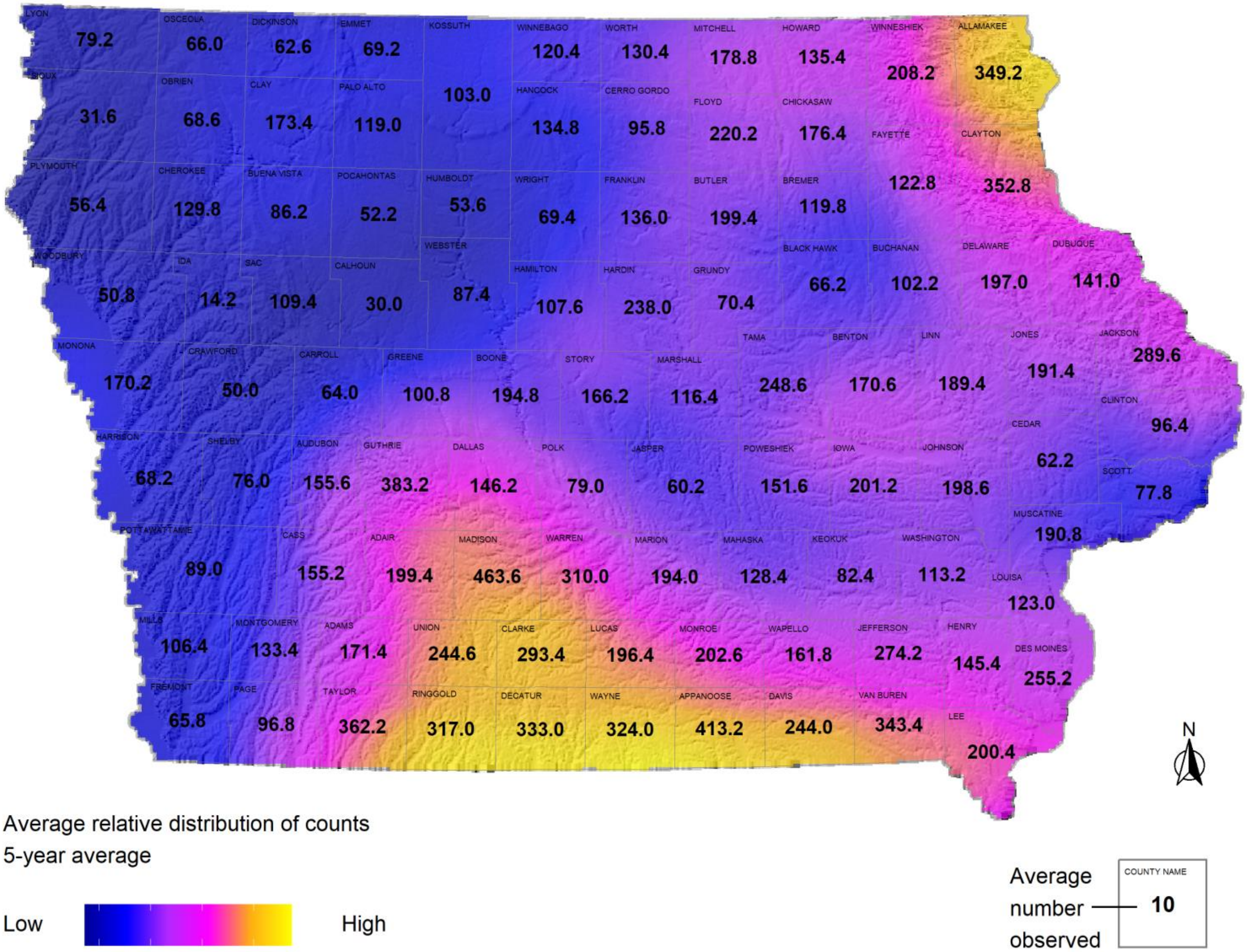


Figure 5. Average relative distribution of spring spotlight observations for white-tailed deer during the past 5 years in Iowa. The number of observations per county is relative to the highest and lowest number of observations across all counties during the survey and may not represent an over- or under-abundance of the species (i.e., high counts are considered high relative to those observed in all other counties).

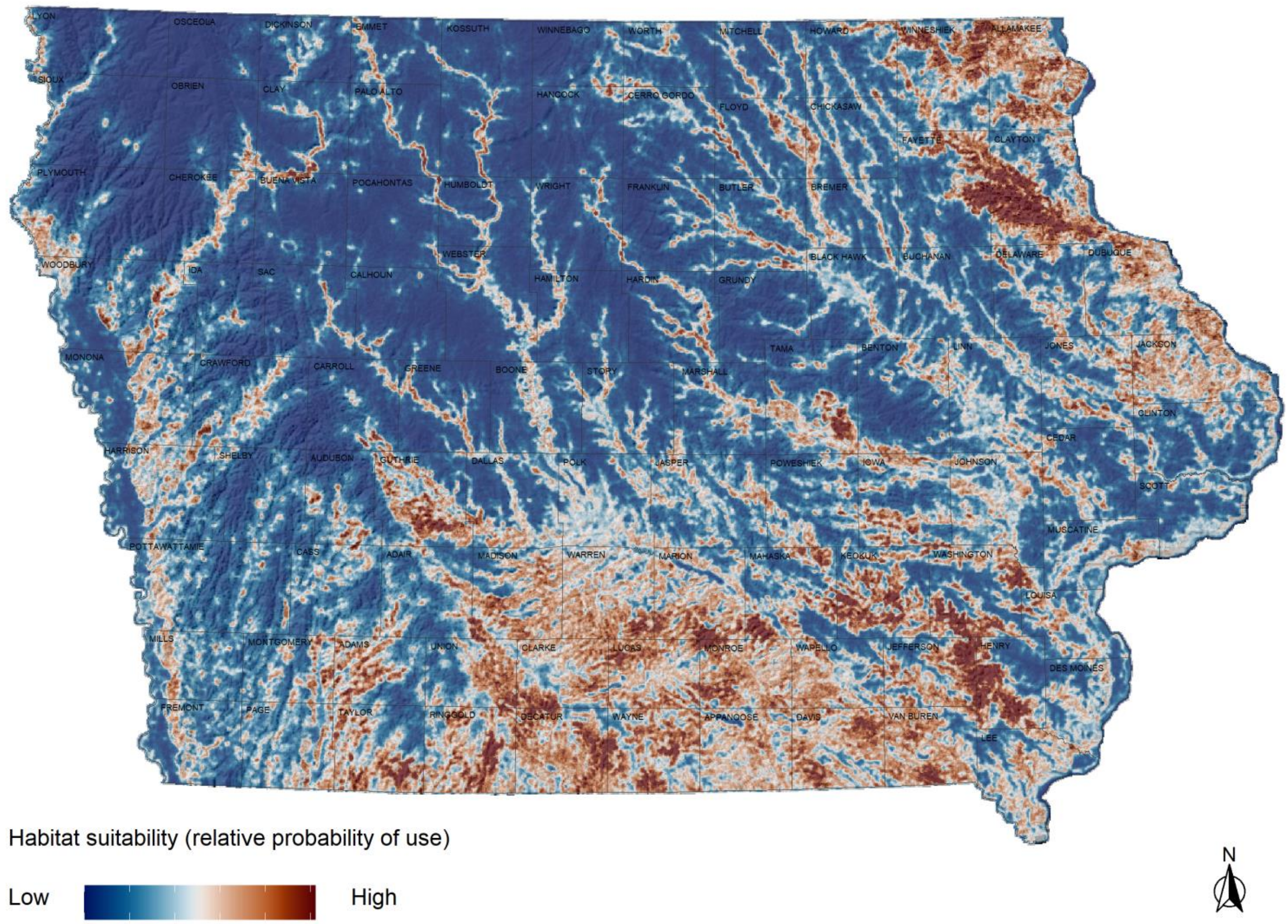


Figure 6. Habitat suitability (i.e., relative probability of use) for white-tailed deer in Iowa based on a resource selection function (RSF; see Kaminski et al. [2019] for details). The RSF model was predicted using spotlight observations for deer from 2012–2016 and the accuracy of the model was tested using 2017 observations (R^2 = 0.95). High values indicate areas of higher relative habitat quality for deer and low values indicate lower habitat quality.

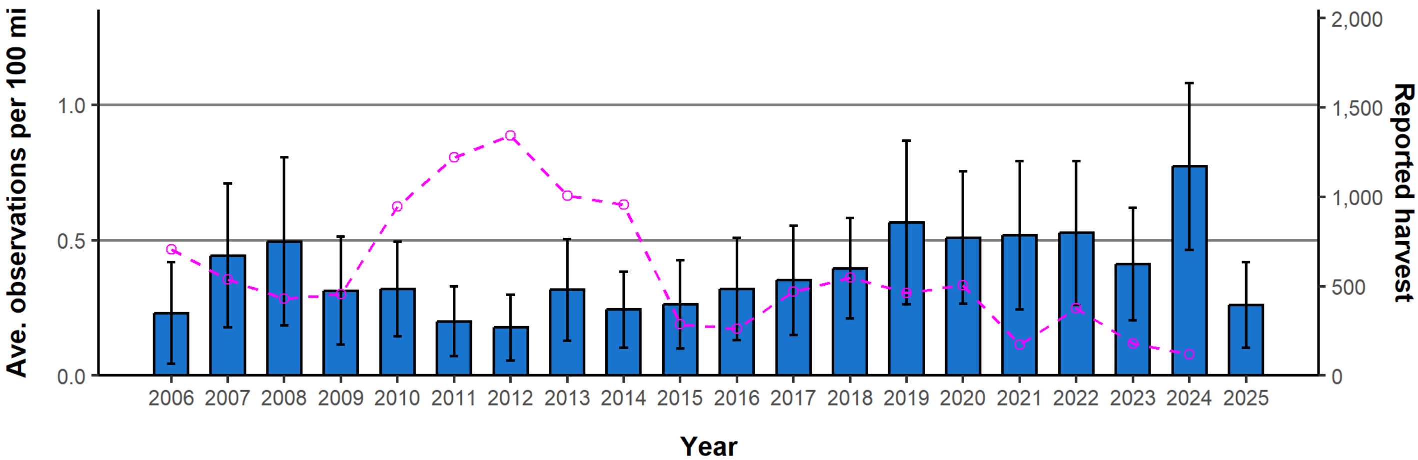


Figure 7. Average badger observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Dashed line indicates the reported furs purchased by licensed fur buyers.

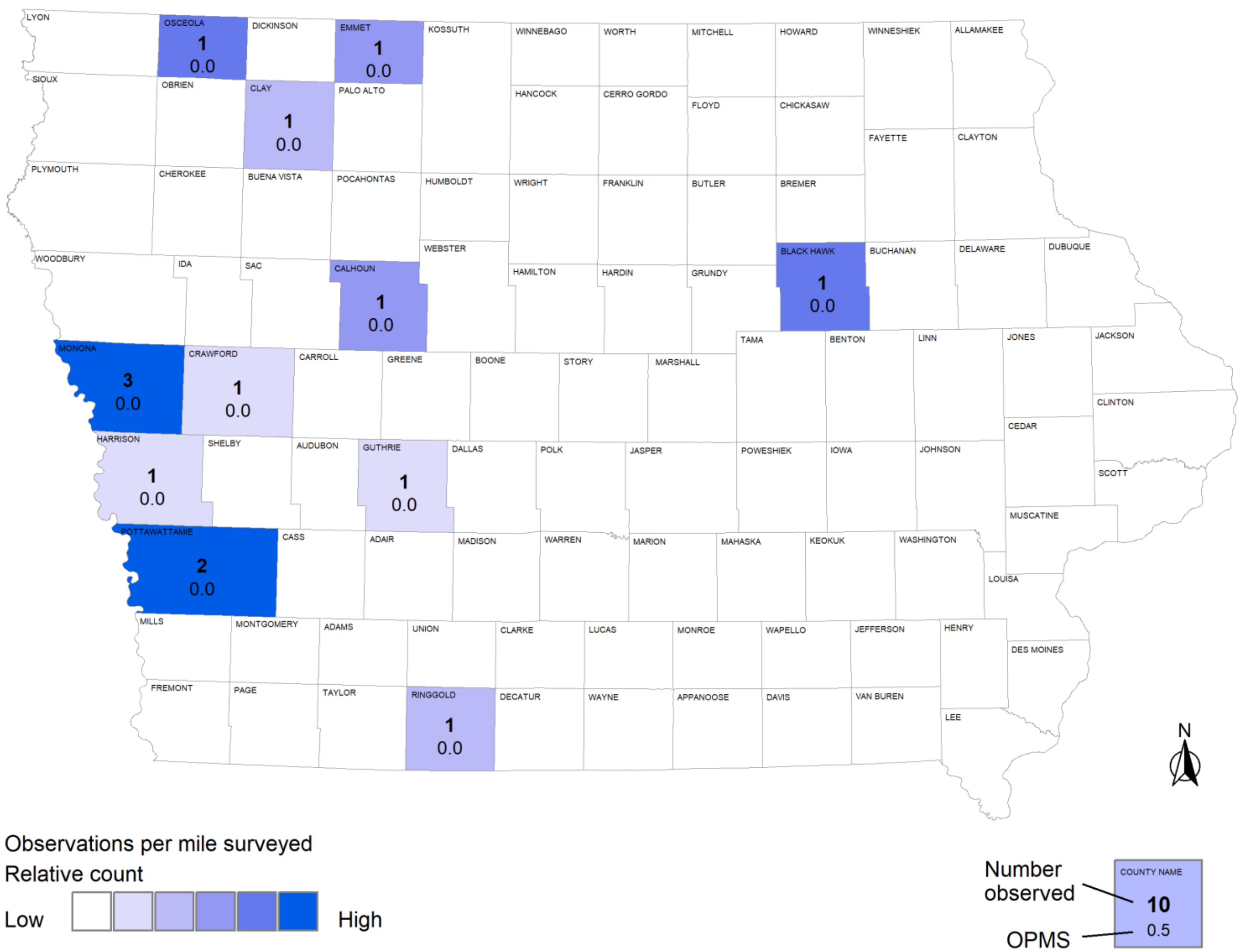


Figure 8. Total number of badger observations per county during the Iowa Spring Spotlight Survey, 2025. Color shading indicates the number of animals counted per mile surveyed (OPMS).

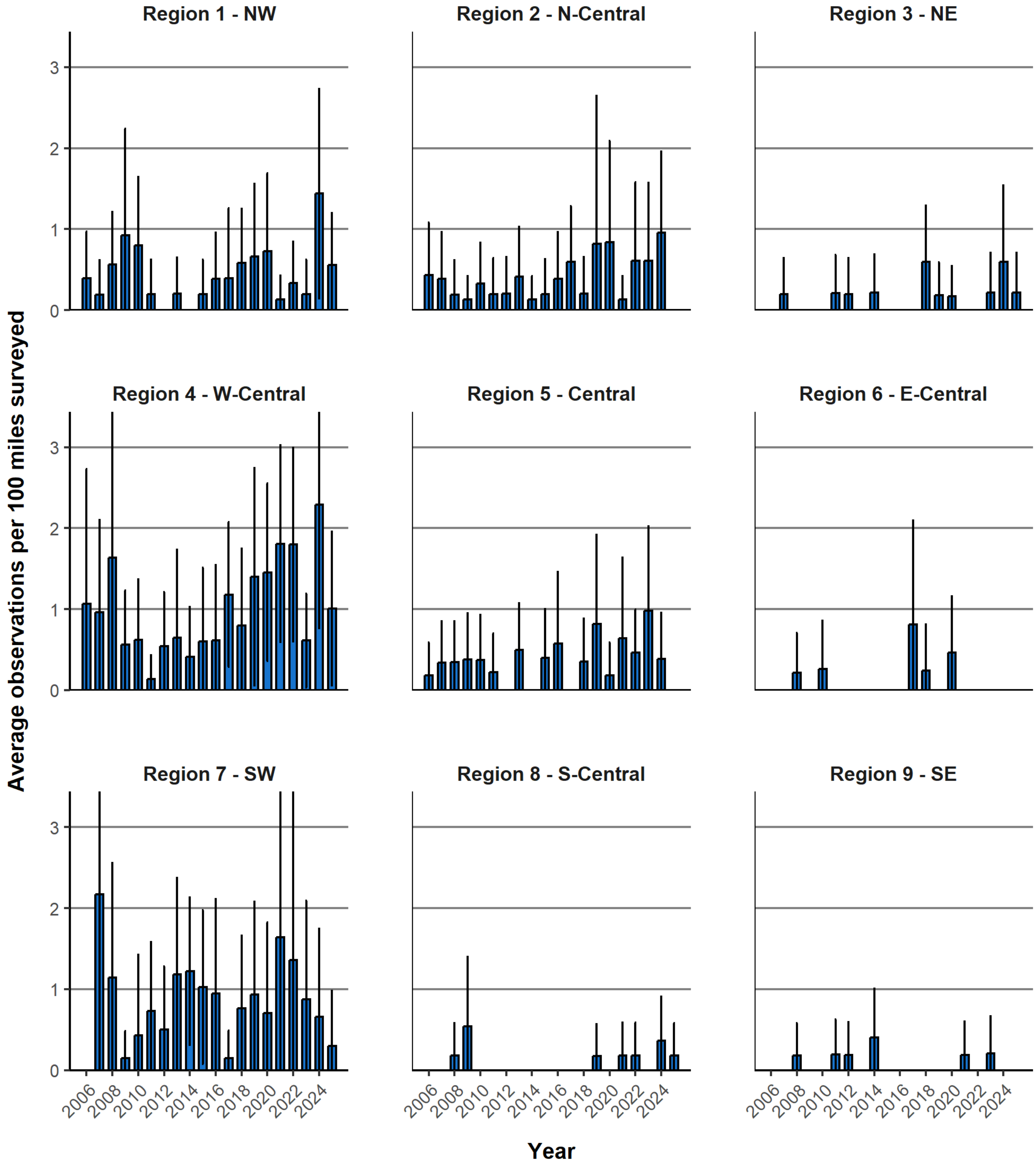


Figure 9. Average badger observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals.

