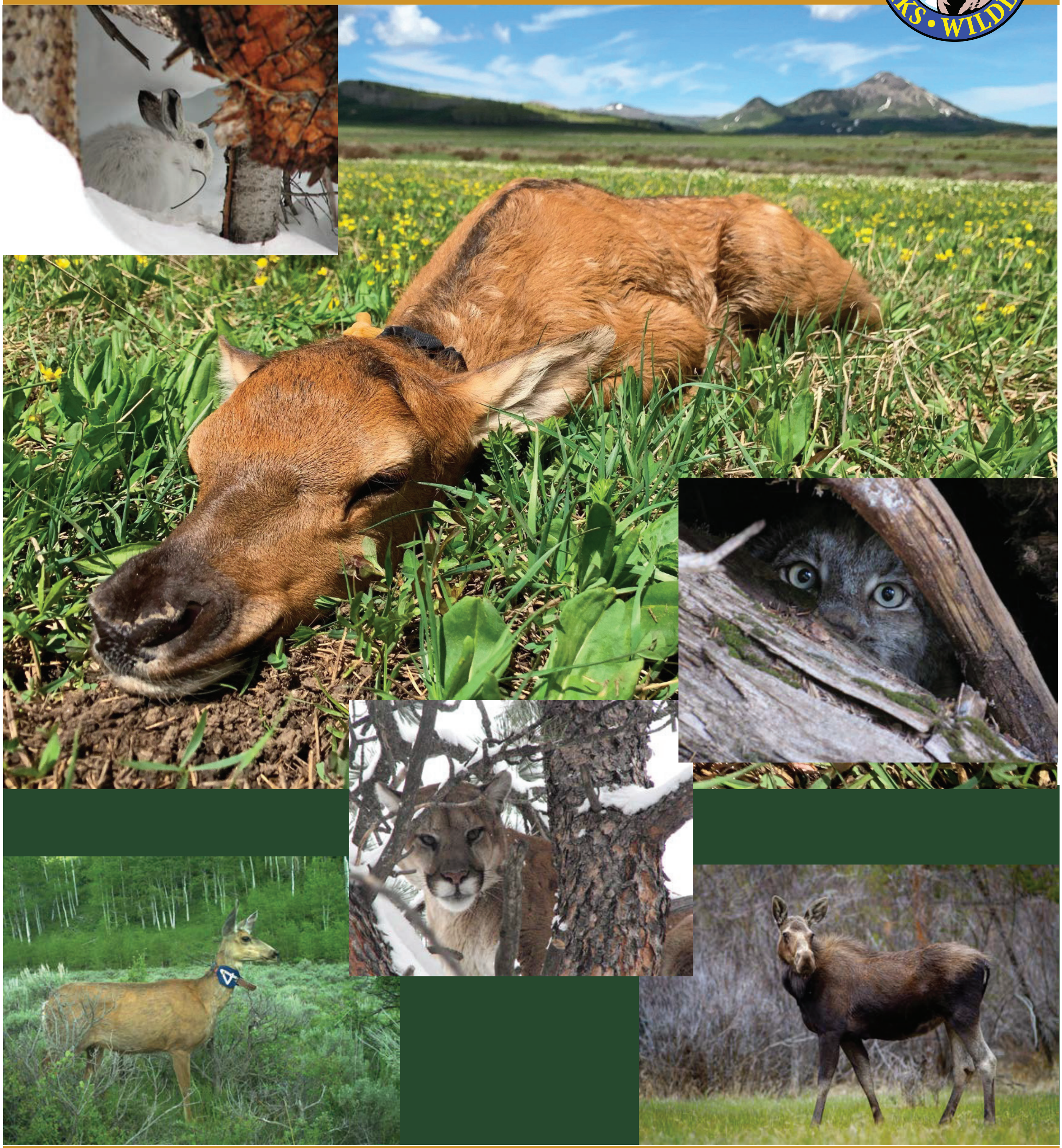
COLORADO PARKS & WILDLIFE

Wildlife Research Reports

MAMMALS – JULY 2020



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WILDLIFE RESEARCH REPORTS

JULY 2019–JUNE 2020

MAMMALS RESEARCH PROGRAM

COLORADO PARKS AND WILDLIFE
Research Center, 317 W. Prospect, Fort Collins, CO 80526

EXECUTIVE SUMMARY

This Wildlife Research Report represents summaries (≤5 pages each with tables and figures) of wildlife research projects conducted by the Mammals Research Section of Colorado Parks and Wildlife (CPW) from July 2019 through June 2020. These research efforts represent long-term projects (4–10 years) in various stages of completion addressing applied questions to benefit the management and conservation of various mammal species in Colorado. In addition to the research summaries presented in this document, more technical and detailed versions of most projects (Annual Federal Aid Reports) and related scientific publications that have thus far been completed can be accessed on the CPW website at http://cpw.state.co.us/learn/Pages/ResearchMammalsPubs.aspx or from the project principal investigators listed at the beginning of each summary.

