Chapter 7: Occurrence and abundance of ants, reptiles, and mammals

By Steven E. Hanser, Matthias Leu, Cameron L. Aldridge, Scott E. Nielsen, Mary M. Rowland, and Steven T. Knick

Published in: *Sagebrush ecosystem conservation and management: Ecoregional assessment tools and models for the Wyoming Basins*, 2011, p. 221-314

Sagebrush Ecosystem Conservation and Management: 221–314, 2011

Chapter 7: Occurrence and Abundance of Ants, Reptiles, and Mammals

Steven E. Hanser, Matthias Leu, Cameron L. Aldridge, Scott E. Nielsen, Mary M. Rowland, and Steven T. Knick

Abstract. Sagebrush (*Artemisia* spp.)-associated wildlife are threatened by habitat loss and fragmentation and by impacts associated with anthropogenic disturbances, including energy development. Understanding how species of concern as well as other wildlife including insects, reptiles, and mammals respond to type and spatial scale of disturbance is critical to managing future land uses and identifying sites that are important for conservation. We developed statistical models to describe species occurrence or abundance, based on area searches in 7.29-ha survey blocks, across the Wyoming Basins Ecoregional Assessment (WBEA) area for six shrub steppe-associated species: harvester ant (*Pogonomyrmex* spp.), thatch ant (*Formica* spp.), short-horned lizard (*Phrynosoma hernandesi*), white-tailed jackrabbit (*Lepus townsendii*), cottontail (*Sylvilagus* spp.) and least chipmunk (*Tamius minimus*). We modeled patterns in occupancy or abundance relative to multi-scale measures of vegetation type and pattern, abiotic site characteristics, and anthropogenic disturbance factors. Sagebrush habitat was a strong predictor of occurrence for short-horned lizards and white-tailed jackrabbits, but weak for the other four species. Vegetation and abiotic characteristics were strong determinants of species occurrence, although the scale of response was not consistent among species. All species, with the exception of the short-horned lizard, responded to anthropogenic disturbance, although responses again varied as a function of scale and direction (negative and positive influences). Our results improve our understanding of how environmental and anthropogenic factors affect species distributions across the WBEA area and facilitate a multi-species approach to management of this sagebrush ecosystem.

Key words: abundance, anthropogenic disturbance, cottontail, habitat, harvester ant, least chipmunk, occurrence, pygmy rabbit, short-horned lizard, thatch ant, white-tailed jackrabbit.

Fragmentation and loss of sagebrush (*Artemisia* spp.) has been implicated in declines in abundance and distribution of sagebrush-obligate wildlife species (Paige and Ritter 1999, Knick et al. 2003, Dobkin and Sauder 2004, Schroeder et al. 2004). These declines have prompted petitions for the listing of several species, including the pygmy rabbit (*Brachylagus idahoensis,* [U.S. Department of the Interior 2003, 2005a, 2008]) and greater sage-grouse (*Centrocercus urophasianus*, [U.S. Department of the Interior 2005b, 2010]) as threatened or endangered species. Identifying causes for species declines has led to an examination of multi-scale environmental factors affecting the distribution and abundance of >350 other wildlife species that occur in sagebrush habitats during all or part of their life cycle (Wisdom et al. 2005).

Declines in abundance or loss of species can affect other species due to the influence individual species have on their environment or through cascading trophic interactions. Many species create, modify, or maintain their environment and through these actions influence ecosystem processes (Jones et al. 1994). For example, pygmy rabbit and least chipmunk (*Tamias minimus*) modify the soil profile through construction of burrows. Harvester ants (*Pogonomyrmex* spp.) alter soil characteristics through nest construction (Mandel and Sorenson 1982, Carlson and Whitford 1991) and also change plant distributions by preferentially harvesting and distributing seeds (Whitford 1978). Harvester ants may consume 10-26% of total seed bank, up to 100% of seed production of their preferred plant species (Crist and MacMahon 1992), and influence the distribution of exotic plant species in sagebrush habitats (Mull and MacMahon 1996).