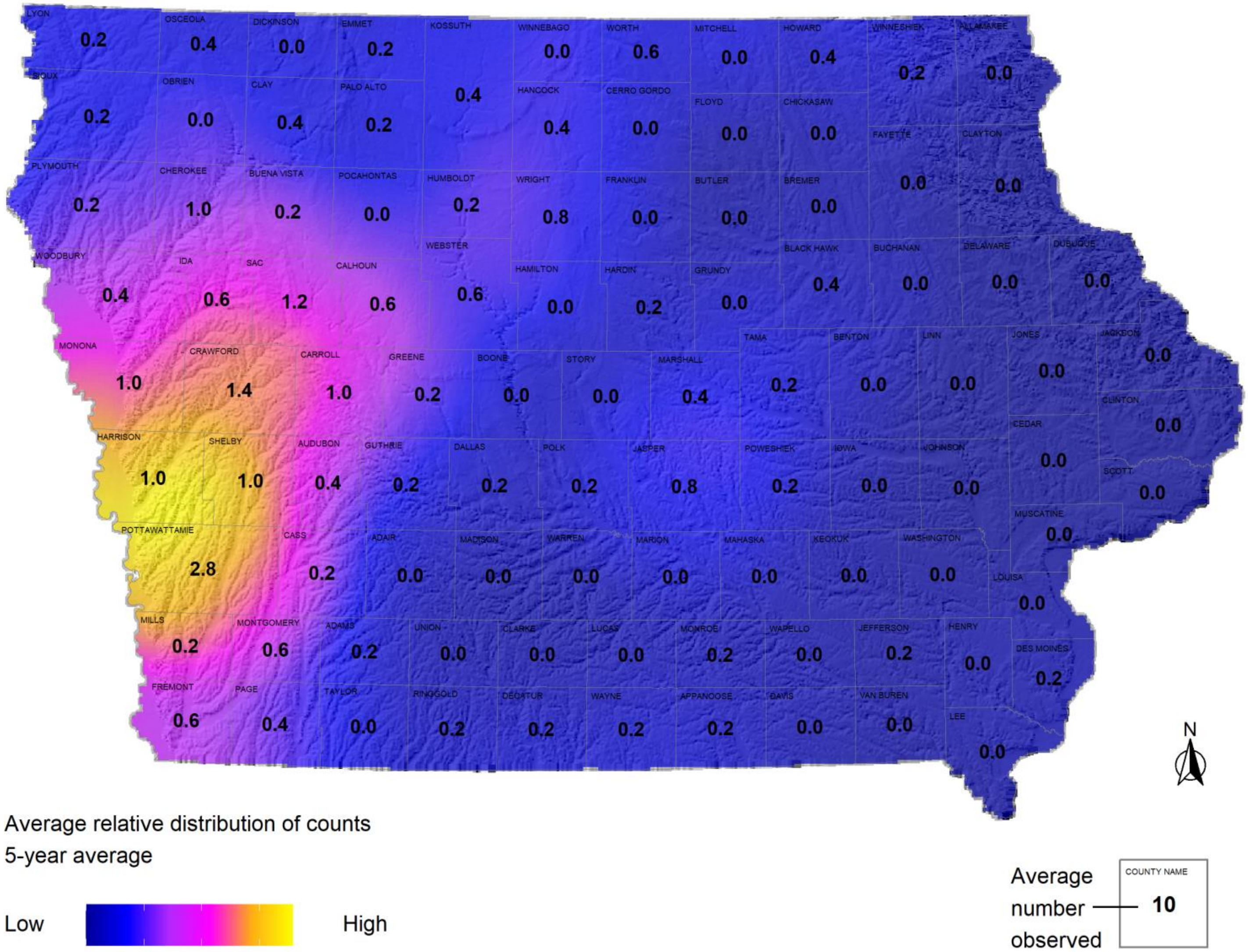


Figure 10. Average relative distribution of spring spotlight observations for badger during the past 5 years in Iowa. The number of observations per county is relative to the highest and lowest number of observations across all counties during the survey and may not represent an over- or under-abundance of the species (i.e., high counts are considered high relative to those observed in all other counties).

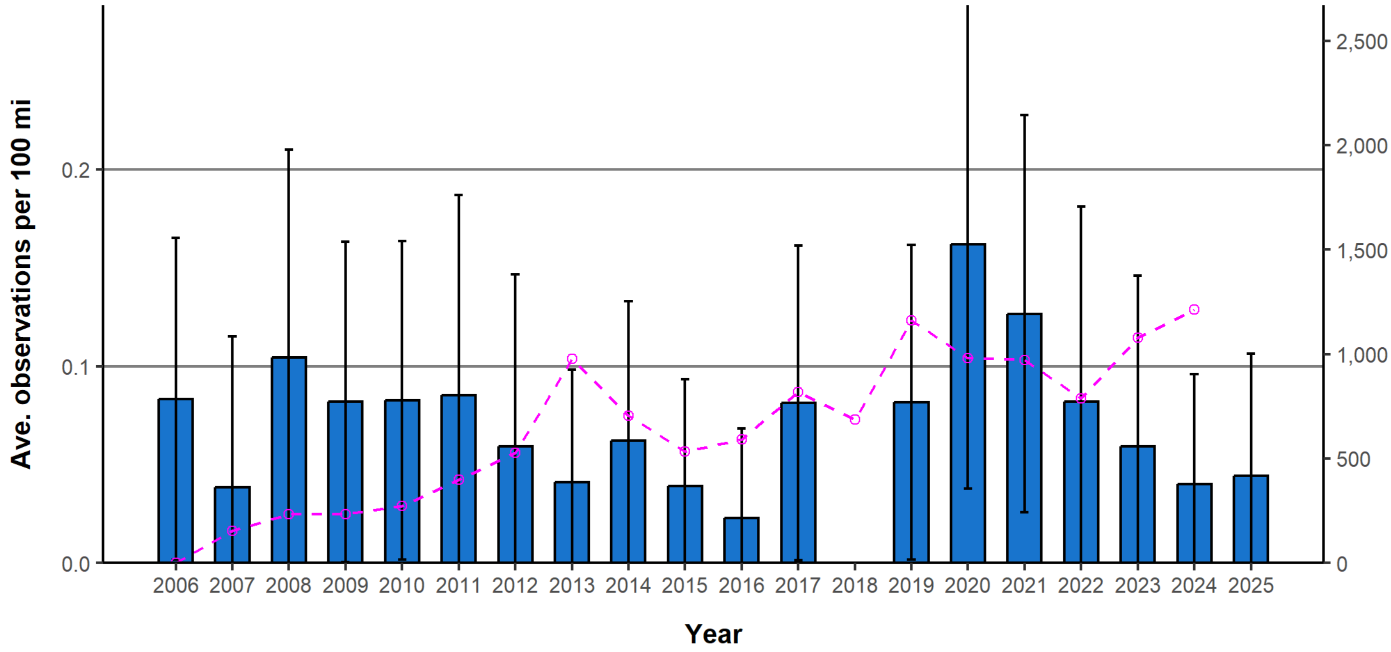


Figure 11. Average bobcat observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Dashed line indicates the reported furs purchased by licensed fur buyers.

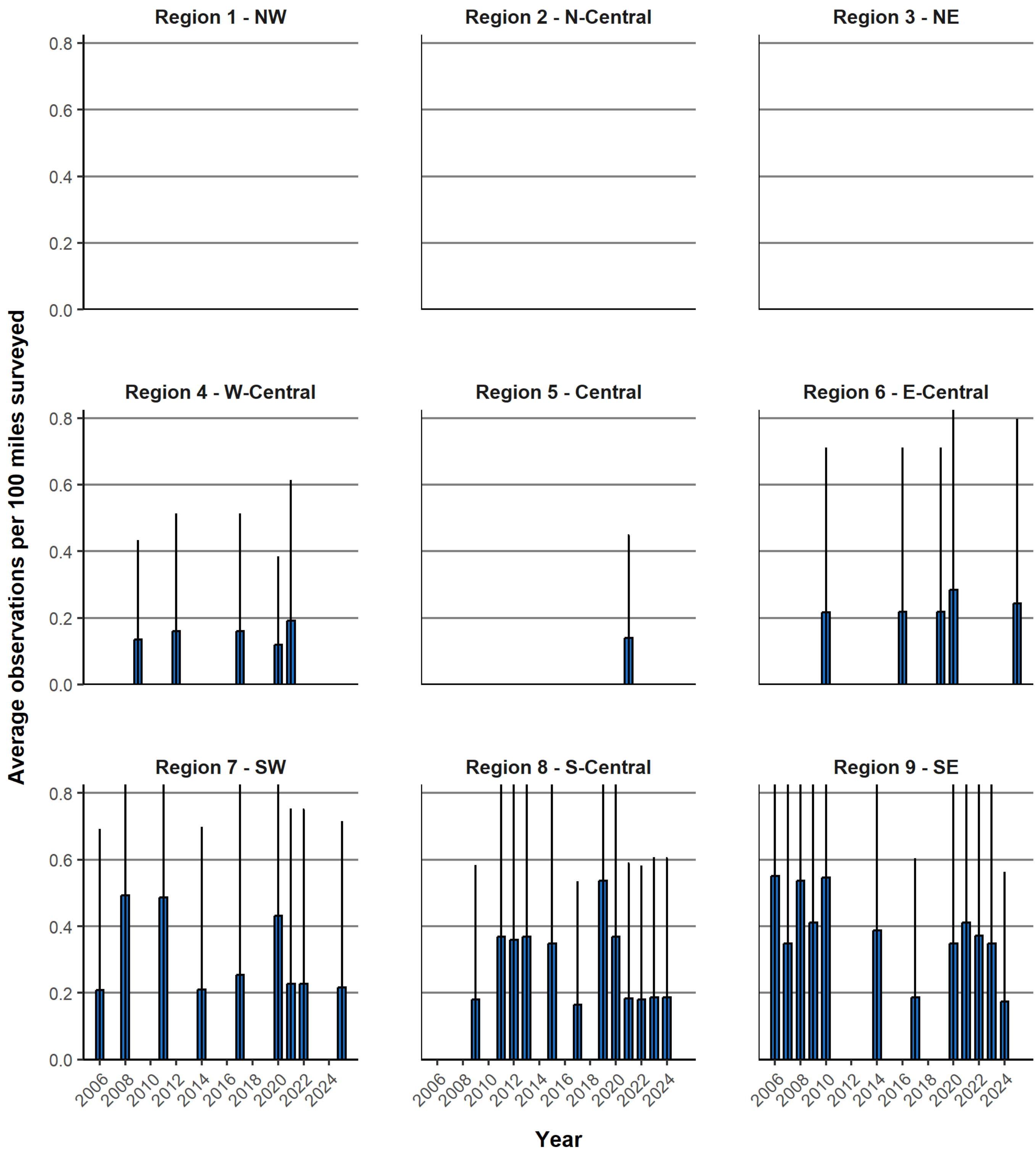


Figure 12. Average bobcat observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals.

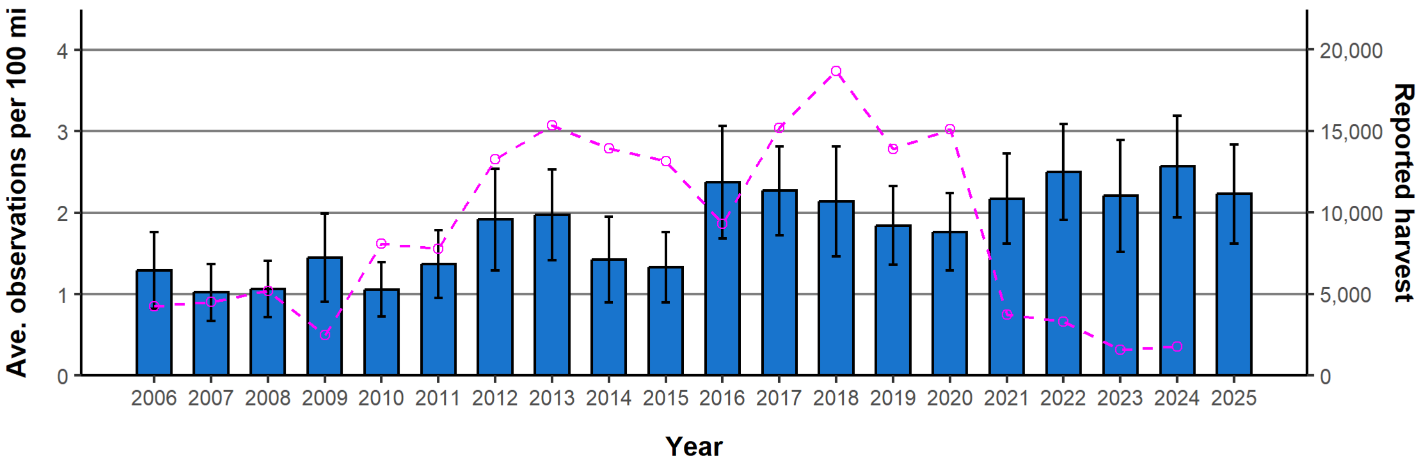


Figure 13. Average coyote observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Dashed line indicates the reported furs purchased by licensed fur buyers.

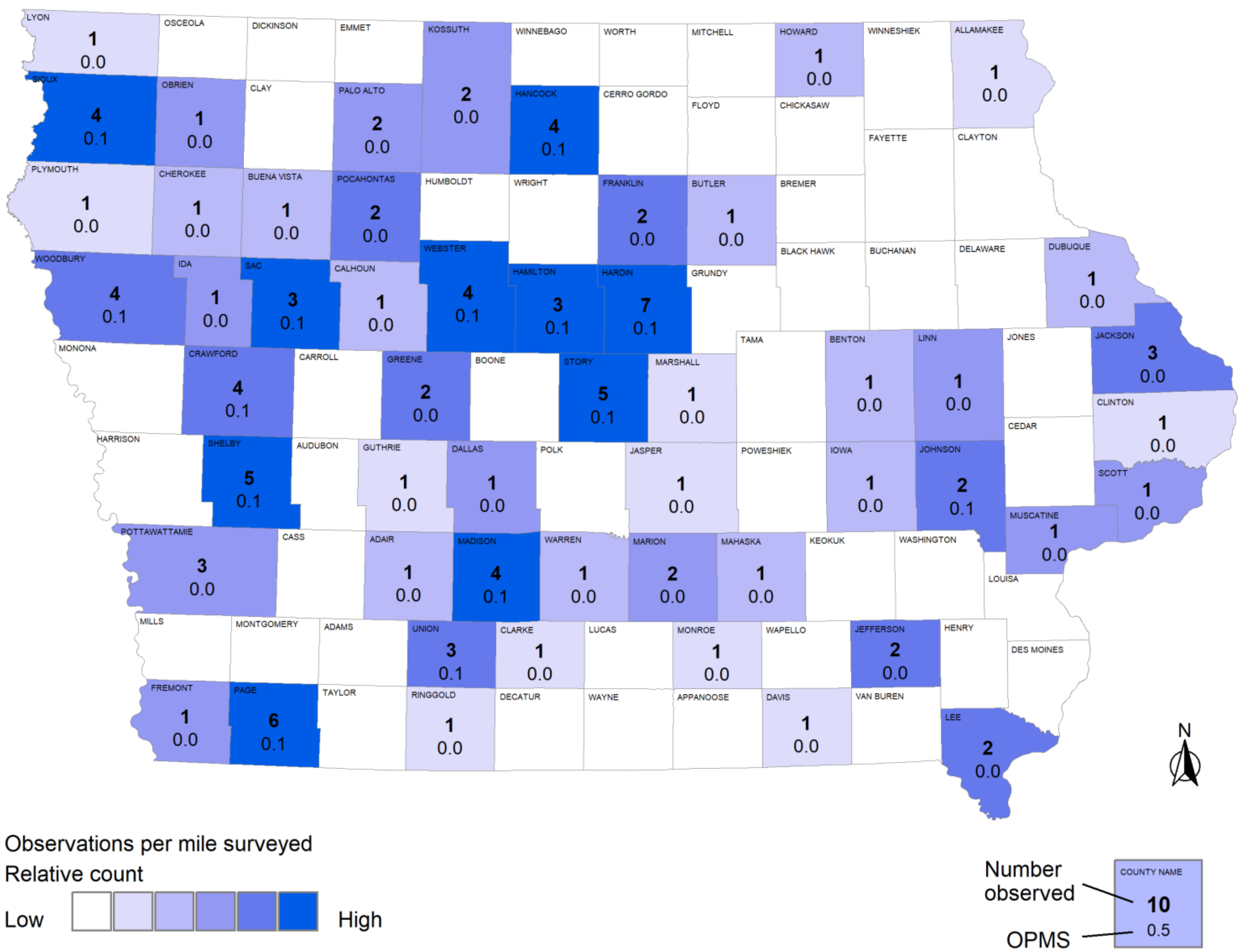


Figure 14. Total number of coyote observations per county during the Iowa Spring Spotlight Survey, 2025. Color shading indicates the number of animals counted per mile surveyed (OPMS).

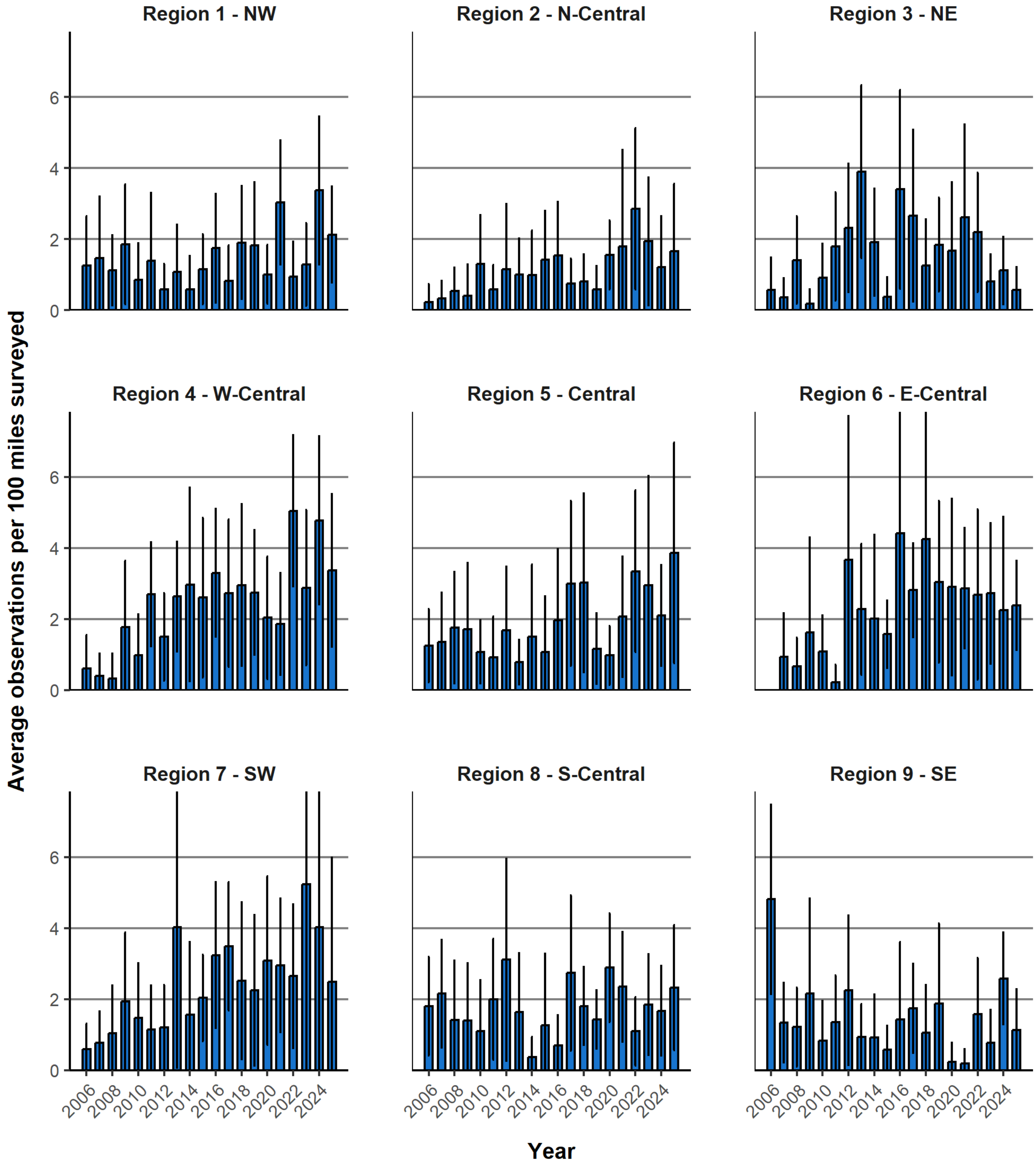


Figure 15. Average coyote observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals.