Current research projects address various aspects of wildlife management and ecology to enhance understanding and management of wildlife responses to habitat alterations, human-wildlife interactions, and investigating improved approaches for wildlife management. The Nongame Mammal Conservation Section addresses ongoing monitoring of lynx in the San Juan mountain range and preliminary results addressing influence of forest management practices on snowshoe hare density in Colorado. The Ungulate Conservation Section includes 4 projects addressing mule deer/energy development interactions to inform future development planning, evaluation of moose demographic parameters that will inform future moose management in Colorado, an evaluation of factors influencing elk calf recruitment, and a recent study initiated to address elk response to human recreation. The Support Services Section describes the CPW library services to provide internal access of CPW publications and online support for wildlife and fisheries management related publications.

In addition to the ongoing project summaries described above, Appendix A includes 15 publication abstracts (<2 page summaries) completed by CPW mammals research staff since July 2019. These scientific publications provide results from recently completed CPW research projects and other outside collaborations with universities and wildlife management agencies. Topics addressed include nongame species ecology and conservation (lynx associations with beetle killed forests, assessment of wolverine monitoring, distribution and habitat associations across 4 western states, snowshoe hare morphology, and lynx response to winter recreation), carnivore ecology and management (mountain lion population response to hunter harvest, factors limiting mountain lion populations, evaluation of Colorado's 2-strike black bear management directive, mountain lion/human interactions along Colorado's Front Range, and assessment of the social dynamics associated with black bear management along the urban-wildland interface), ungulate ecology and management (mule deer response to energy development activity, 2 publications addressing moose calf detection and estimating parturition dates, and application of acoustic technology to address mule deer foraging behavior), and wildlife genetics research (investigating mountain lion gene flow and genetic diversity).

We have benefitted from numerous collaborations that support these projects and the opportunity to work with and train wildlife technicians and graduate students that will likely continue their careers in wildlife management and ecology in the future. Research collaborators include the CPW Wildlife Commission, statewide CPW personnel, Federal Aid in Wildlife Restoration, Colorado State University, Montana State University, University of Wyoming, U.S. Bureau of Land Management, U.S. Forest Service, City of Boulder and Jefferson County Open Space, City of Durango, CPW big game auction-raffle grants, Species Conservation Trust Fund, Great Outdoors Colorado, CPW Habitat Partnership Program, Safari Club International, Boone and Crocket Club, Colorado Mule Deer Association, The Mule Deer Foundation, Muley Fanatic Foundation, Wildlife Conservation Society, Summerlee Foundation, EnCana Corp., ExxonMobil/XTO Energy, Marathon Oil, Shell Exploration and Production, WPX Energy, and private land owners providing access to support field research projects.

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Colorado Parks and Wildlife

WILDLIFE RESEARCH PROJECT SUMMARY

Canada Lynx Monitoring in Colorado

Period Covered: July 1, 2018 – June 30, 2019

Principal Investigators: Eric Odell, Eric.Odell@state.co.us; Jake Ivan, Jake.Ivan@state.co.us; Scott Wait, Scott.Wait@state.co.us

In an effort to restore a viable population of Canada lynx (*Lynx canadensis*) to the southern portion of their former range, 218 individuals were reintroduced into Colorado from 1999–2006. In 2010, the Colorado Division of Wildlife (now Colorado Parks and Wildlife [CPW]) determined that the reintroduction effort met all benchmarks of success, and that the population of Canada lynx in the state was apparently viable and self-sustaining. In order to track the persistence of this new population and thus determine the long-term success of the reintroduction, a minimally-invasive, statewide monitoring program is required. During 2014−2019 CPW initiated a portion of the statewide monitoring scheme described in Ivan (2013) by completing surveys in a random sample of monitoring units (n = 50) from the San Juan Mountains in southwest Colorado (n = 179 total units; Figure 1).