Direct trophic interactions may also be influenced by changing habitat conditions (Clark et al. 1997, Grabowski 2004). Ants, including harvester ants, are the primary food source of the short-horned lizard (*Phrynosoma hernandesi*; Powell and Russell 1985), a species of conservation concern (U.S. Department of the Interior 2002). Changes in the environment that influence the distribution of ants can alter short-horned lizard distribution and abundance (Suarez and Case 2002). Similarly, interactions between raptors, including golden eagle (*Aquila chrysaetos*) and ferruginous hawk (*Buteo regalis*), and their mammalian prey such as white-tailed jackrabbit (*Lepus townsendii*) and cottontail (*Sylvilagus* spp.) (McGahan, 1967), can be disrupted by natural or human disturbances that alter their environment. Construction of power lines can increase the number of nesting raptors in an area (Steenhof et al. 1993) potentially leading to increased predation pressure on local mammal and bird populations. Human disturbance may also have indirect effects (Leu et al. 2008) on prey species that change abundance of food for predator populations.

We developed spatially explicit models of occurrence and abundance for multiple ant, reptile, and mammal species in the Wyoming Basins Ecoregional Assessment (WBEA). We used field surveys conducted throughout the Wyoming Basins (Ch. 4) to derive relationships between species occurrence and abundance and Geographic Information System (GIS)-derived habitat and disturbance variables measured across multiple extents. Our models provide a multi-species view of the sagebrush ecosystem that can improve our ability to adapt management actions to ecosystem changes. Additionally, these models are useful for assessing effects of proposed or future development across the WBEA area on more common species or those of less perceived conservation priority, but which still play important roles in ecological processes.

METHODS

Field Surveys

We conducted two rounds of field surveys within 7.29 ha survey blocks sampled in 2005 and 2006 (Ch. 4) using a plot-search technique to sample ants, lizards, snakes, pygmy rabbits, and small to medium-sized mammals. We randomly selected the order in which survey blocks were surveyed each day and the starting location within each survey block (NE, NW, SE, and SW corner of each survey block). For each survey, we noted start time and measured sampling effort (min). We sampled survey blocks by walking parallel transects spaced 30 m apart for a total length of 2.16 km (Fig. 4.2). The first round of surveys was conducted from 28 April through 21 June between 0800 and 1000 hr during which we focused on sampling ants, pygmy rabbits, and other medium-sized mammals. The second round, focused on reptiles and medium-sized mammals, was conducted from 6 July through 2 September on sunny days between 0800 hr (actual start time varied with air temperature) and 1800 hr.

Ants

We counted ant mounds on survey blocks while walking transects (McIver et al. 1997). We differentiated between mound types based on mound characteristics (Beever and Herrick 2006). Mounds built of sand or pebbles were designated as harvester ant mounds (*P. occidentalis* and *P. owyheei*) and those constructed of thatch were thatch ant mounds (*Formica haemorrhoidulis, F. obscuripes, F.obscuriventris* and *F. oreas*; Wheeler and Wheeler 1988). While walking transects, observers tallied mounds detected by type within 15 m of the transect line.

Reptiles

We used visual encounter surveys to sample lizards and snakes. Surveys were conducted during peak activity hours of lizard and snake species to maximize detectability (Diller and Johnson 1982; Guyer and Linder 1985). Observers tracked time of sampling effort. Transects were walked slowly, carefully checking the understory vegetation and sagebrush canopy for basking lizards, noting reptiles detected within 15 m (Germaine and Wakeling 2001). When possible, we used binoculars to identify species. We recorded the perpendicular distance from the transect to each observation.

Pygmy rabbits

Observers looked for burrow locations while walking transects and scanned the surrounding area for pygmy rabbits. Observers tracked time of sampling effort. Total number of rabbits seen and number of burrows detected were recorded within each of five burrow categories (modified from Ulmschneider 2004, Himes and Drohan 2007): (1) active with pellets (brown pellets near a burrow, at least one entrance open without cobwebs or debris indicating lack of use, usually shows a trail); (2) active without pellets (burrow entrance is not collapsed but no pellets found; also burrows in snow where no tracks or pellets are visible); (3) inactive with pellets (burrow entrances have cobwebs, grass seeds, or other debris in entrance, but with brown pellets; may show transitory use); (4) inactive without pellets (burrow seems right for pygmy rabbit; burrow entrances have cobwebs, grass seeds, or other debris in entrance but no pellets or recent activity present); and (5) undetermined (burrow characteristics suggested pygmy rabbit, but pellets were confusing or absent, it was not in association with other pygmy rabbit burrows [identified by pellets or sightings], or burrow status was unknown due to weather damage).