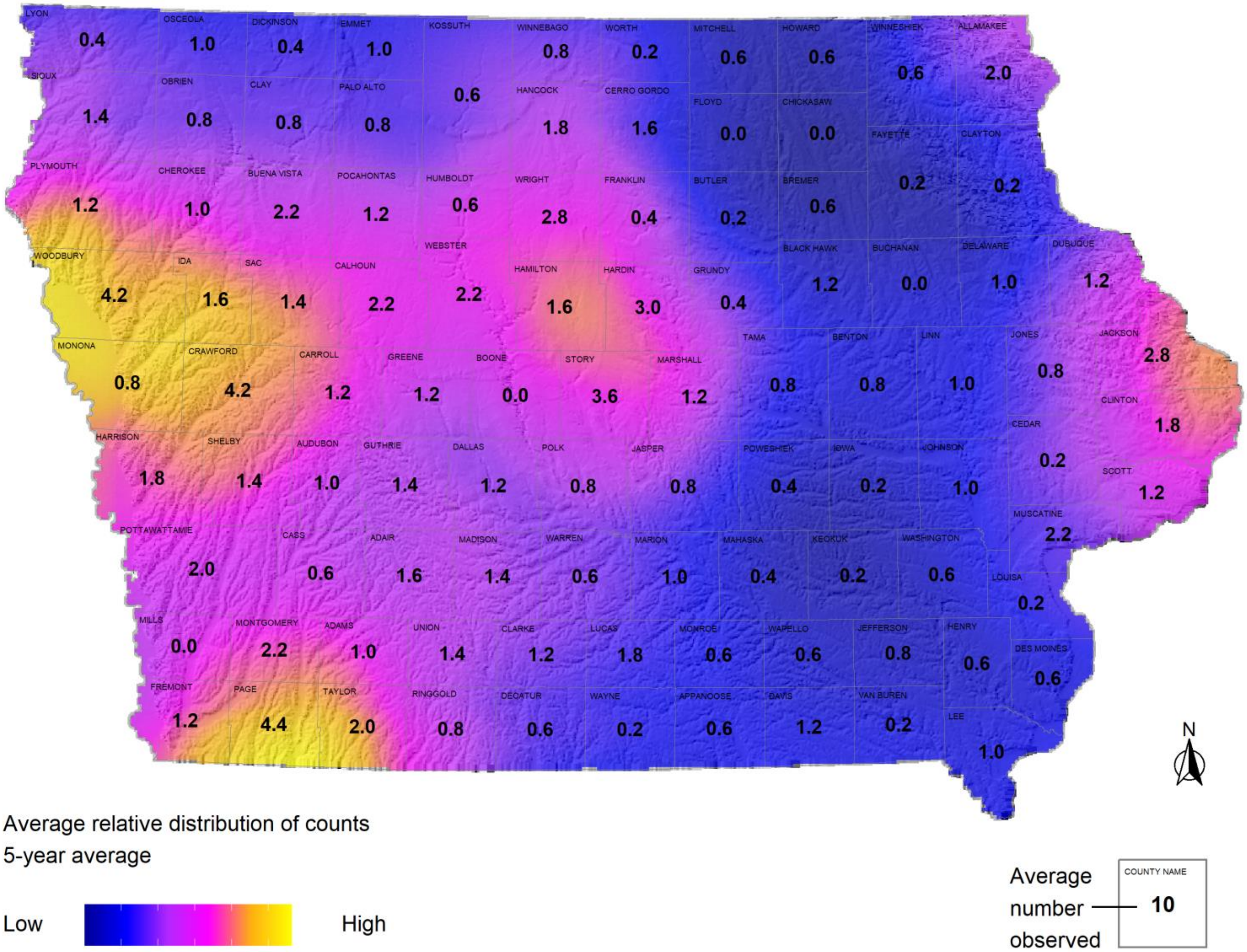


Figure 16. Average relative distribution of spring spotlight observations for coyote during the past 5 years in Iowa. The number of observations per county is relative to the highest and lowest number of observations across all counties during the survey and may not represent an over- or under-abundance of the species (i.e., high counts are considered high relative to those observed in all other counties).

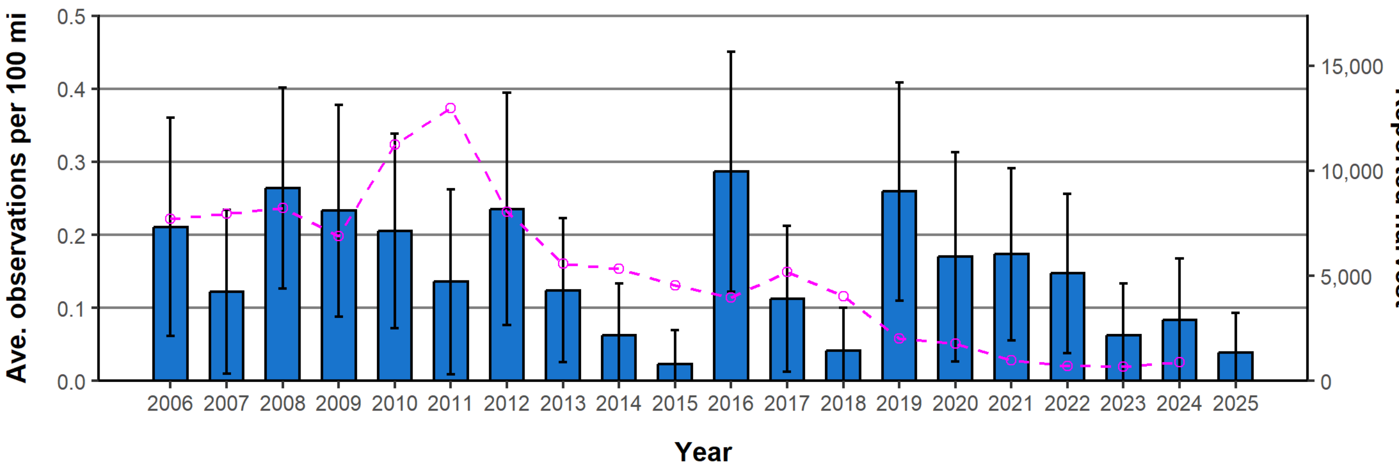


Figure 17. Average mink observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Dashed line indicates the reported furs purchased by licensed fur buyers.

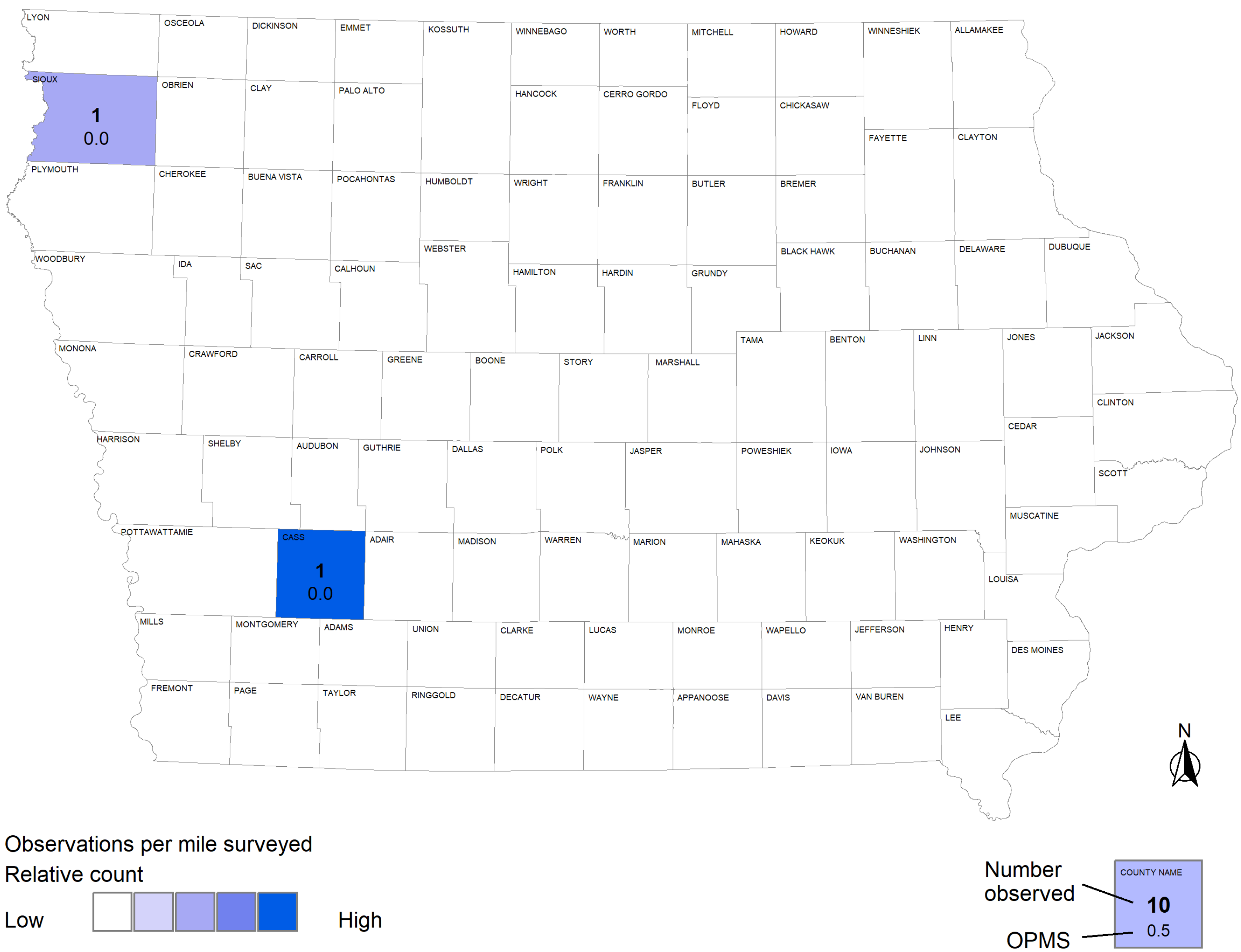


Figure 18. Total number of mink observations per county during the Iowa Spring Spotlight Survey, 2025. Color shading indicates the number of animals counted per mile surveyed (OPMS).

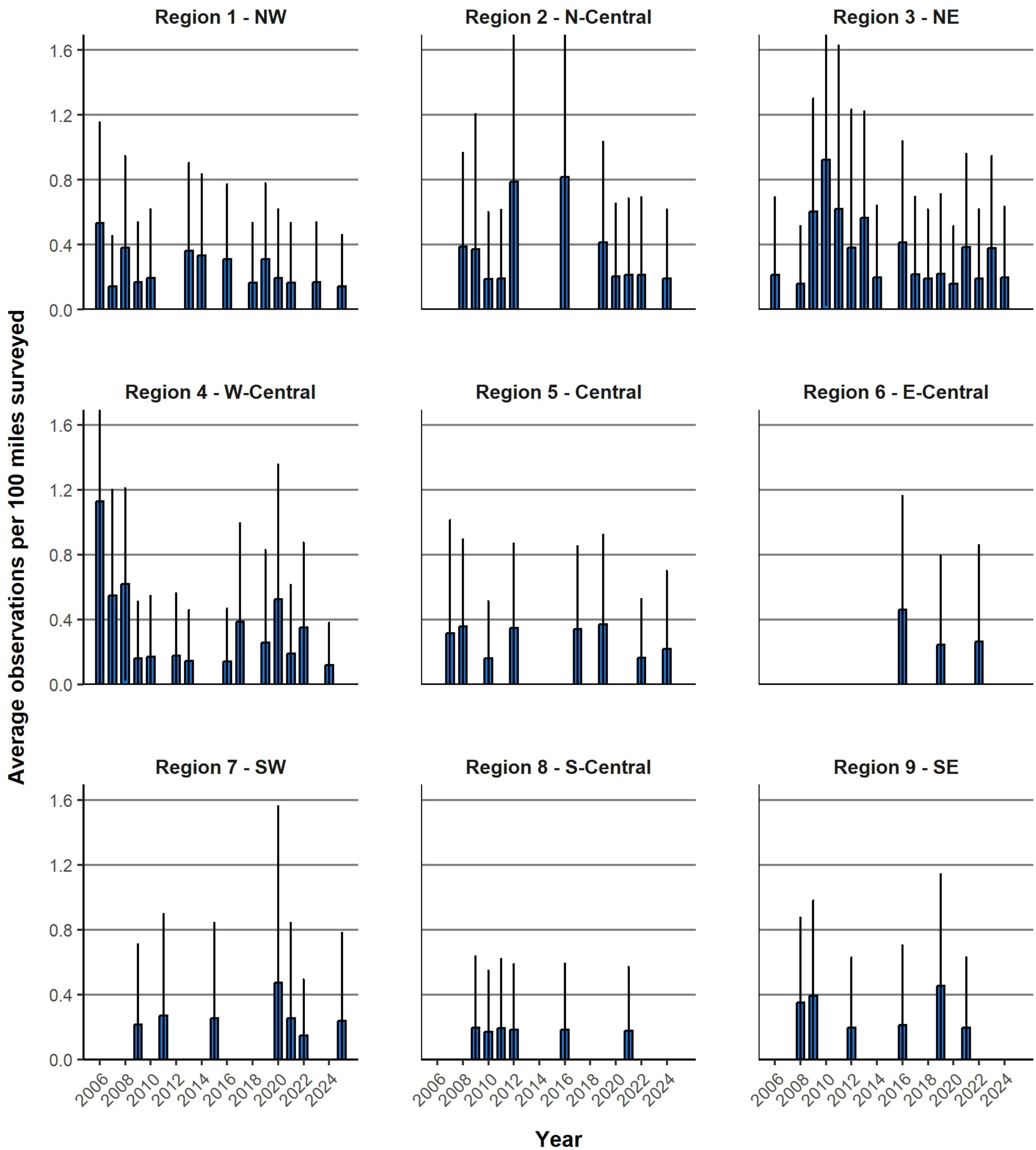


Figure 19. Average mink observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals.

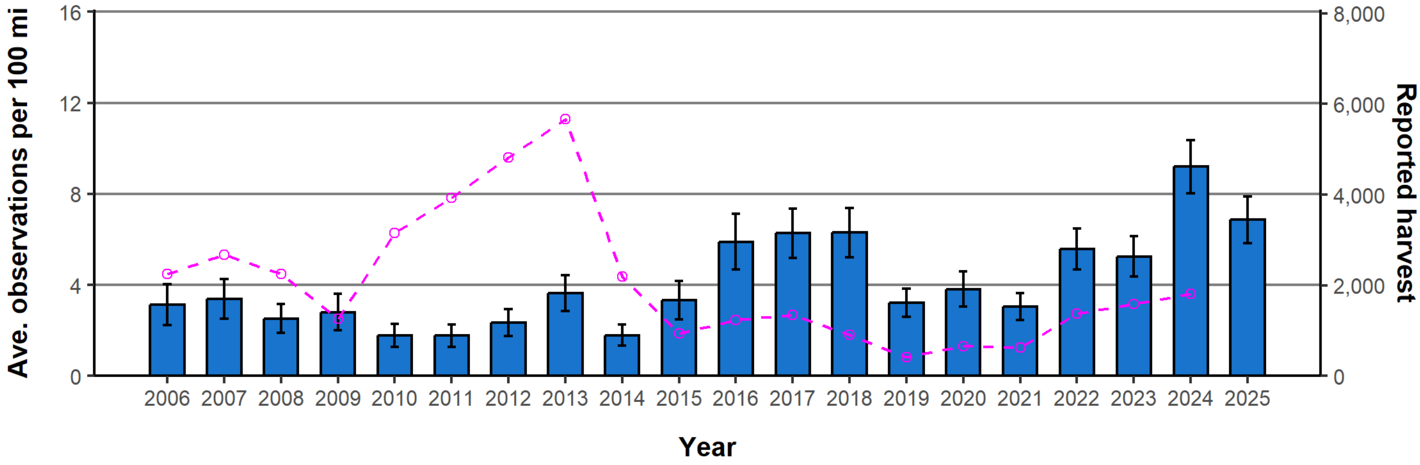


Figure 20. Average opossum observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Dashed line indicates the reported furs purchased by licensed fur buyers.