During 2018−2019 personnel from CPW and USFS completed the fifth year of monitoring work on this same sample. Specifically, 14 units were sampled via snow tracking surveys conducted between December 1 and March 31. On each of 1–3 independent occasions, survey crews searched roadways (paved roads and logging roads) and trails for lynx tracks. Crews searched the maximum linear distance of roads possible within each survey unit given safety and logistical constraints. Each survey covered a minimum of 10 linear kilometers (6.2 miles) distributed across at least 2 quadrants of the unit. The remaining 36 units could not be surveyed via snow tracking. Instead, survey crews deployed 4 passive infrared motion cameras in each of these units during fall 2018. Cameras were baited with visual attractants and scent lure to enhance detection of lynx living in the area. Cameras were retrieved during summer or fall 2019 and all photos were archived and viewed by at least 2 observers to determine species present in each. Camera data were then binned such that each of 10 15-day periods from December 1 through April 30 was considered an 'occasion,' and any photo of a lynx obtained during a 15-day period was considered a 'detection' during that occasion.

Surveyors covered 510 km (317 mi) during snow tracking surveys and detected lynx at 6 units (Table 1). This represents a 5-year low in snow tracking effort and is due mostly to the record-setting snows experienced during the 2018–2019 winter. However, the mean distance surveyed per visit as well as the number of units with lynx remained similar to previous years. Surveyors collected more photos during 2018–2019 than in any other year. This was due in part to replacing snow tracking units with camera units in recent years, but mostly because many cameras were not retrieved until late summer or fall 2019 due to access issues related to the heavy snow pack. For the second year in a row we collected <50% of the number of lynx photos collected during the initial years of the monitoring effort, although the number of units with lynx returned to 'normal' after last year's low (Table 2). Perhaps the abnormal snow patterns during the past few years (lack of snow in 2017–18, record snow in 2018–19) impacted our detection probability. Alternatively, lack of detections could have been due to the new lure (Caven's

Violator 7; Minnesota Trapline Products, https://www.minntrapprod.com/Bobcat-and-Lynx/products/829/) we used in 2017–2018 and 2018–19 after the lure we used previously (Pikauba; Luerres Forget's Lures, http://www.leurresforget.com/product.php?id_product=15) became unavailable. Unfortunately, the changes in snow and lure are confounded, thus making it difficult to determine which factor resulted in fewer detections. We will use the same new lure in 2019–2020, which if accompanied by a normal snowfall, may allow us to retrospectively assess the lack of detections. Compared to previous years, we obtained new lynx detections at a camera unit near Table Mountain northwest of Creede and one north of Lemon Reservior. Also, we detected lynx again for only the second season at a unit west of Trujillo Meadows, near the New Mexico border. However, we failed to detect lynx in two units near Silverton that have had detections each winter since the inception of monitoring (Figure 1). Potential tracks were observed in each of these, but conditions were such that they could not be confirmed. An adult female with kittens was detected at cameras in a unit near Platoro Reservoir, thus documenting that at least some reproduction occurred in the study area.

We used the R (R Development Core Team 2018) package 'RMark' (Laake 2018) to fit standard occupancy models (MacKenzie *et al.* 2006) to our survey data using program MARK (White and Burnham 1999). Thus, we estimated the probability of a unit being occupied (i.e., used) by lynx over the course of the winter (ψ), along with the probability of detecting a lynx (p) given that the unit was occupied. 'Survey method' and 'year' were treated as group variables so that we could, based on previous work, 1) allow detection probability to vary by survey method, 2) allow for detection probability for 2017–18 and/or 2018–19 to differ from other years due to abnormal snow or new lure, and 3) include a breeding season effect for detection at cameras (lynx tend to move more in late winter when they begin to breed, and thus should encounter cameras more often). We also considered a suite of covariates that could potentially explain variation in occupancy including proportion of the unit that was covered by spruce/fir forest, average years since bark beetle infestation, variability (standard deviation) in years since bark beetle infestation, proportion of the unit impacted by bark beetles, proportion of the unit that was burned during Summer 2013, and the number of photos of other species that could potentially impact presence of lynx (e.g., snowshoe hares as a food source, coyotes as potential competitors). We limited our model set by first setting a general structure for ψ while assessing fit of various combinations of variables expected to affect p. We then fixed the best-fitting structure for p, and assessed combinations of the covariates expected to influence ψ, allowing up to 2 of these covariates at a time, in addition to the covariates on detection. We included data from the pilot study (2010–11) as well as the first five years of monitoring (2014−2019) to maximize sharing of information across surveys.