We only considered actual sightings and active burrows to indicate presence of pygmy rabbits (burrow categories one and two above) for analyses. We excluded all other detection categories because burrows could have been dug or maintained by other fossorial mammals and because contemporary habitat use could not be determined from inactive burrows. We also restricted the dataset to the known range of the species (Ch. 2).

Medium-sized mammals

We surveyed small to medium-sized mammal species on survey blocks concurrent with both sampling rounds. For each survey, individual mammals detected within 15 m of the transect line were recorded by species to assess occurrence and abundance on survey blocks. Survey blocks were considered occupied if an individual was detected in one or both sampling periods.

Abundance Categories and Detection Probability

We classified abundance levels according to three classes for species that had a minimum of 100 occurrences (Ch. 4). Survey blocks with zero detections were categorized as absent. Histograms of survey blocks with counts > 0 were used to categorize survey blocks into two abundance classes (low and high) based on patterns in the frequency distribution.

We used program DISTANCE (Thomas et al. 2006) to calculate detection probability for species with distance estimated for each detection and an adequate number of detections (n > 60). Detections were

TABLE 7.1. Summary of ant surveys during 2005 and 2006 on 326 survey blocks in the Wyoming Basins Ecoregional Assessment area. Shown are harvester and thatch ant occurrence (total detections) in relation to road juxtaposition, by year, and total detections for both years.

Survey block type	Harvester ant			Thatch ant		
	2005	2006	Total	2005	2006	Total
On road	28 (775)	31 (962)	59 (1,737)	19 (69)	20 (162)	39 (231)
Near road	35 (797)	34 (675)	69 (1,472)	20 (148)	26 (180)	46 (328)
Far road	26 (1,105)	23 (397)	49 (1,502)	162 (32)	25 (112)	41 (144)
Total	89 (2,677)	88 (2,034)	177 (4,711)	55 (249)	71 (454)	126 (703)

entered in DISTANCE using distance intervals dependent upon the detection curve for the species. We considered the half-normal and hazard rate key functions using simple polynomial and cosine series expansions and selected models with the lowest AIC value. We did not fit other covariates to the detectability function.

Our data for medium-sized mammals did not meet assumptions necessary to calculate detection probability (Mackenzie et al. 2006), but we did have multiple surveys at each location. On survey blocks where we detected a species, we calculated the proportion of blocks with detections in one or both survey bouts as an informal assessment of detectability. Species that, when detected, are recorded during both survey bouts on a survey block are likely to have higher detectability.

Model Selection

Variables included in the model selection process for all species in this chapter included the standard candidate predictor set (Table 4.2). We did not consider mountain sagebrush (*A. tridentata* ssp. *vaseyana*) or four soil variables (pH, salinity, bulk density, and available water capacity), which were not directly associated with these species. We also excluded the other four soil variables (sand, silt, clay, and soil depth) from the candidate predictor set for non-fossorial species (white-tailed jackrabbit and cottontail). We calculated descriptive statistics for all predictor variables within presence/absence or abundance classes for each species. We also determined the number of survey blocks with predictor variable values > 0 within each abundance class and excluded from model development all variables/scales with <20 survey blocks in a class. We excluded correlated predictor variables from potential analyses, prior to model development (Ch. 4).

We used a hierarchical multi-stage modeling approach (Ch. 4) assessing all

TABLE 7.2. Reptile species detected in the Wyoming Basins Ecoregional Assessment area during area searches in 2005 and 2006 on 324 survey blocks. Shown are occurrences (detections) by year and totals for both years.

Species	Scientific name	2005	2006	Total
Bull snake	*Pituophis catenifer sayi*	1 (1)	0 (0)	1 (1)
Garter snake	*Thamnophis* spp.	1 (1)	1 (1)	2 (2)
Great basin gopher snake	*Pituophus melanoleucus deserticola*	0 (0)	1 (1)	1 (1)
Sagebrush lizard	*Sceloporus graciosus*	15 (22)	12 (13)	27 (35)
Prairie-lined racerunner	*Cnemidophorus sexlineatus viridis*	1 (1)	0 (0)	1 (1)
Short-horned lizard	*Phrynosoma hernandesi*	30 (36)	33 (39)	63 (75)