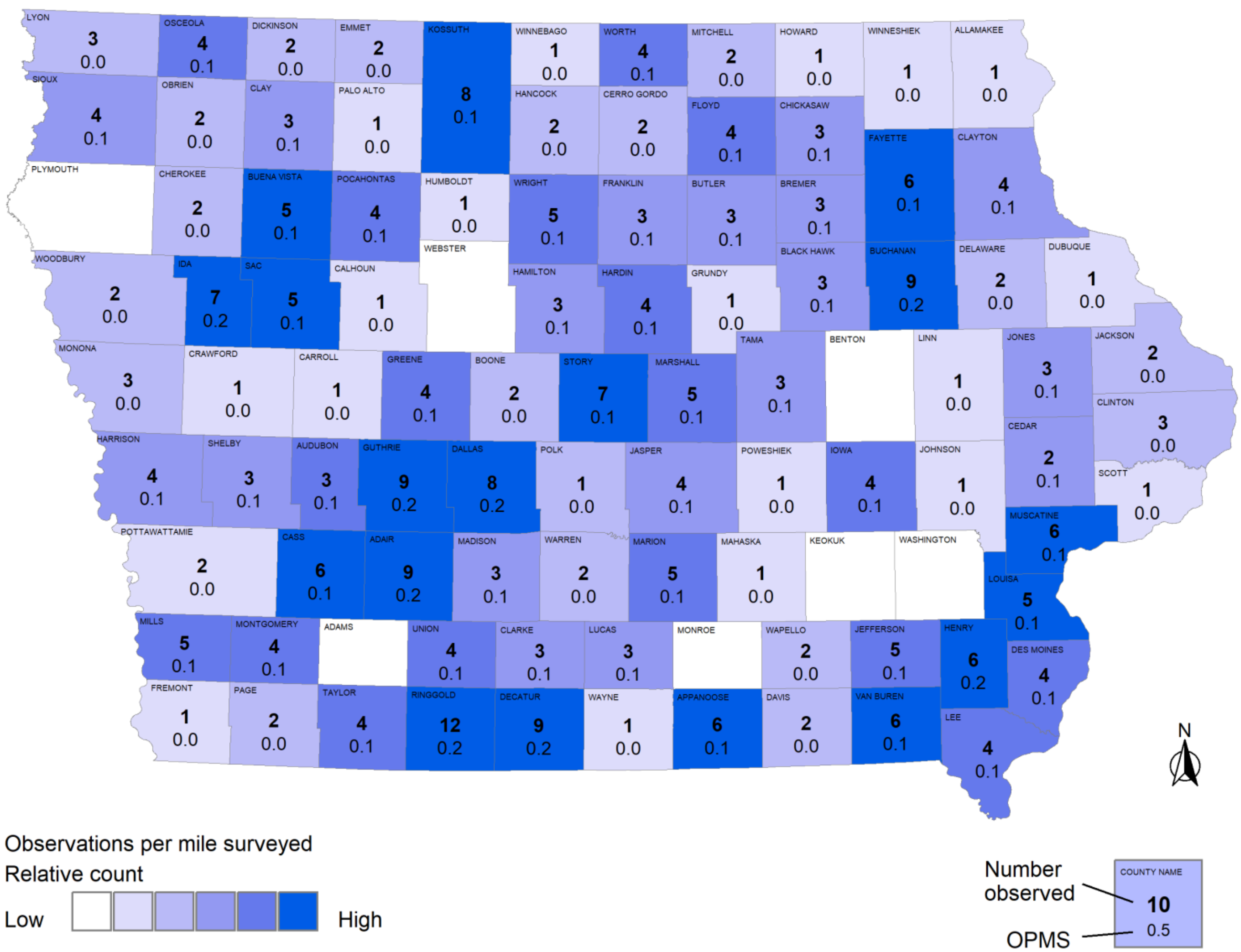


Figure 21. Total number of opossum observations per county during the Iowa Spring Spotlight Survey, 2025. Color shading indicates the number of animals counted per mile surveyed (OPMS).

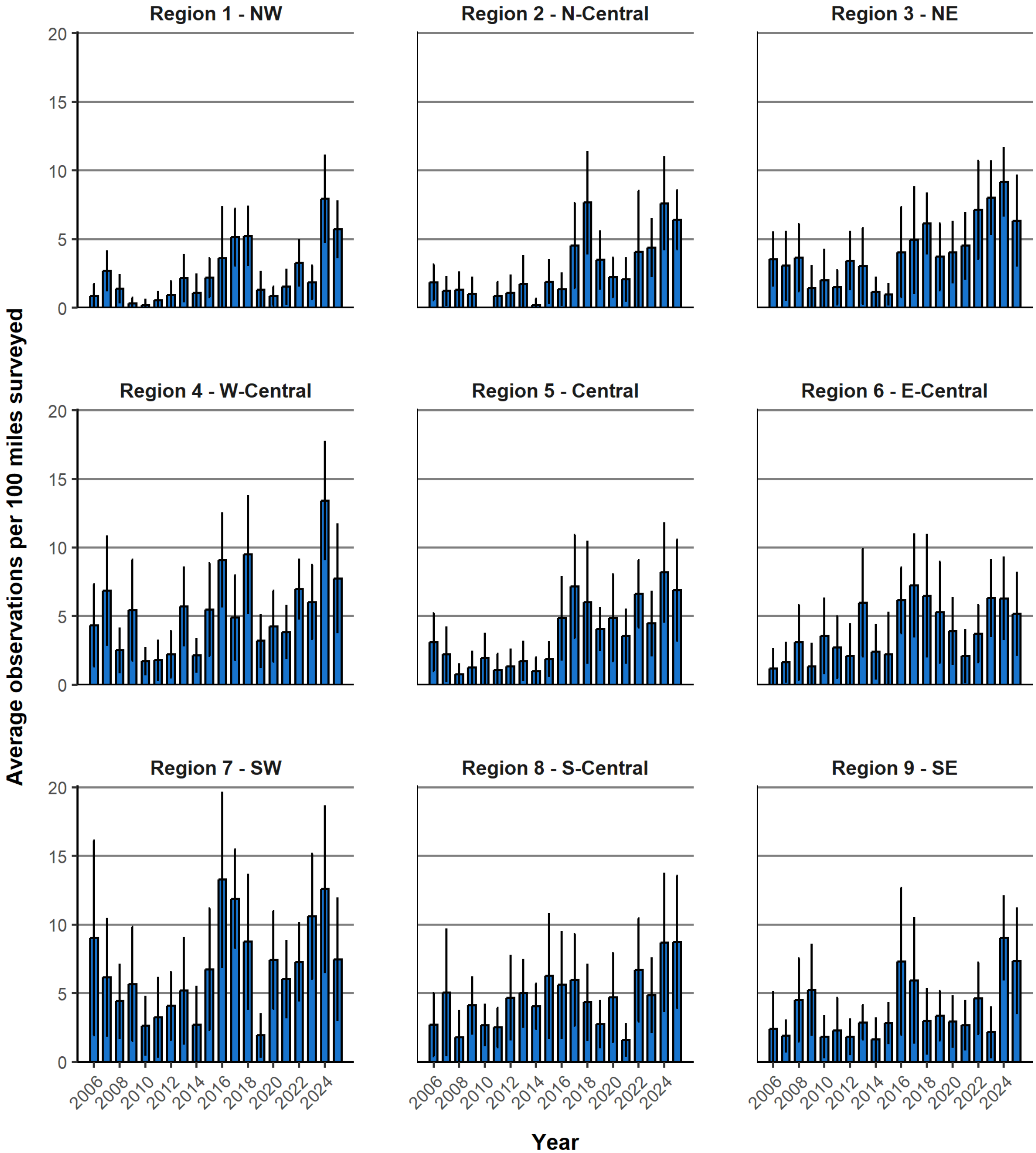


Figure 22. Average opossum observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals.

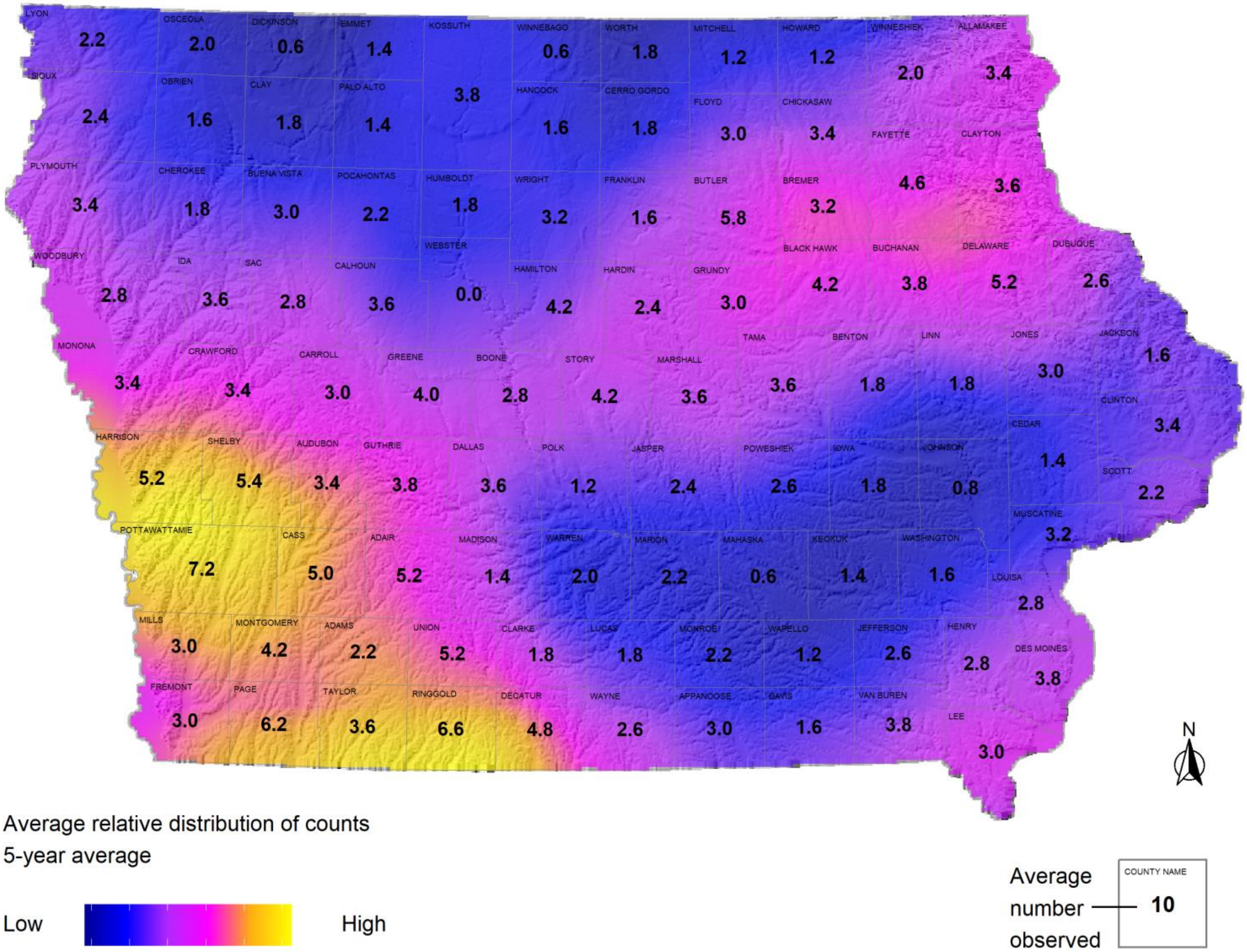


Figure 23. Average relative distribution of spring spotlight observations for opossum during the past 5 years in Iowa. The number of observations per county is relative to the highest and lowest number of observations across all counties during the survey and may not represent an over- or under-abundance of the species (i.e., high counts are considered high relative to those observed in all other counties).

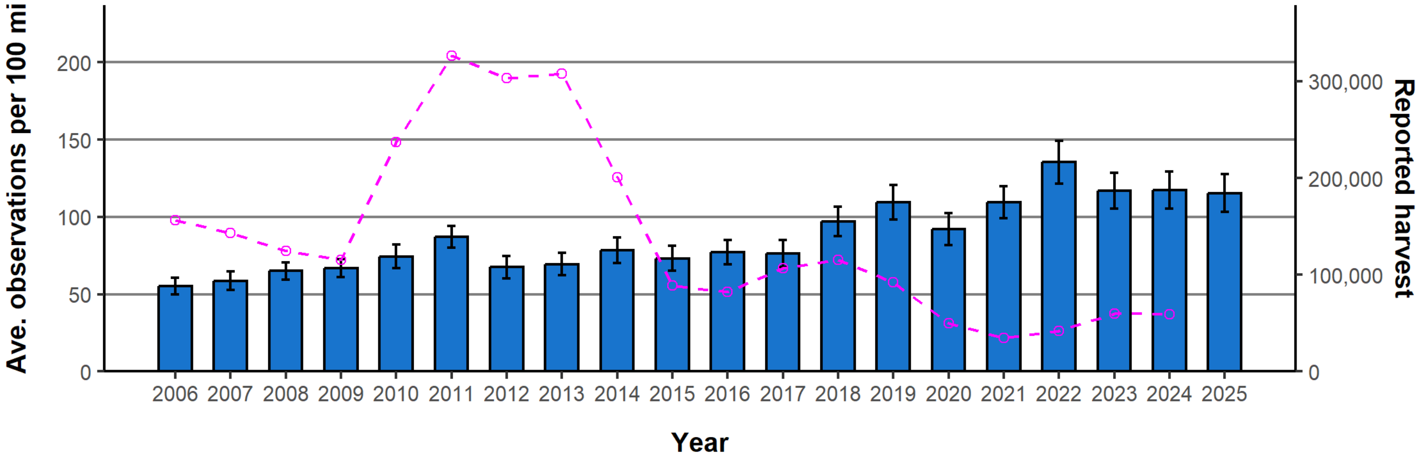


Figure 24. Average raccoon observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Dashed line indicates the reported furs purchased by licensed fur buyers.

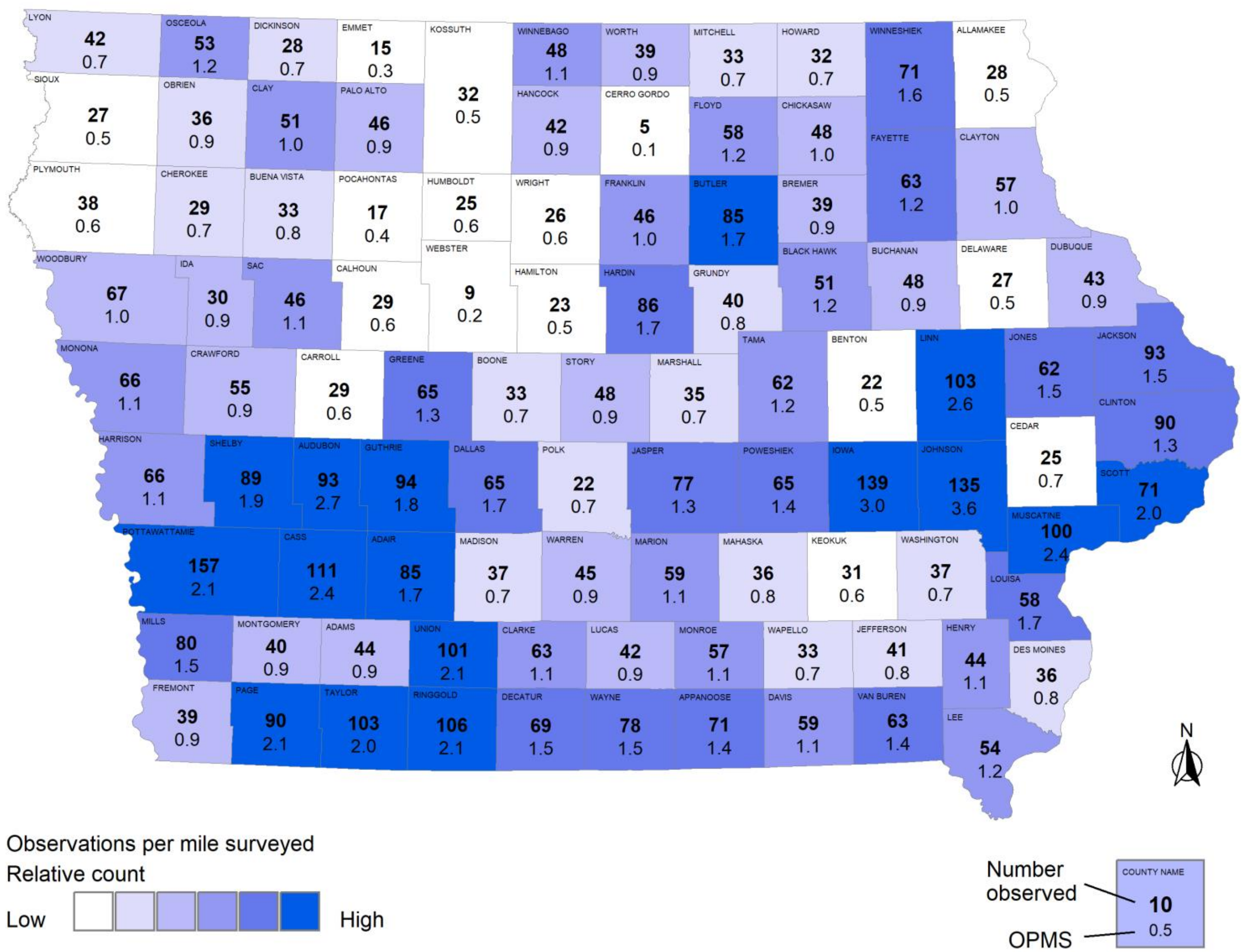


Figure 25. Total number of raccoon observations per county during the Iowa Spring Spotlight Survey, 2025. Color shading indicates the number of animals counted per mile surveyed (OPMS).

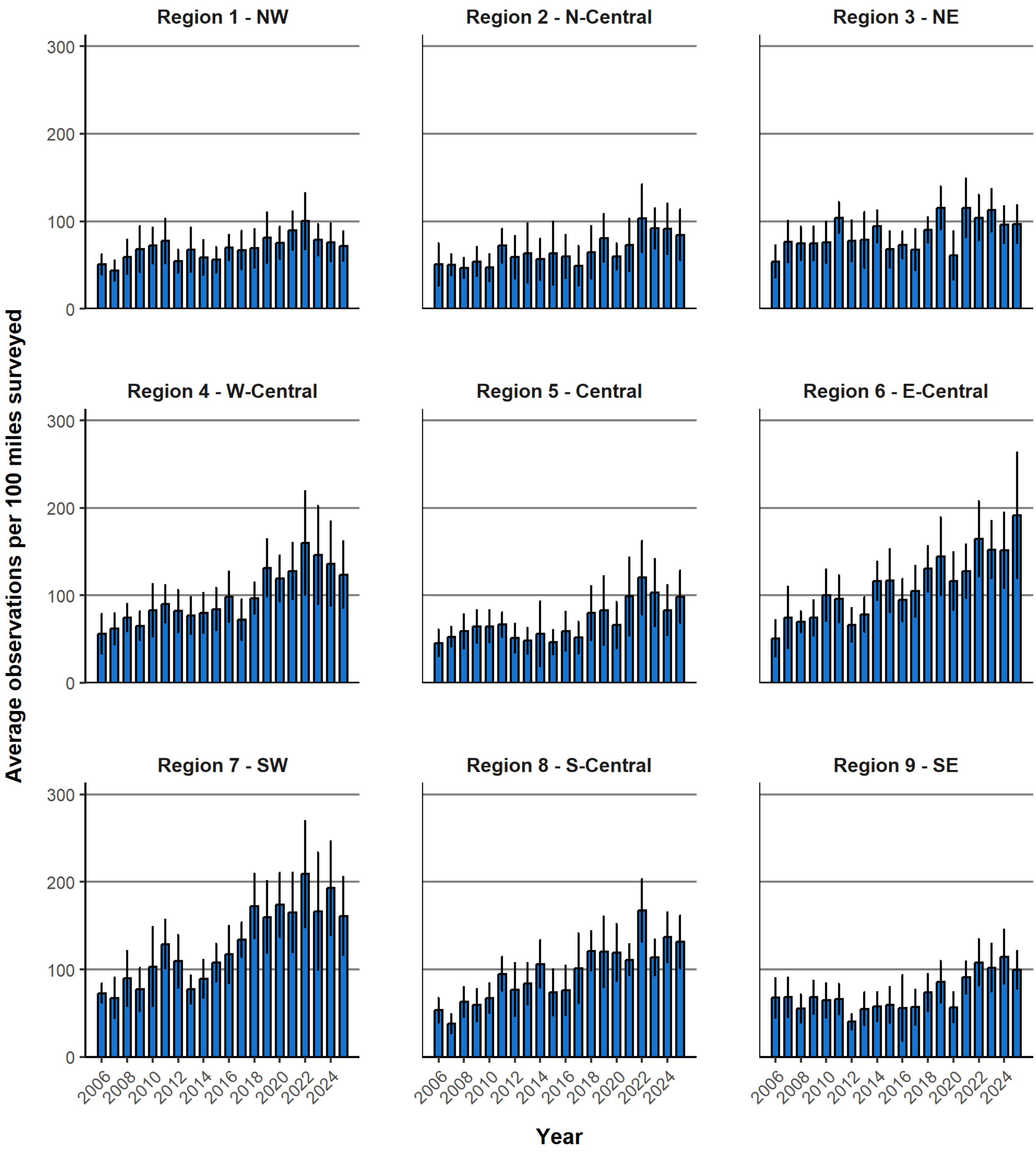


Figure 26. Average raccoon observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals.