Since the inception of our monitoring program, the best-fitting model characterized occupancy as a function of 2 covariates: the proportion of the sample unit covered by spruce-fir forest and the number of photos of hares recorded at camera stations (Appendix 1). However, for the 2018–19 sampling year, the best fitting model characterized occupancy as a function of proportion of the sample unit covered by spruce-fir and by the number of cougar photos recorded at camera sites. The association with spruce-fir was positive, indicating that the probability of lynx use increased with more spruce-fir; the association with cougars was negative, indicating that probability of lynx use decreased with more photos of cougars. The second best model included bobcat photos in addition to spruce-fir; again lynx use was negatively associated with increased bobcat photos. Other covariates appeared in top models with spruce-fir, but addition of these covariates did not improve AIC_c scores beyond the model with spruce-fir only (Appendix 1). This phenomenon indicates that these other variables were not informative. Detection probability was relatively high for snow tracking surveys (p = 0.59, SE=0.05), and relatively low for camera surveys (p = 0.22, SE = 0.03) during December–February and April, although detection at cameras increased to 0.39 (SE = 0.07) during breeding season (March) as expected. We found a significant, negative effect on p during winters when Violator 7 was used as lure (p = 0.03, SE = 0.01 for December–February and April; p = 0.06, SE = 0.03 for breeding season), although it is unclear whether this drop in detection probability was due to abnormal snowpack or the alternate scent lure. We estimated that 31% of the sample units in the San Juan's were occupied by lynx (95% confidence interval: 12–60%)

during 2018–19. Confidence intervals were quite large for the second year in a row, owing to the extra parameter needed to model the "Violator 7 effect and to the low, poorly estimated detection probability that resulted (Figure 2). The spatial distribution of lynx in the San Juans remained largely unchanged (Figure 1).

LITERATURE CITED

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Table 1. Summary statistics from snow tracking effort.

Season	#Units Surveyed	#Units with Lynx	#Lynx Tracks	#Genetic Samples[a]	Km Surveyed (Total)	Mean Km Surveyed per Visit	#CPW Personnel	#USFS Personnel
2014–2015	24	8	13	10[b]	1,088	20.1	30	13
2015–2016	17	7	14	9[c]	987	21.9	23	6
2016–2017	16	8	13	7[d]	703	18.0	20	8
2017–2018	14	7	9	3[e]	578	19.3	14	5
2018–2019	14	6	7	2[e]	510	19.6	16	5

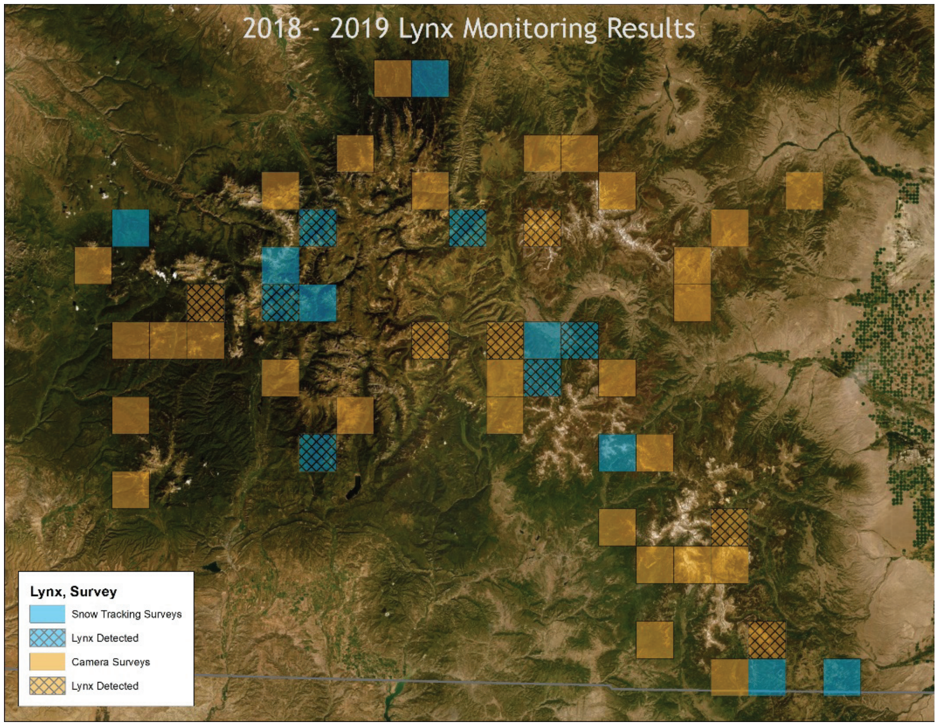
[a] Number of genetic samples (scat or hair) collected via backtracking putative lynx tracks
[b] DNA analysis confirms that all samples collected from putative lynx tracks were lynx
[c] DNA analysis confirms that 6 of 9 samples were lynx (1 coyote, 1 either mule deer or human, 1undetermined)
[d] DNA analyses confirmed that 5 of 7 samples were lynx (1 coyote, 1 snowshoe hare)
[e] DNA confirmation pending