model subsets using logistic or generalized ordered logistic regression (GOLOGIT2 within Stata 10.1, Stata Corporation, College Station, TX, USA; Williams 2006) modeling approaches. We first examined scatterplots and histograms of sagebrush, NDVI, and abiotic variables to look for non-linearities and interactions and, if detected, included them in analyses. We used Akaike's Information Criterion, corrected for small sample sizes (AIC_c), for model selection (Burnham and Anderson 2002). We first evaluated each sagebrush and NDVI variable and identified circular moving window radius (extent) and combinations that had the strongest relationship to species occurrence. We used these selected sagebrush and NDVI variables as a base model and tested the relationship between species occurrence and all spatial extents for each vegetation, abiotic, and disturbance variable to identify the best spatial extent for each variable using AIC_c values. We then allowed the best spatial extent for each variable to compete with all possible combinations of other variables within the same category to identify the AIC_c-selected top model within that category. To avoid overfitting in generalized ordered logistic and logistic regression models, we limited the number of variables in all competing models to 10% (one variable per 10 survey blocks in the lowest frequency class) of the sample size in the lowest frequency class (Hosmer and Lemeshow 2000). After identifying the AIC_c-selected top model within vegetation, abiotic, and disturbance categories, we allowed variables within these models to compete both within and across submodels to develop the best overall composite model, holding sagebrush and NDVI base model constant. In order to incorporate model uncertainty, we used a weighted average of coefficients from models with a cumulative AIC_c weight of just ≥ 0.9 (Burnham and Anderson 2002). Coefficients were set to zero when a model did not contain a particular vari-

TABLE 7.3. Summary of pygmy rabbit surveys in the Wyoming Basins Ecoregional Assessment area on 329 survey blocks in 2005 and 2006 in relation to road proximity. Shown are occurrence and (total count) for sightings, active burrows with or without feces, undetermined activity burrows, and inactive burrows with or without feces.

	2005				2006				
	On road	Near road	Far road	Total	On road	Near road	Far road	Total	Study total
Sightings	1 (1)	1 (1)	0 (0)	2 (2)	3 (5)	3 (4)	4 (4)	10 (13)	12 (15)
Active burrows with feces	2 (4)	4 (8)	1 (2)	7 (14)	3 (4)	3 (4)	3 (4)	9 (12)	16 (26)
Active burrows without feces	4 (4)	3 (4)	1 (3)	8 (11)	1 (1)	4 (4)	0 (0)	5 (5)	13 (16)
Undetermined	3 (15)	5 (9)	3 (4)	11 (28)	1 (1)	1 (1)	1 (6)	3 (8)	14 (36)
Inactive burrows with feces	4 (19)	3 (9)	2 (3)	9 (31)	7 (10)	3 (5)	4 (4)	14 (19)	23 (50)
Inactive burrows without feces	4 (10)	4 (14)	4 (12)	12 (36)	5 (10)	8 (14)	4 (7)	17 (31)	29 (67)