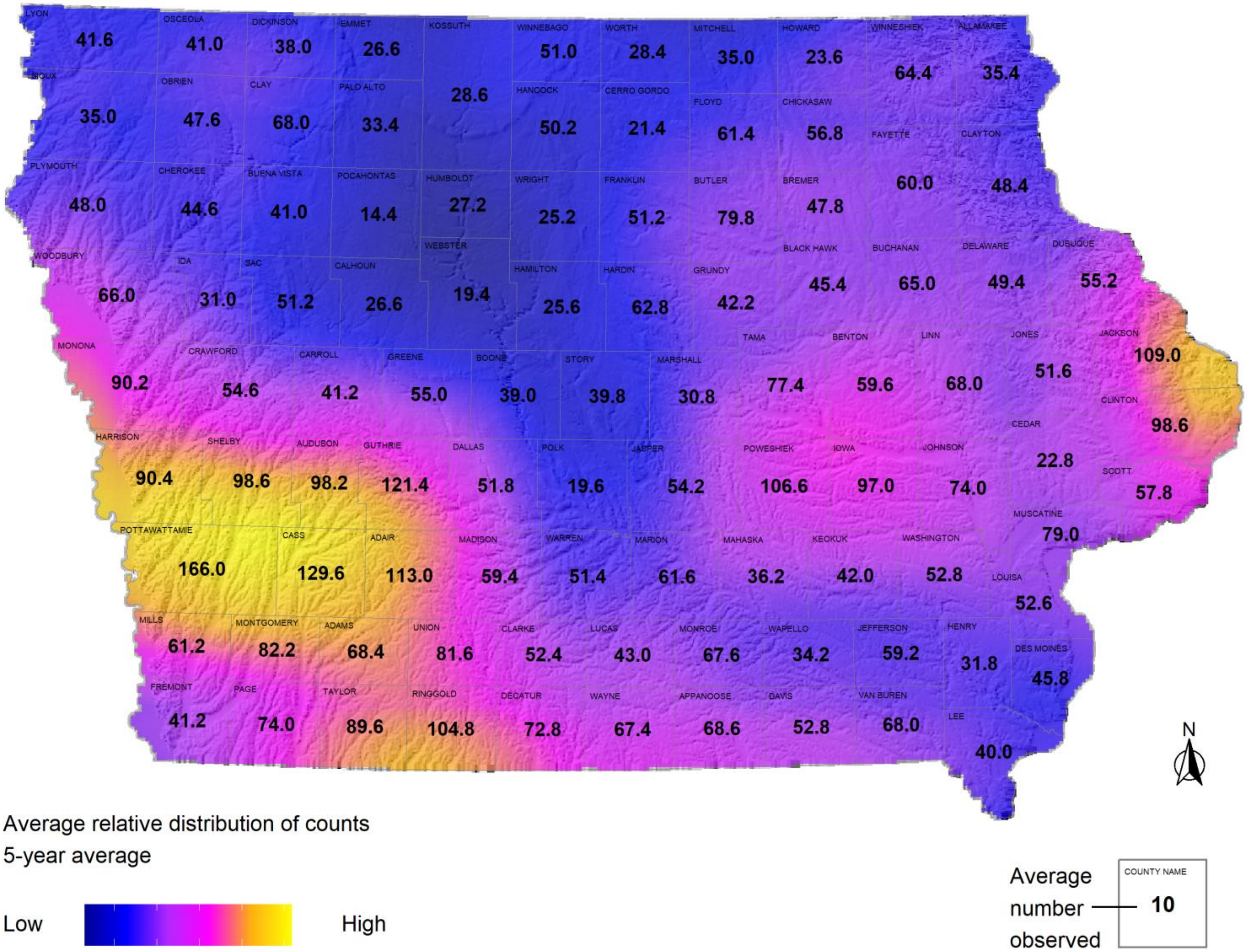


Figure 27. Average relative distribution of spring spotlight observations for raccoon during the past 5 years in Iowa. The number of observations per county is relative to the highest and lowest number of observations across all counties during the survey and may not represent an over- or under-abundance of the species (i.e., high counts are considered high relative to those observed in all other counties).

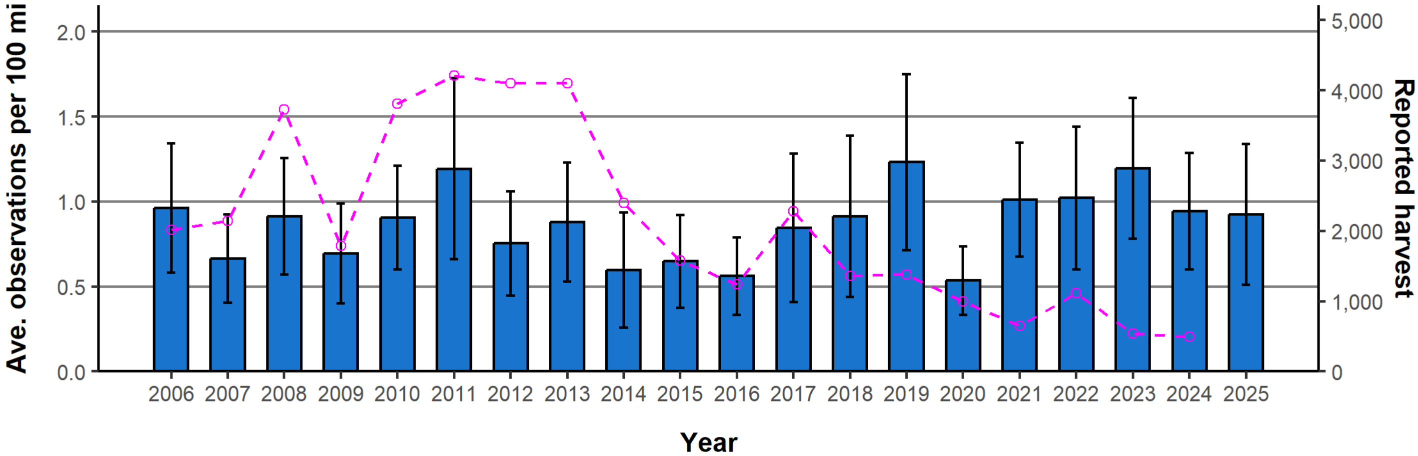


Figure 28. Average red fox observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Dashed line indicates the reported furs purchased by licensed fur buyers.

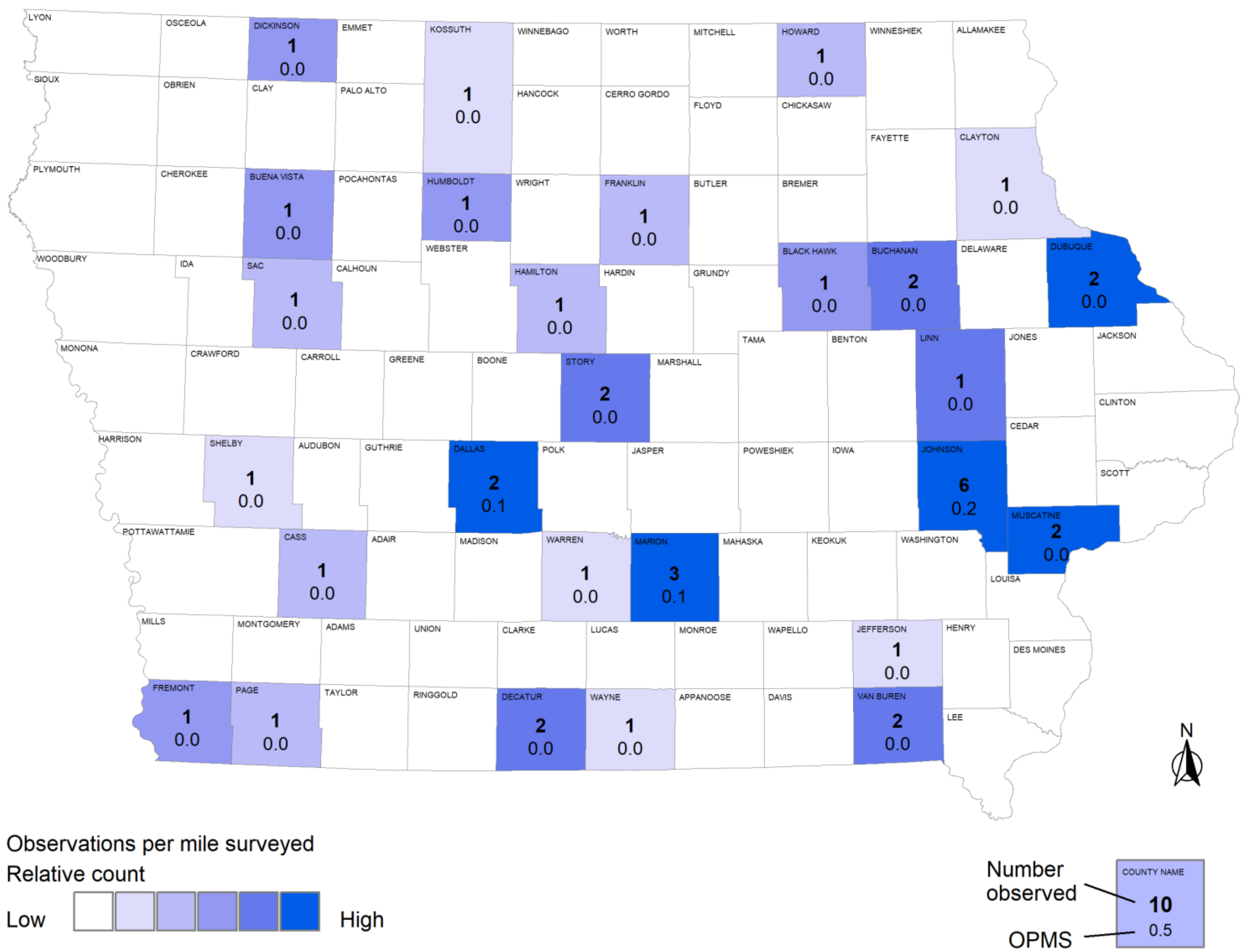


Figure 29. Total number of red fox observations per county during the Iowa Spring Spotlight Survey, 2025. Color shading indicates the number of animals counted per mile surveyed (OPMS).

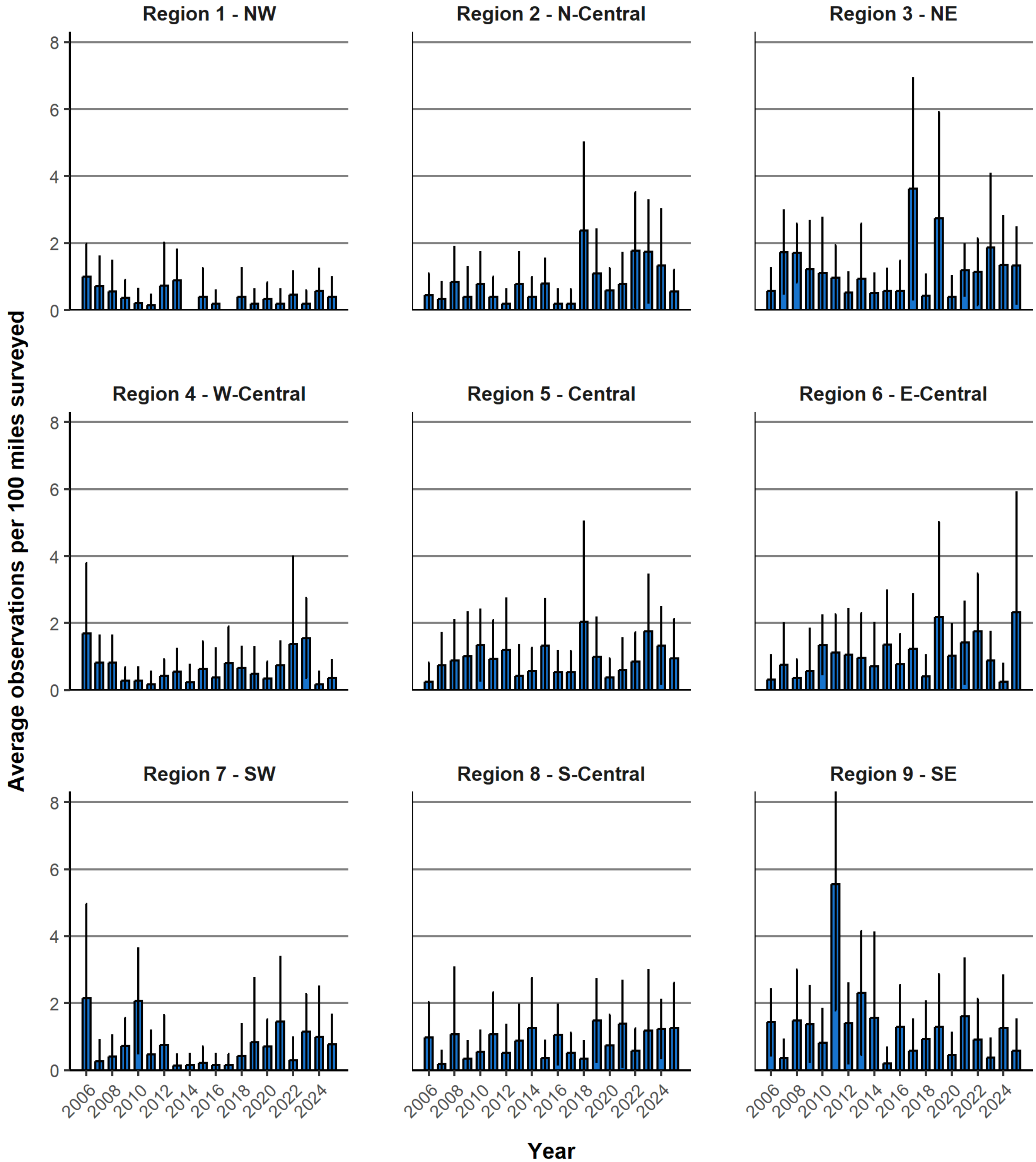


Figure 30. Average red fox observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals. Red fox includes observations listed as "fox" due to the rarity of gray fox in the state.

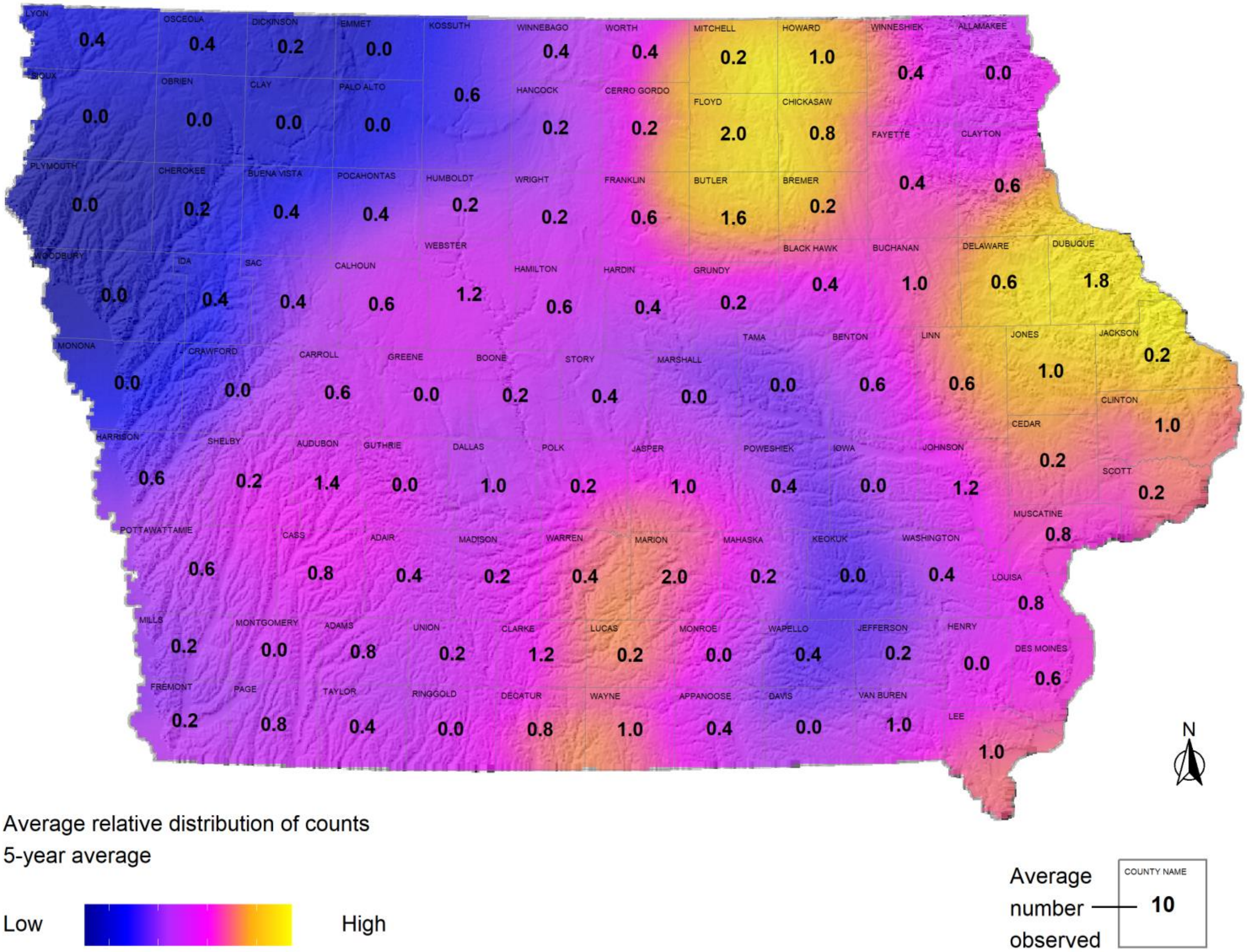


Figure 31. Average relative distribution of spring spotlight observations for red fox during the past 5 years in Iowa. The number of observations per county is relative to the highest and lowest number of observations across all counties during the survey and may not represent an over- or under-abundance of the species (i.e., high counts are considered high relative to those observed in all other counties).