Table 2. Summary statistics from camera effort.

Season	#Units Surveyed	#Units With Lynx	#Photos (Total)	#Photos (Lynx)	#Cameras With Lynx	#CPW Personnel	#USFS Personnel
2014–2015	32	8 (7)	134,694	301	14	46	12
2015–2016	31	7 (6)	101,534	455	10	33	9
2016–2017	33	6 (5)	168,705	251	10	29	9
2017–2018	35	5 (4)	173,279	90	8	35	8
2018–2019	36	7 (5)	204,243	60	10	31	7

[a] Number in parenthesis indicates units with lynx during the official survey period (Dec 1–Apr 30)

a)



b)

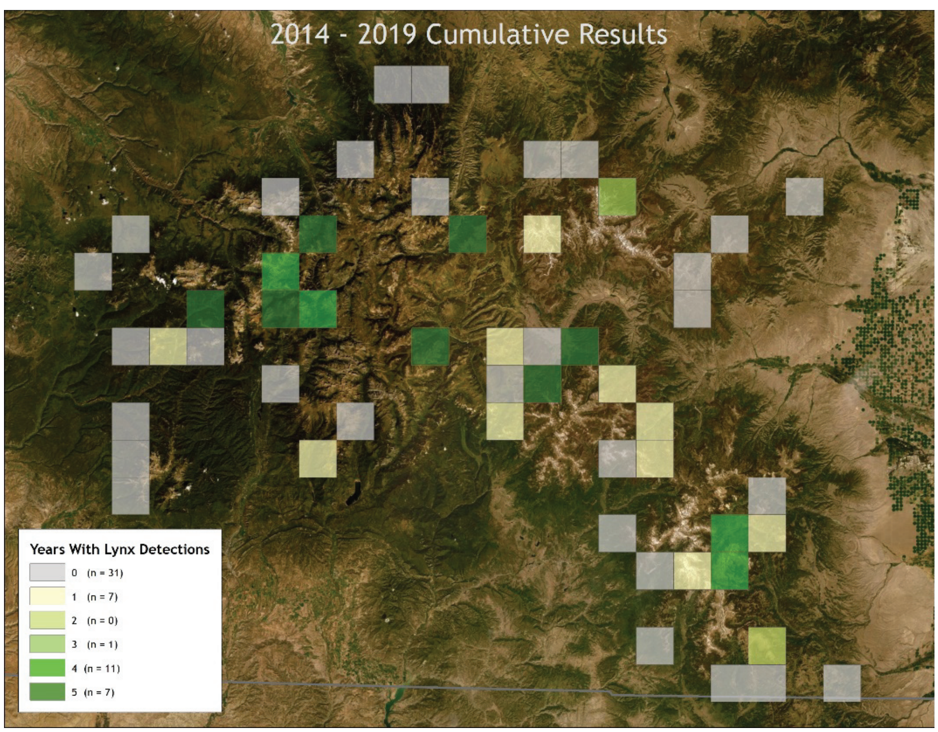


Figure 1. Lynx monitoring results for a) the current sampling season (2018–2019) and b) the cumulative monitoring effort (2014–2019), San Juan Mountains, southwest Colorado. Colored units (n = 50) indicate those selected at random from the population of units (n = 179) encompassing lynx habitat in the San Juan Mountains. Lynx were detected in 12 units in 2018−2019 and 23 units cumulatively since monitoring began in 2014−2015.