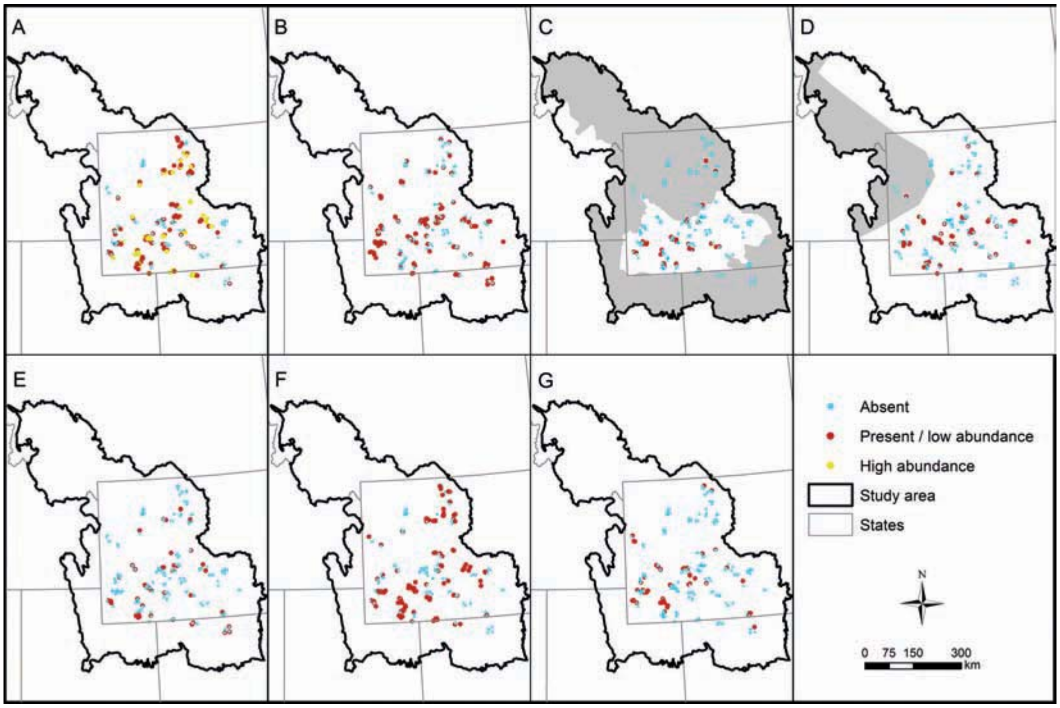

FIG. 7.1. Distribution of survey blocks in the Wyoming Basins Ecoregional Assessment area surveyed for (A) harvester ants, (B) thatch ants, (C) pygmy rabbits, (D) short-horned lizards, (E) white-tailed jackrabbits, (F) cottontails, and (G) least chipmunks. Ant mounds were an indicator of harvester ant abundance and survey blocks were designated as absent (blue, zero roost piles), low abundance (red, 1-ant mounds), or high abundance (yellow, >18 ant mounds). For all other species, survey blocks were designated as present (red, ≥1 detection) or absent (blue, no detection). The gray shaded areas are outside the current range of the species (Ch. 2; Patterson et al. 2003).

able. Accuracy of statistical models was evaluated with receiver operating characteristic (ROC) plots estimating area under the curve (AUC, Metz 1978). We determined an optimal cutoff threshold for predicting presence-absence of each species (i.e., habitat or non-habitat) using a sensitivity-specificity equality approach (Liu et al. 2005) and applied this threshold to assess predictive capacity for each model (Nielsen et al. 2004).

Spatial Application and Dose Response

We predicted species occurrence in a GIS at a 90-m resolution (pixel size) using the final model coefficients in ArcGIS raster calculator (ESRI 2006) and displayed final model predictions in 10% probability classes. Masks of non-sagebrush habitats (areas with <3% sagebrush habitat in a 5-km moving window) and those areas outside the known range of each species (pygmy rabbit: Ch. 2; all other species: Patterson et al. 2003) were used to identify areas where predictions were either not possible or where extrapolations occurred with high uncertainty. Probability of occurrence maps were subsequently converted to binary presence/absence maps based on sensitivity-specificity equality thresholds to maximize prediction success for each model. Where applicable, probability of occurrence output from generalized ordered logistic regression models were combined into a composite three-class abundance surface, predicting absent, low, and high abundance. The bin breakpoint separating absent from low/high abundance habitat was based on the sensitivity-specificity equality threshold to maximize prediction success for each model. Within low/high abundance habitat, the threshold was set at the point where predicted probability of high abundance habitat exceeded the probability of being low abundance habitat. Presence-absence maps allowed us to quantify proportion of WBEA area containing habitat likely to support populations of a species. For species with multiple abundance classes, we also assessed proportion of WBEA area likely to support low and high abundance populations of a given species.

Following development of species models, we plotted predicted probability of occurrence relative to changes in sagebrush metrics to assess critical levels of sagebrush required for a species to be present and to characterize response to losses or fragmentation of sagebrush habitat. We calculated these values using the Dose Response Calculator for ArcGIS (Hanser et al. 2011). We used the optimal cut-off threshold to identify the sagebrush threshold value above which the species was likely to occur.

Model Evaluation

We evaluated model fit for species for which we were able to obtain independent data by comparing observed proportion of locations in each probability bin against expected proportion of locations from the model using regression analysis (Johnson et al. 2006). A model with good fit should have a high R^2 value, a slope not different from 1.0, and an intercept not different from zero (Johnson et al. 2006).

RESULTS

Field Surveys

We sampled 329 survey blocks (165 in 2005 and 164 in 2006), of which 125 (65 in 2005, 60 in 2006) were on-road survey blocks, 103 (50 in 2005 and 53 in 2006) near-road survey blocks, and 101 (50 in 2005 and 51 in 2006) far-road survey blocks (Ch. 4). The number of survey blocks included in analyses varied depending on species surveyed.