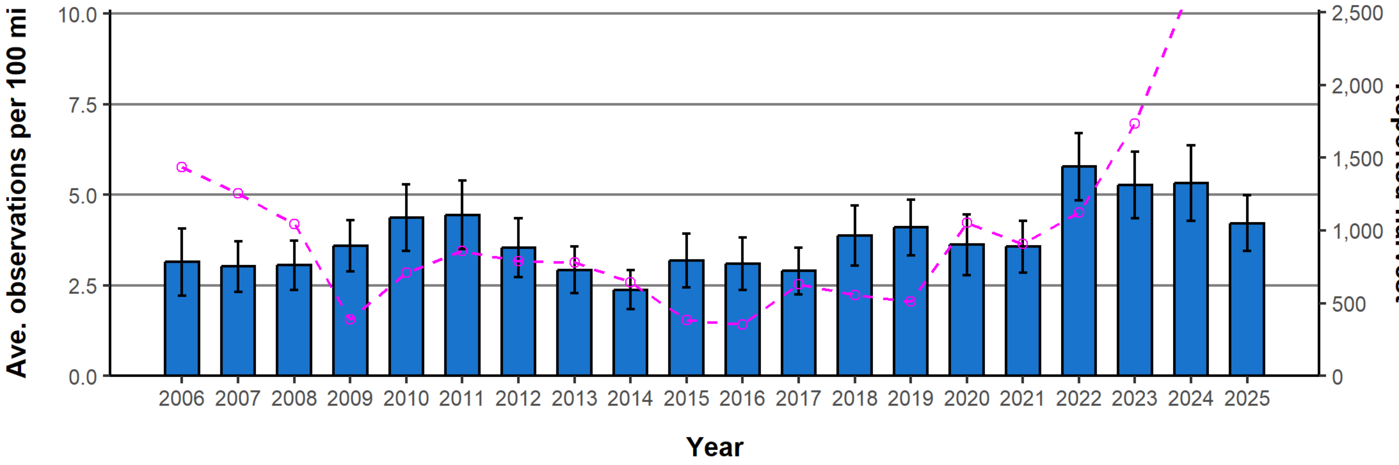


Figure 32. Average striped skunk observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Dashed line indicates the reported furs purchased by licensed fur buyers.

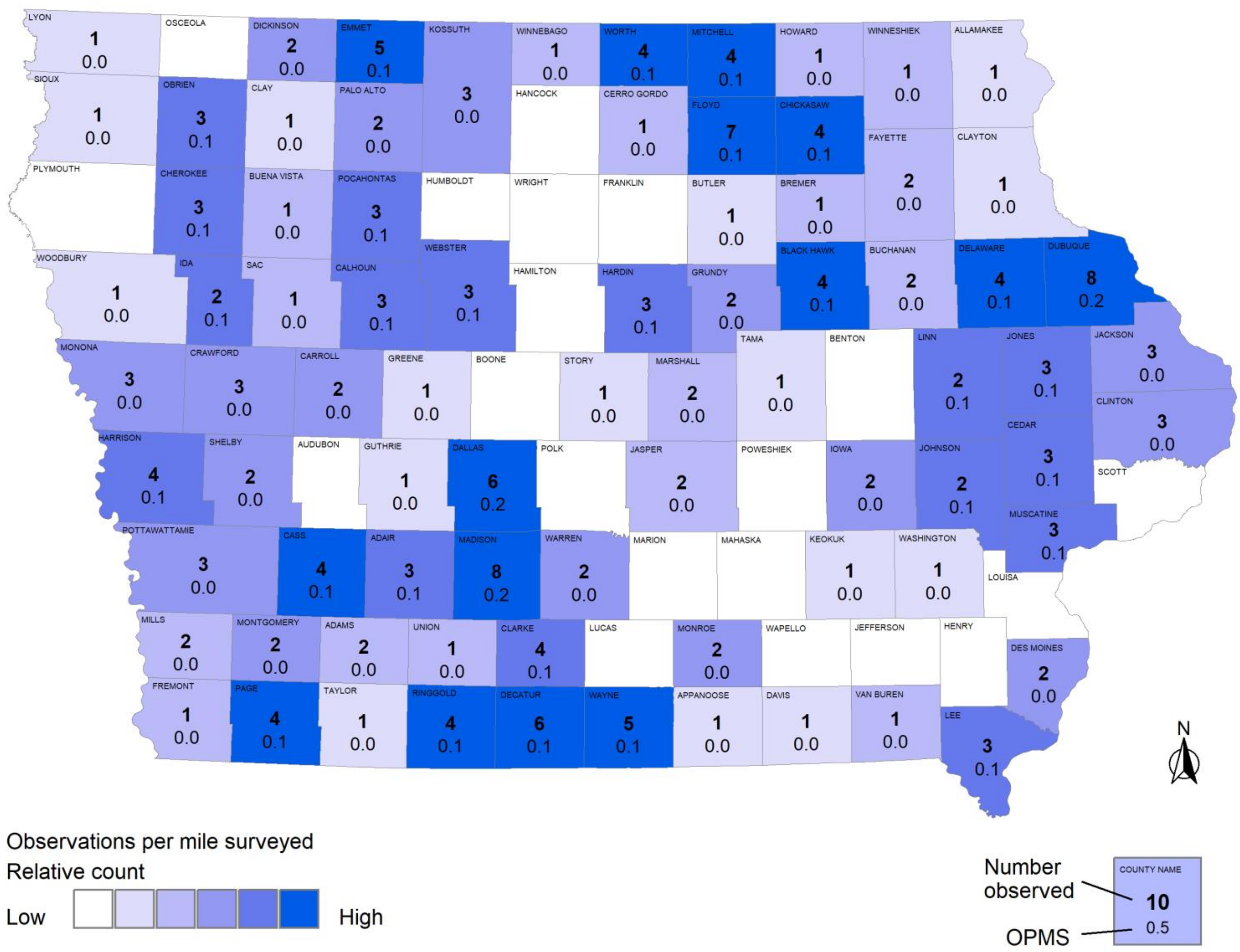


Figure 33. Total number of striped skunk observations per county during the Iowa Spring Spotlight Survey, 2025. Color shading indicates the number of animals counted per mile surveyed (OPMS). Counts likely include few or no spotted skunk.

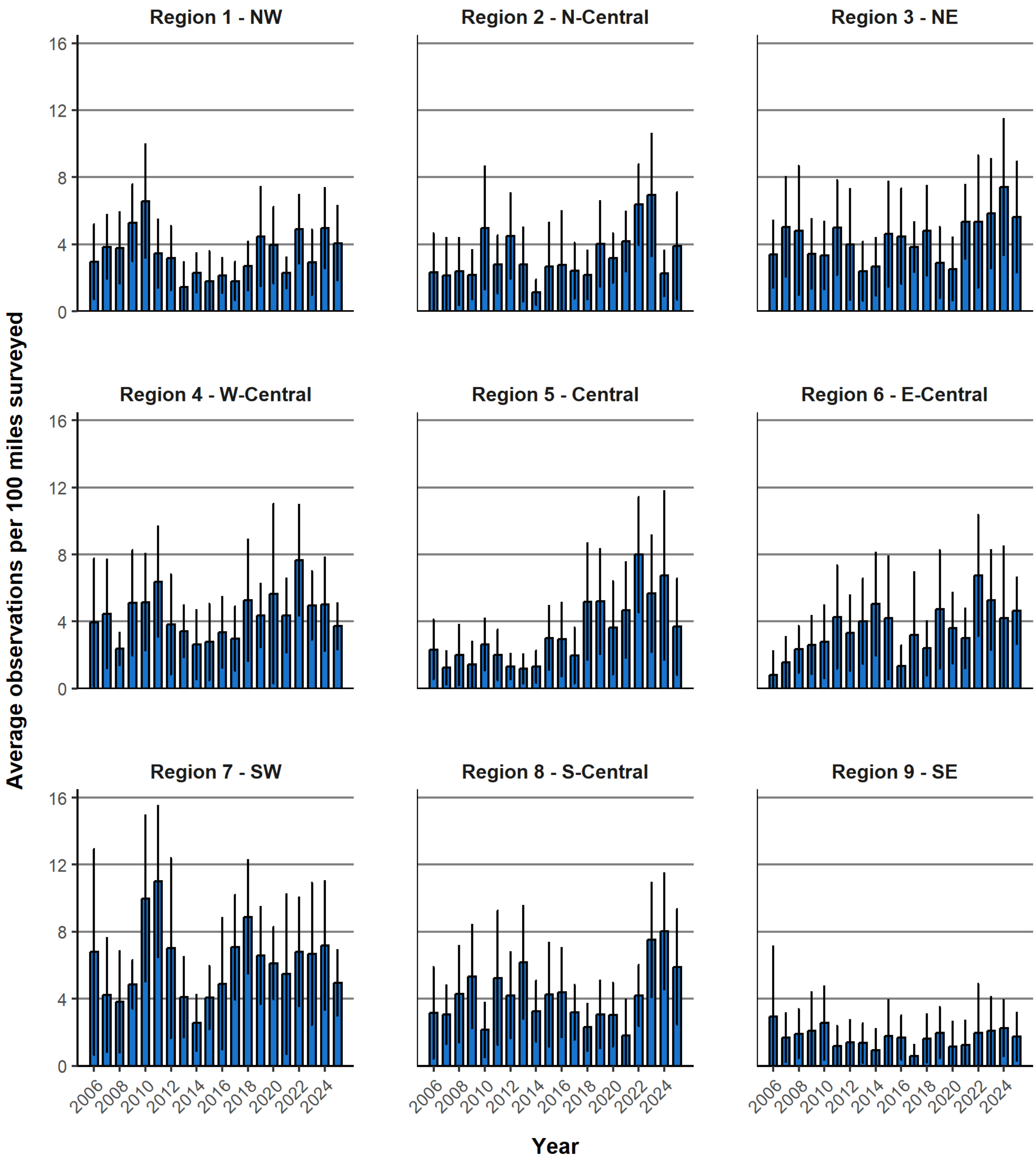


Figure 34. Average skunk observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals. Skunk includes all observations recorded as "striped skunk" and "skunk" and likely includes none or few spotted skunk observations due to the rarity of the species in the state.

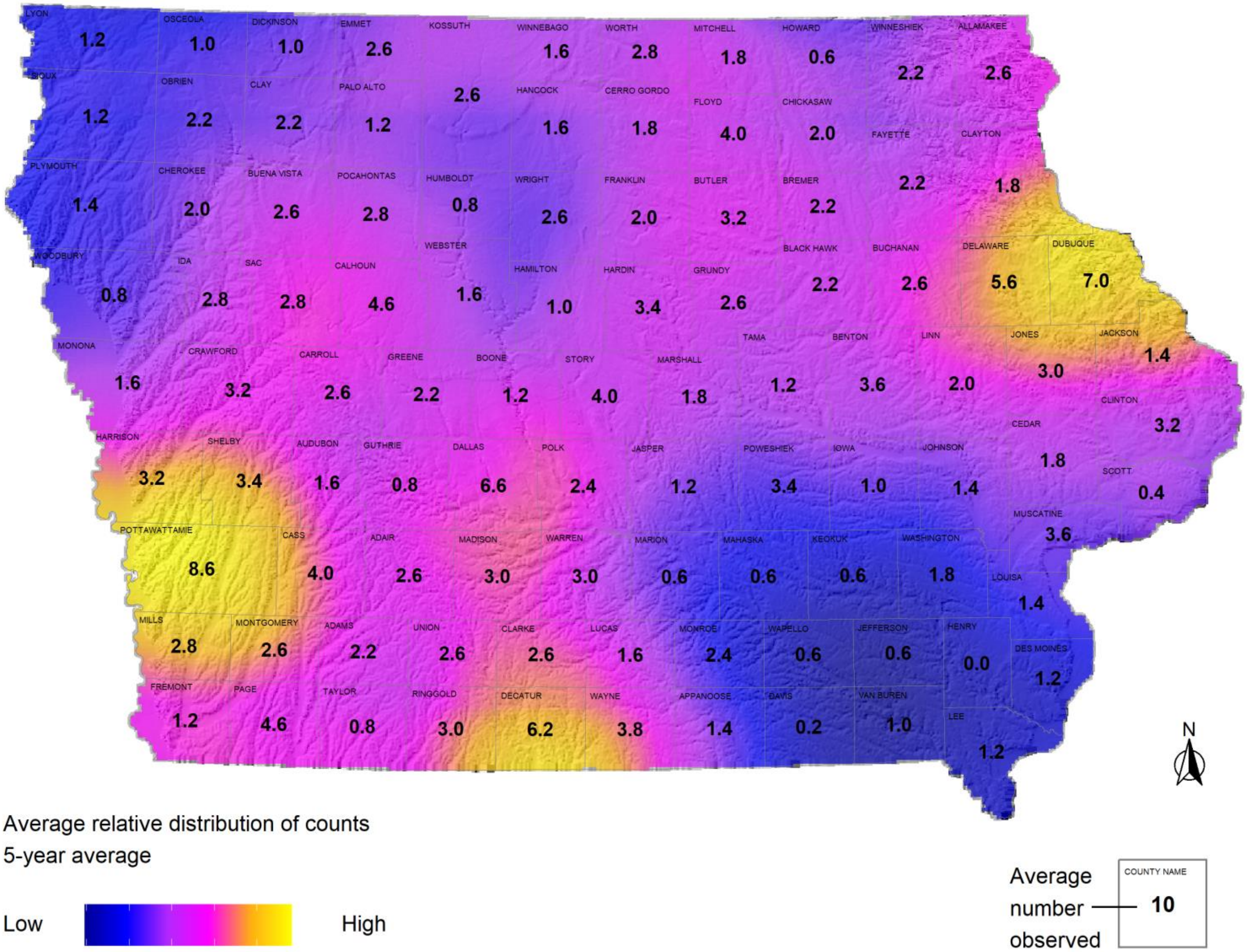


Figure 35. Average relative distribution of spring spotlight observations for skunk during the past 5 years in Iowa. The number of observations per county is relative to the highest and lowest number of observations across all counties during the survey and may not represent an over- or under-abundance of the species (i.e., high counts are considered high relative to those observed in all other counties). Counts likely include few or no spotted skunk observations due to their rarity in the state.

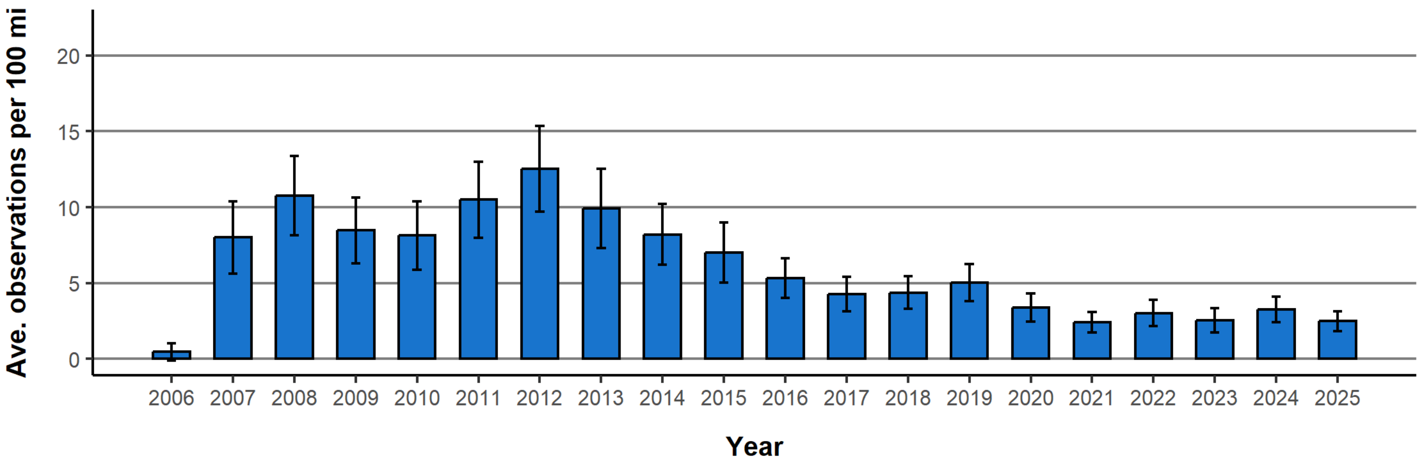


Figure 36. Average free-ranging house cat observations per 100 miles surveyed during the Iowa Spring Spotlight Survey, 2006–2025. Error bars indicate 95% confidence intervals. Observations were not recorded in most counties during 2006.