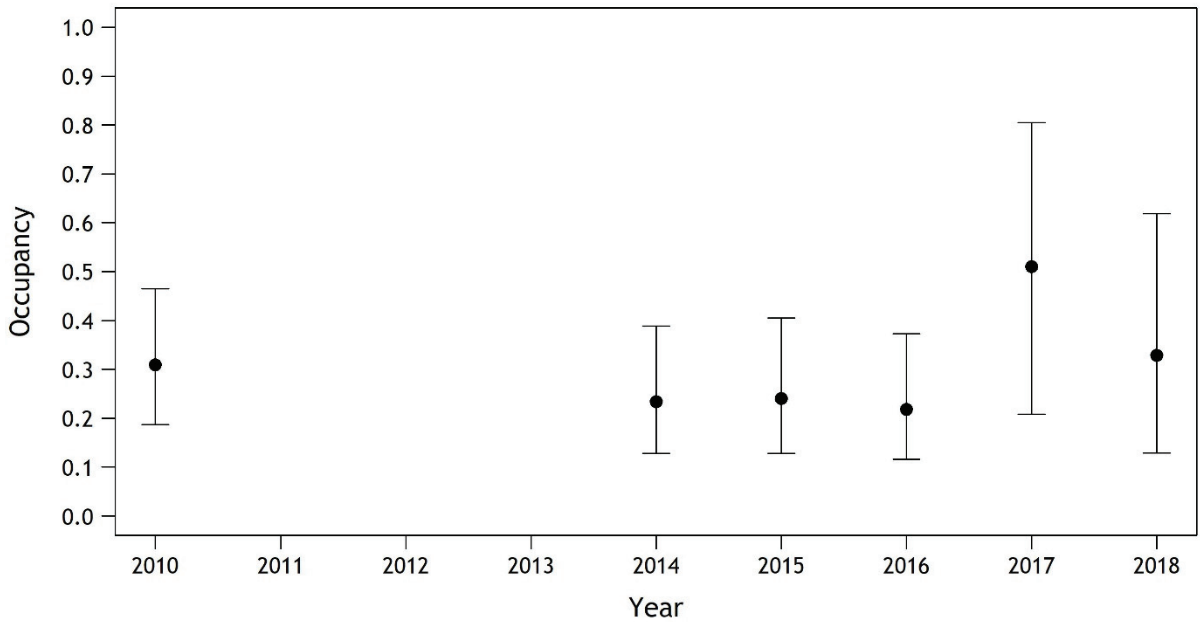


Figure 2. Model-averaged occupancy estimates and 95% confidence intervals for occupancy of Canada lynx in the San Juan Mountains, southwest Colorado. 'Year' indicates when the efforts were initiated (e.g., 2010−11, 2018−19).

Appendix 1. Model selection results for lynx monitoring data collected in the San Juan Mountains, Colorado, 2010–2019. Rankings are based on Akaike's Information Criterion adjusted for small sample size (AIC_c). Ten variables were considered as covariates to inform estimation of occupancy (ψ). The complete model set (n = 56) included all combinations of two, in addition to modeling detection (p) as a function of survey method, breeding season, and alternate lure used during the 2017–18 and 2018–19 seasons. Only the best 10 models are shown.

Model	AIC_c	ΔAIC_c	AIC_c Wts	No. Par.
p(Best[a]) ψ (Cougar + Prop Spruce/Fir)	817.89	0	0.64	12
p(Best) ψ (Bobcat + Prop Spruce/Fir)	820.87	2.98	0.15	12
p(Best) ψ (Prop Spruce/Fir)	822.92	5.03	0.05	11
p(Best) ψ (Prop Burned + Prop Spruce/Fir)	824.14	6.26	0.03	12
p(Best) ψ (Coyote + Prop Spruce/Fir)	824.26	6.38	0.03	12
p(Best) ψ (Years Since Beetles + Prop Spruce/Fir)	824.46	6.57	0.02	12
p(Best) ψ (Fox + Proportion Spruce/Fir)	824.61	6.72	0.02	12
p(Best) ψ (Hare + Proportion Spruce/Fir)	825.03	7.14	0.02	12
p(Best) ψ (Prop Beetle + Prop Spruce/Fir)	825.06	7.17	0.02	12
p(Best) ψ (Variability Beetles + Prop Spruce/Fir)	825.08	7.19	0.02	12

[a]Best-fitting structure for detection probability included effects for survey method, breeding season, and an effect for the 2017–18 and 2018–19 survey seasons when Violator 7 was used for lure rather than Pikauba.