Ants

We sampled 326 survey blocks for ant mounds. Harvester ants were detected at 54% and thatch ants at 38% of survey blocks (Table 7.1, Fig. 7.1). Occurrence of harvester ants did not differ between 2005 and 2006; thatch ants occurred more frequently in 2006. Harvester ants were more abundant with nearly seven times the number of mounds ($\bar{x}$= 2.01 mounds/ha; range: 0–41.7) detected than for thatch ants ($\bar{x}$ = 0.30; range: 0–12.1). In relation to stratified road distances, harvester ants were most numerous at on-road survey blocks whereas thatch ants were most numerous at near-road survey blocks.

Reptiles

We sampled 324 survey blocks for reptiles, including 156 in 2005 and 168 in 2006. No reptiles were detected on 74% of survey blocks. Where reptiles were detected, we observed 115 individual reptiles representing six species. The vast majority (95%) were lizards. Short-horned lizards were the most common species; we counted 64 individuals at 16% of the survey plots (Fig. 7.1, Table 7.2). We detected three snake species.

Pygmy rabbits

We surveyed 326 survey blocks for pygmy rabbits and their signs. We detected only 19 separate occurrences (Fig. 7.1c) within the known pygmy rabbit range, defined as a survey block with either a sighting or active burrows with feces. Small sample sizes precluded development of predictive models of pygmy rabbit distributions. Sightings were higher in 2006 (12 of 171) than in 2005 (2 of 155) (Table 7.3). One pygmy rabbit sighting in the Worland

TABLE 7.4. Summary of mammal surveys in the Wyoming Basins Ecoregional Assessment area during 2005 and 2006 on 329 survey blocks. Shown are occurrence (survey blocks detected), total detection in relation to road juxtaposition, and total detections for both years.

		2005			
			Total Detections		
Common name	Scientific name	Occurrence	On road	Near road	Far road
Golden-mantled ground squirrel	*Spermophilus lateralis*	0	0	0	0
Least chipmunk	*Tamias minimus*	46	50	25	40
Least weasel	*Mustela erminea*	1	0	1	0
Long-tailed weasel	*Mustela frenata*	1	0	2	0
Cottontail	*Sylvilagus* spp.	69	166	75	101
Red squirrel	*Tamiasciurus hudsonicus*	0	0	0	0
Thirteen-lined ground squirrel	*Spermophilus tridecemlineatus*	5	1	1	4
Uinta ground squirrel	*Spermophilus armatus*	0	0	0	0
White-tailed jackrabbit	*Lepus townsendii*	29	23	12	13
White-tailed prairie dog	*Cynomys leucurus*	17	30	26	27
Wyoming ground squirrel	*Spermophilus elegans*	17	11	19	9

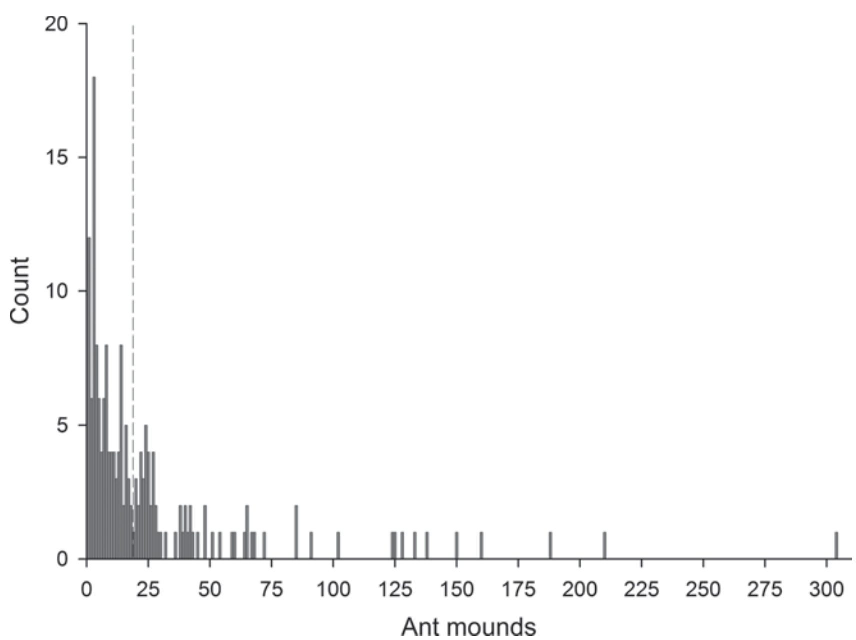

FIG. 7.2. Histogram of survey blocks (n = 177) in the Wyoming Basins Ecoregional Assessment area surveyed for harvester ant mounds where the number of mounds was > 0. Abundance at each survey block was represented by the total number of mounds. Survey blocks with zero mounds were classified as absent, survey blocks with 1-18 mounds as low abundance, and >18 mounds as high abundance. The dashed vertical line indicates the boundary between low and high abundance classes.