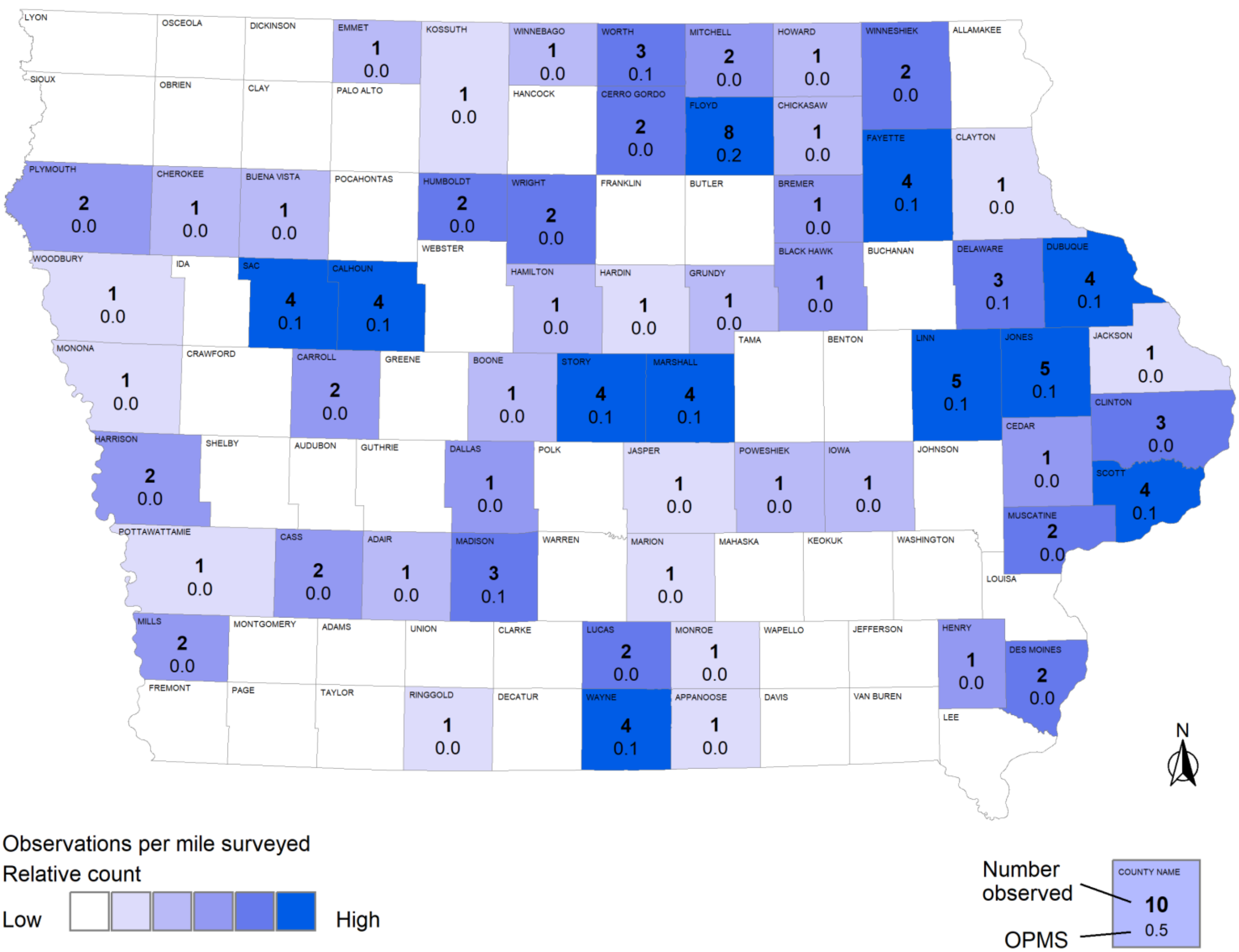


Figure 37. Total number of free-ranging house cat observations per county during the Iowa Spring Spotlight Survey, 2025. Cats located at farmsteads not included in counts. Color shading indicates the number counted per mile surveyed (OPMS).

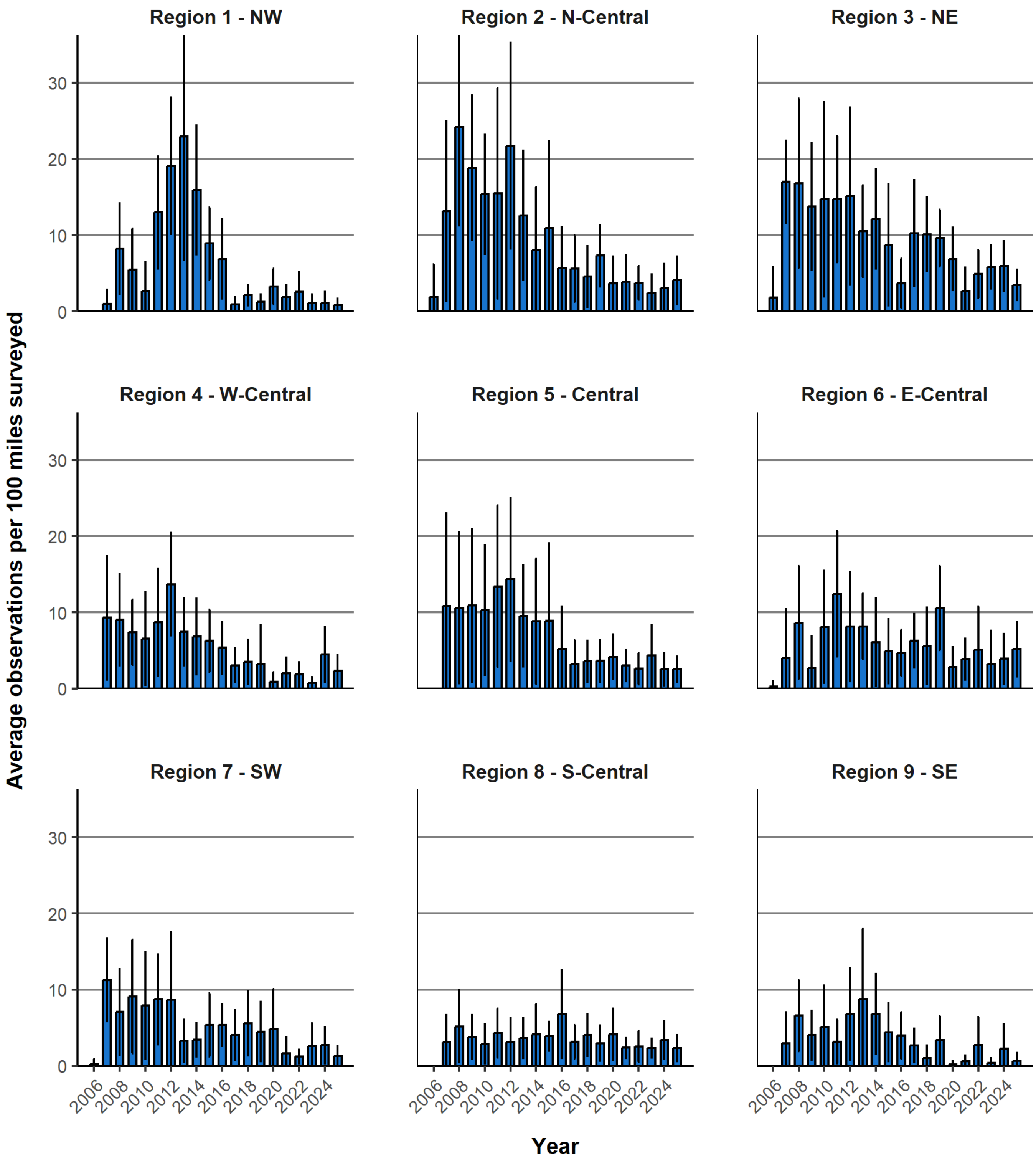


Figure 38. Average free-ranging house cat observations per 100 miles surveyed during the Spring Spotlight Survey for nine regions of Iowa, 2006–2025. Error bars indicate 95% confidence intervals. Cats located at farmsteads or human developments were not included in counts. Observations were not recorded in most counties during 2006.

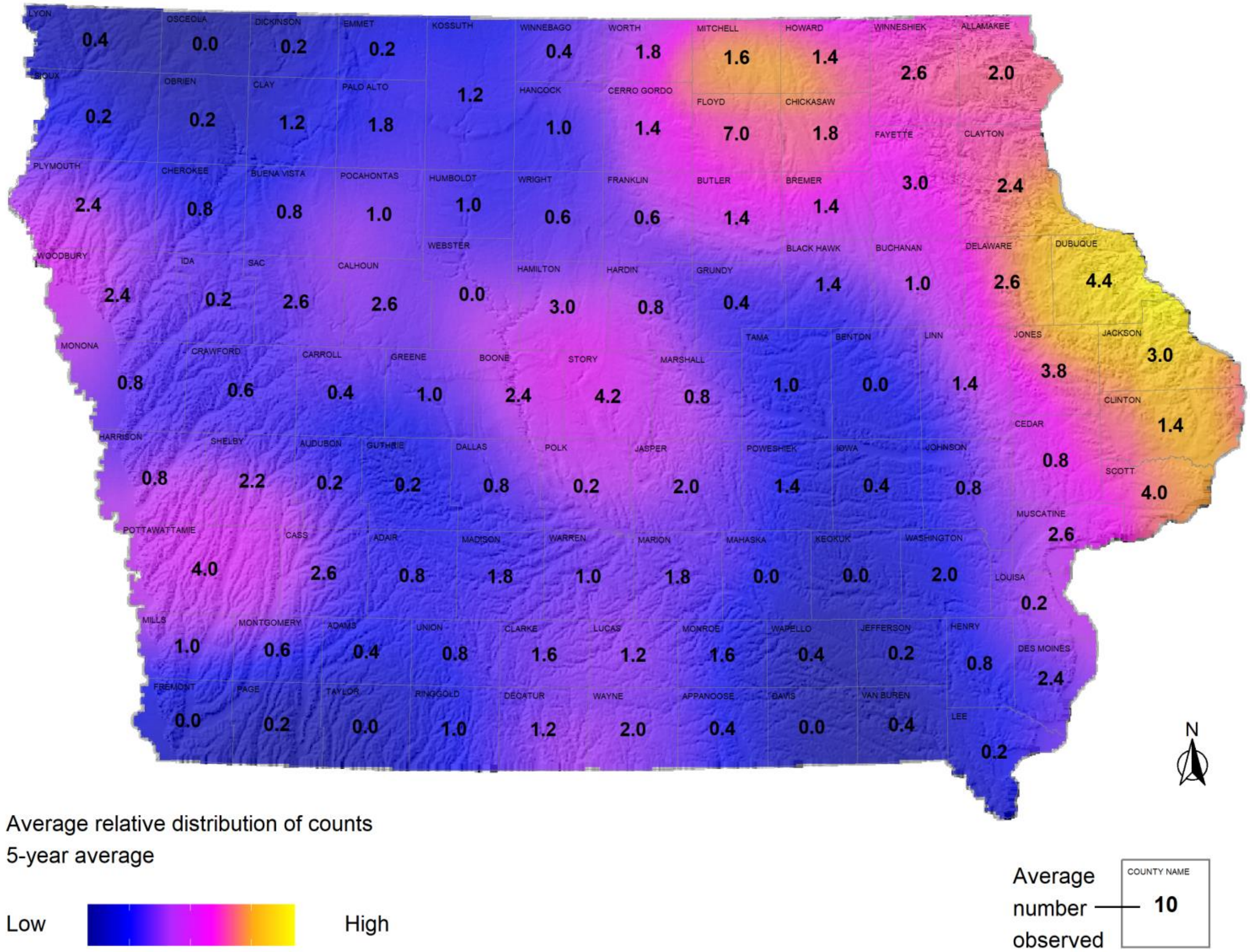
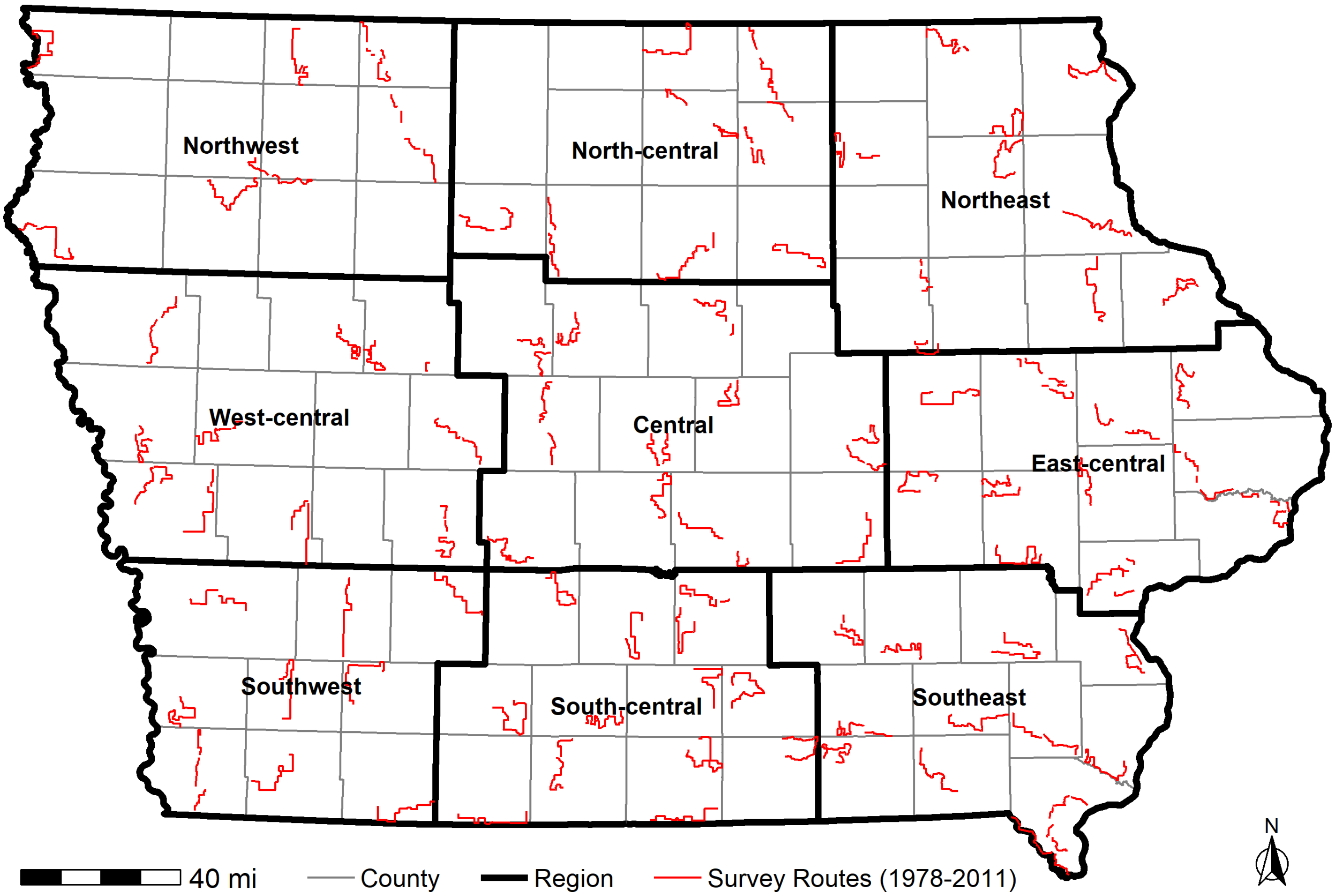


Figure 39. Average relative distribution of spring spotlight observations for house cat during the past 5 years in Iowa. The number of observations per county is relative to the highest and lowest number of observations across all counties during the survey and may not represent an over- or under-abundance of the species (i.e., high counts are considered high relative to those observed in all other counties). House cats located at farmsteads or human developments were not included in counts.

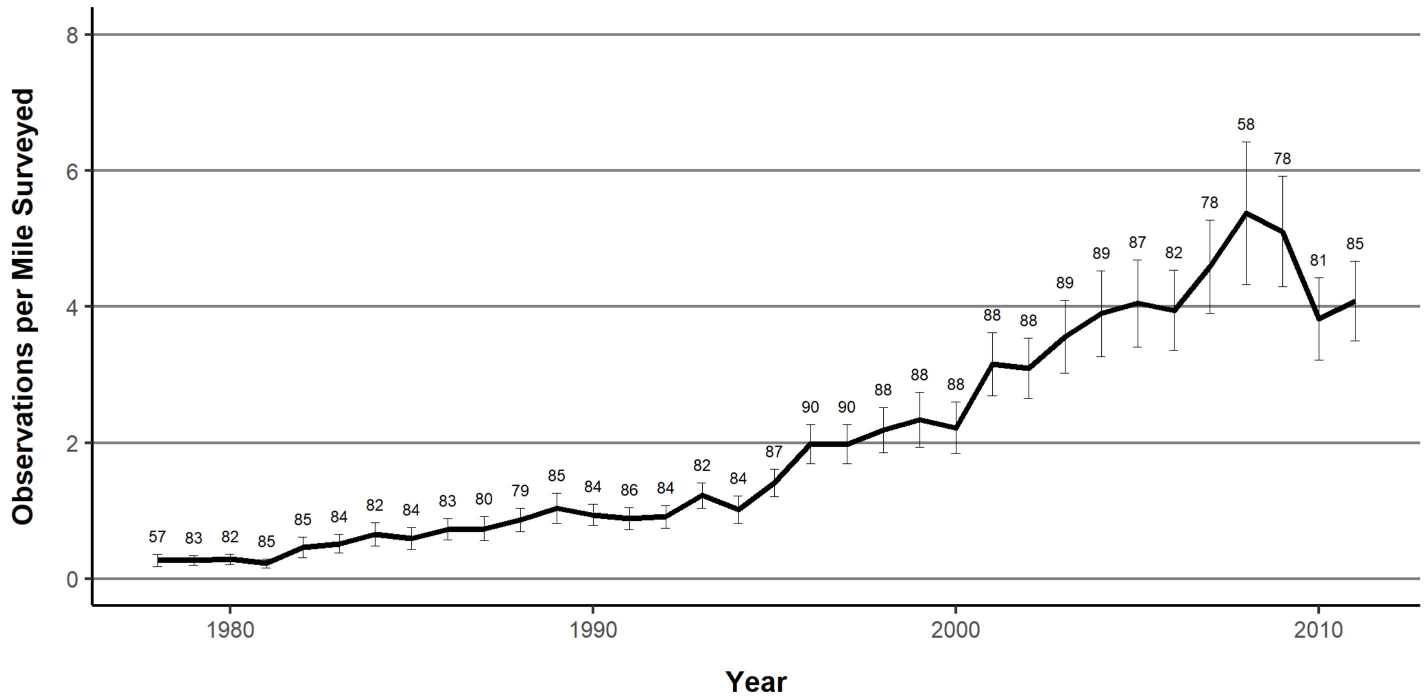
APPENDICES

APPENDIX A



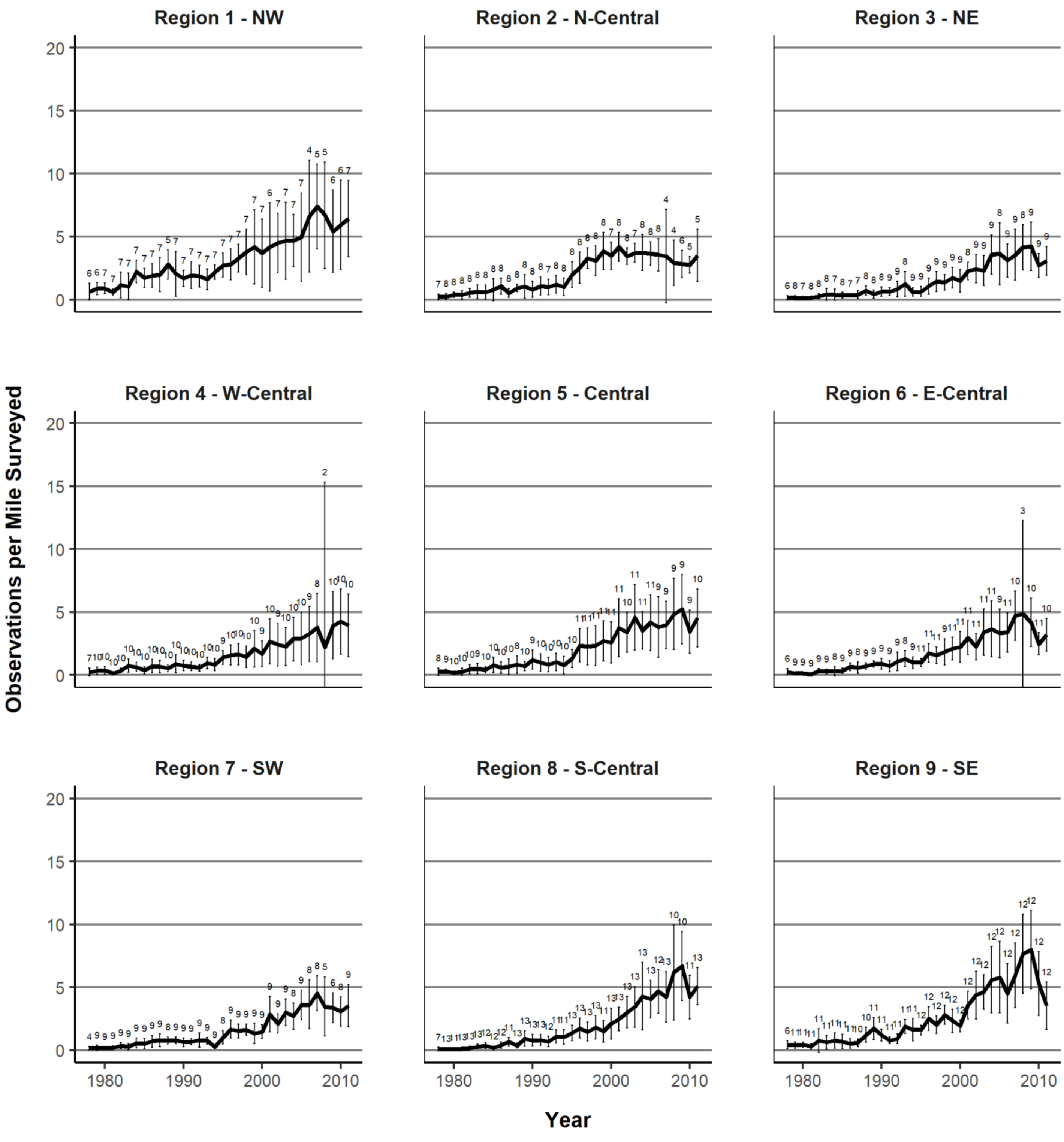
Appendix A. Regions used for summarizing Spring Spotlight Survey observations in Iowa and historical Spring Spotlight Survey routes sampled from 1978–2011.

APPENDIX B



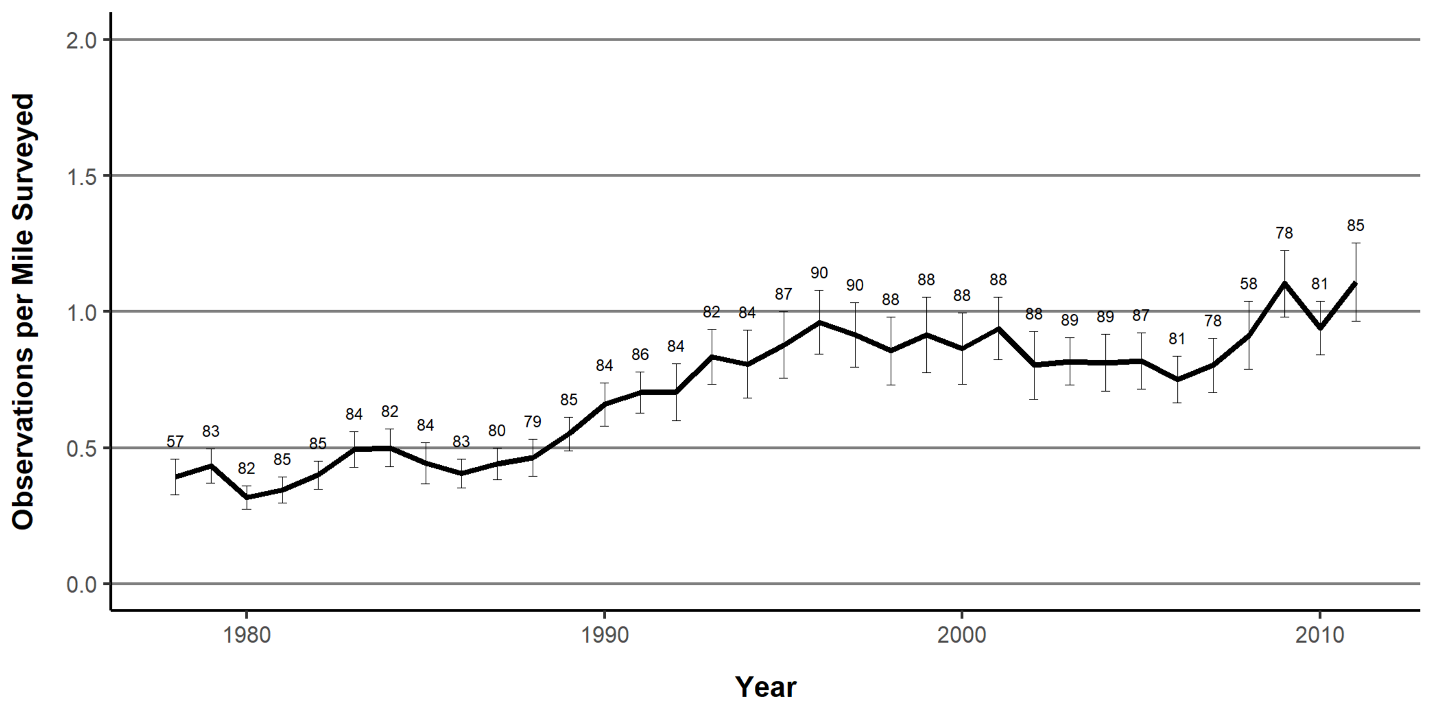
Appendix B. Statewide average white-tailed deer observations per mile surveyed during the Iowa Spring Spotlight Survey, 1978–2011. Observations were standardized by mile surveyed to account for regions in which counties were not surveyed. Error bars indicate 95% confidence intervals. Numbers above error bars indicate the number of transects surveyed each year.

APPENDIX C



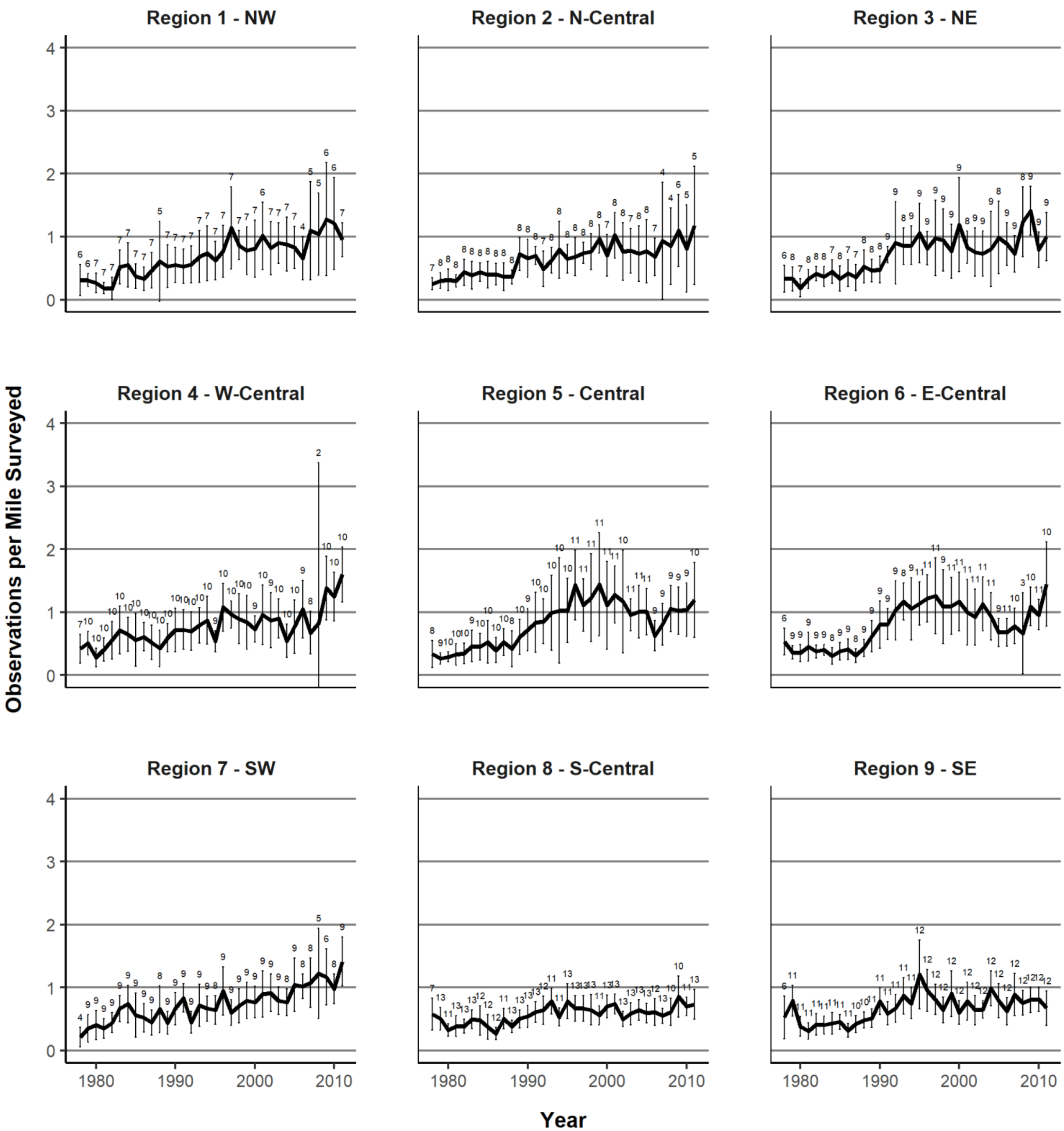
Appendix C. Average white-tailed deer observations per mile surveyed during the Iowa Spring Spotlight Survey, 1978–2011. Error bars indicate 95% confidence intervals. Numbers above error bars indicate the number of transects surveyed each year. Surveys were conducted parallel to forest cover and not standardized by the amount of available habitat in each region.

APPENDIX D



Appendix D. Average raccoon observations per mile surveyed during the Iowa Spring Spotlight Survey, 1978–2011. Observations were standardized by mile surveyed to account for variable number of transects surveyed each year. Error bars indicate 95% confidence intervals. Numbers above error bars indicate the number of transects surveyed each year.

APPENDIX E



Appendix E. Average raccoon observations per mile surveyed during the Iowa Spring Spotlight Survey, 1978–2011. Error bars indicate 95% confidence intervals. Numbers above error bars indicate the number of transects surveyed each year. Surveys were conducted parallel to forest cover and not standardized by the amount of available habitat in each region.

APPENDIX F

PREDICTING SPECIES COUNTS USING WEATHER VARIABLES FOR THE IOWA SPRING SPOTLIGHT SURVEY

Dan J. Kaminski, Iowa Dept. of Natural Resources

INTRODUCTION

Spring spotlight survey observations vary by environmental factors such as weather (e.g., humidity, temperature), landscape (e.g., land cover, terrain), and animal behavior. We estimated regression models to predict species counts using weather variables that potentially influence animal behavior and detection probability during the Iowa spring spotlight survey to help explain annual variability in counts.

METHODS

We estimated multiple regression models for deer and 8 species of mesocarnivores, including badger, coyote, mink, opossum, raccoon, red fox, skunk, and house cat, using spring spotlight survey data from 2007–2022. We identified several environmental variables potentially capable of influencing animal behavior or detection probability and eliminated those that were highly correlated ($r \geq 0.60$). We selected six variables, including observations per mile in the previous year for each species (as an index of population abundance), total accumulated winter season severity index, average humidity and average temperature on survey nights, and the number of rain events ≥1 inch and average temperature in the 28 days prior to surveys. We log-transformed all predictor variables to better meet assumptions of normality. We evaluated negative binomial regression models for all species, but if theta approached infinity according to function glm.nb in Program R, we used a Poisson regression model to predict species counts. We tested the predictive capabilities of each model by estimating the relationship between observed and predicted counts for each species using linear regression. We estimated all models using Program R 4.2.2.

RESULTS

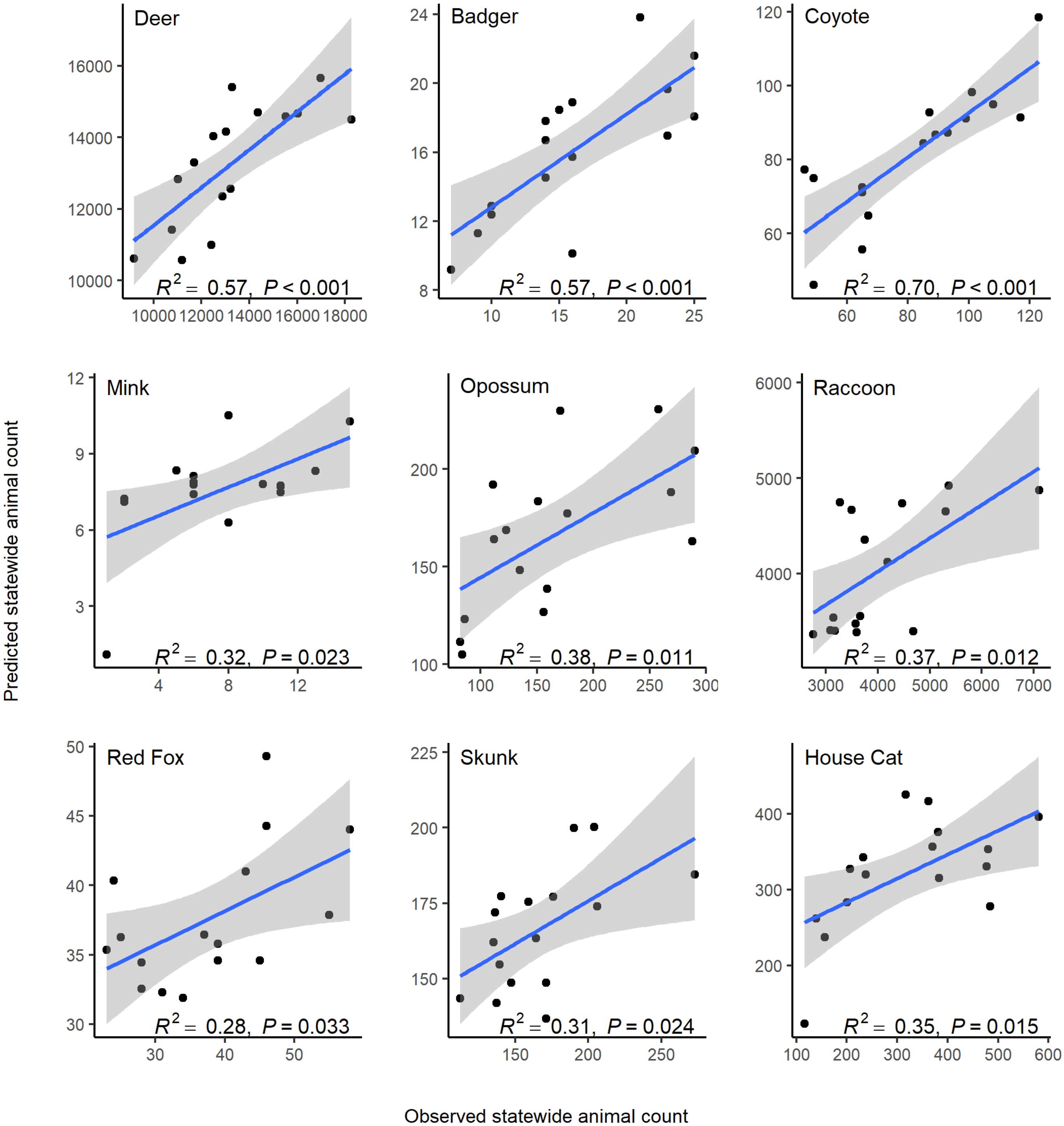
Linear regression model relationships between predicted and observed counts for each species were significant, indicating weather variables explained in-part spring spotlight observations for each species and contributed to annual variability in species counts (R^2 = 0.28–0.70; Table 1; Figure 1).

DISCUSSION

These models provide information on how weather influences species observations and demonstrate that some weather variables leading up to spring surveys and on survey nights are predictive of spring spotlight counts. Tested weather variables accounted for 28% (red fox) to 70% (coyote) of the variability in predicted counts and provided insight as to why observations may fluctuate across years. Additional work is necessary to test other environmental variables such as land cover (e.g., proportions of forest or grass cover), moon phase, or wind speed. Although these models were all significant, we view them as preliminary models given the extent of additional work that may be completed to improve predictions.

Appendix F, Table 1. Multiple regression models (negative binomial [Neg Bin] or Poisson) used to predict species counts for spring spotlight survey observations, 2007–2022, Iowa, USA. Predictor variables included log-transformed values for observations per mile in the previous year for each species (OPMPY), cumulative accumulated winter season severity index (AWSSI), average humidity (SurvHum) and average temperature (SurvTemp) on survey nights, number of precipitation events ≥1 inch in 28 days prior to surveys (Precip28d), and average daily temperature in the 28 days prior to surveys (Temp28d).

Species	Model	β_0	β_1 OPMPY	β_2 AWSSI	β_3 SurvHum	β_4 SurvTemp	β_5 Precip28d	β_6 Temp28d
Deer	Neg Bin	6.68	0.405	0.392	0.889	-0.640	0.183	-0.481
Badger	Poisson	-8.81	-0.053	0.263	2.806	0.011	-0.197	-0.594
Coyote	Neg Bin	13.43	0.359	-0.449	-0.954	-1.297	-0.247	-0.579
Mink	Neg Bin	0.66	0.056	0.109	0.844	0.094	0.146	0.689
Opossum	Neg Bin	15.45	-0.197	-0.846	0.833	-2.506	0.665	-1.306
Raccoon	Neg Bin	9.20	0.065	-0.035	0.240	-0.453	-0.043	-0.453
Red fox	Neg Bin	1.56	0.512	0.179	0.964	0.820	0.016	-0.029
Skunk	Neg Bin	8.27	0.435	-0.036	-0.940	-0.179	0.111	0.289
House cat	Neg Bin	-7.67	-0.464	0.666	0.056	2.253	-0.170	1.733



Appendix F, Figure 1. Relationship between observed and predicted spring spotlight survey counts for 9 wildlife species in Iowa, USA. Black points indicate species counts, blue lines indicate linear regression models, and grey ribbons indicate standard errors of the models. Predicted counts were estimated from spring spotlight survey counts, 2007–2022, using a negative binomial or Poisson regression model and 6 predictor variables, including log-transformed values for observations per mile in the previous year for each species, cumulative accumulated winter season severity index, average humidity and average temperature on survey nights, number of precipitation events ≥1 inch in the 28 days prior to surveys, and average daily temperature in the 28 days prior to surveys.