TABLE 7.4. Extended

2006				Total				
	Total Detections				Total Detections			
Occurrence	On road	Near road	Far road	Occurrence	On road	Near road	Far road	Total
3	1	1	3	3	1	1	3	5
10	5	4	8	56	55	29	48	132
0	0	0	0	1	0	1	0	1
0	0	0	0	1	0	2	0	2
76	150	116	105	145	316	191	206	713
3	0	12	1	3	0	12	1	13
29	22	19	18	34	23	20	22	65
13	5	6	47	13	5	6	47	58
42	25	18	18	71	48	30	31	109
2	1	0	1	19	31	26	28	85
16	8	8	17	33	19	27	26	72

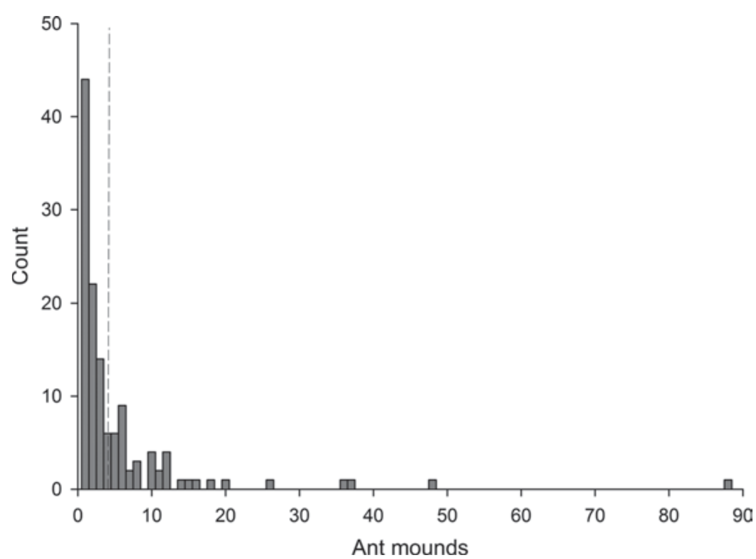

FIG. 7.3. Histogram of survey blocks (n = 126) in the Wyoming Basins Ecoregional Assessment area surveyed for thatch ant mounds (*Formica* spp.) where the number of mounds was >0. Abundance at each survey block is represented by the total number of mounds. The dashed vertical line indicates the selected boundary (4 mounds) between low and high abundance classes. There were 40 survey blocks above this selected boundary.

TABLE 7.5. Results of AIC_c-based model selection for harvester ant occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale sagebrush and NDVI; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
1	$ALLSAGE_{5km} + NDVI_{1km}$	-303.19	4	614.50	0.00	0.18
2	$ALLSAGE_{5km} + NDVI_{1km} + NDVI_{1km}^2$	-302.31	5	614.82	0.32	0.15
3	$BIGSAGE_{18km} + NDVI_{1km} + NDVI_{1km}^2$	-301.04	7	616.43	1.94	0.07

[a] Variable definitions provided in Table 4.2

TABLE 7.6. Evaluation statistics from AIC_c-based univariate model selection for harvester ant occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale vegetation, abiotic, and disturbance predictor variables (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and Akaike weight [w_i]). We ran generalized ordered logistic models with all sagebrush (5-km radius) and NDVI (1-km radius) variables as a base model for variables tested. We used AIC_c to sort models for each variable in ascending order to identify the extent at which harvester ants respond to individual variables.

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	$CFRST_{3km}$	-301.85	5	614.08	0.00	0.34
	$CFRST_{5km}$	-302.00	5	614.37	0.29	0.29
	$CFRST_{1km}$	-302.60	5	615.58	1.50	0.16
	$CFRST_{540}$	-302.90	5	616.18	2.10	0.12
	$CFRST_{270}$	-303.19	5	616.75	2.67	0.09
	$GRASS_{3km}$	-302.55	5	615.47	0.00	1.00
	MIX_{5km}	-301.93	5	614.23	0.00	0.77
	MIX_{18km}	-303.16	5	616.70	2.47	0.23
	RIP_{1km}	-302.48	5	615.34	0.00	0.26
	RIP_{5km}	-302.93	5	616.23	0.89	0.17
	RIP_{540}	-302.94	5	616.26	0.91	0.16
	RIP_{3km}	-302.96	5	616.29	0.95	0.16
	RIP_{18km}	-303.19	5	616.75	1.40	0.13
	RIP_{270}	-303.19	5	616.75	1.40	0.13
	$SALT_{1km}$	-302.81	5	616.00	0.00	0.20
	$SALT_{18km}$	-302.94	5	616.25	0.24	0.18
	$SALT_{540}$	-303.04	5	616.45	0.44	0.16
	$SALT_{5km}$	-303.05	5	616.47	0.47	0.16
	$SALT_{270}$	-303.08	5	616.53	0.53	0.16
	$SALT_{3km}$	-303.17	5	616.72	0.72	0.14
	$EDGE_{5km}$	-293.91	6	600.35	0.00	0.49
	$CONTAG_{1km}$	-297.39	6	607.30	6.94	0.02
	$EDGE_{1km}$	-298.24	6	609.01	8.66	0.01
	$CONTAG_{3km}$	-298.68	6	609.89	9.54	0.00

TABLE 7.6. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$EDGE_{3km}$	-302.87	5	616.11	15.76	0.00
Abiotic	CTI	-302.44	5	615.26	0.00	0.71
	CTI^{2b}	-302.24	6	617.01	1.75	0.29
	$ELEV^{2b}$	-267.45	8	551.82	0.00	0.93
	ELEV	-272.25	6	557.03	5.22	0.07
	$iH2Od_{500}^{c}$	-298.44	6	609.41	0.00	0.42
	$iH2Od_{1km}^{c}$	-298.47	6	609.46	0.04	0.41
	$iH2Od_{250}^{c}$	-300.38	5	611.13	1.72	0.18
	$pH2Od_{1km}^{c}$	-302.64	5	615.66	0.00	0.43
	$pH2Od_{250}^{c}$	-303.06	5	616.49	0.83	0.29
	$pH2Od_{500}^{c}$	-303.07	5	616.51	0.85	0.28
	SOLAR	-302.61	5	615.59	0.00	0.59
	$SOLAR^{2b}$	-301.91	6	616.35	0.76	0.41
	$Tmin^{2b}$	-290.83	7	596.37	0.00	0.57
	Tmin	-292.20	6	596.92	0.55	0.43
	TRI_{1km}	-295.94	7	606.59	0.00	0.78
	TRI_{540}	-297.66	7	610.02	3.43	0.14
	TRI_{18km}	-298.53	7	611.76	5.17	0.06
	TRI_{270}	-301.95	5	614.27	7.68	0.02
	CLAY	-301.25	5	612.87	0.00	1.00
	$SOIL_{cm}$	-299.94	5	610.26	0.00	1.00
	SAND	-296.42	6	605.36	0.00	1.00
Disturbance	AG_{1km}^{c}	-301.41	5	613.19	0.00	0.55
	AG_{500}^{c}	-302.00	5	614.38	1.19	0.30
	AG_{250}^{c}	-302.73	5	615.83	2.63	0.15
	$MjRD_{1km}^{c}$	-301.38	5	613.13	0.00	0.43
	$MjRD_{500}^{c}$	-301.55	5	613.48	0.35	0.36
	$MjRD_{250}^{c}$	-302.05	5	614.47	1.34	0.22
	$PIPE_{1km}^{c}$	-297.75	5	605.88	0.00	0.79
	$PIPE_{500}^{c}$	-299.28	5	608.94	3.07	0.17
	$PIPE_{250}^{c}$	-300.63	5	611.63	5.75	0.04
	$POWER_{1km}^{c}$	-302.14	5	614.65	0.00	0.41
	$POWER_{500}^{c}$	-302.44	5	615.26	0.61	0.30
	$POWER_{250}^{c}$	-302.51	5	615.40	0.75	0.28
	$RDdens_{5km}$	-302.83	5	616.04	0.00	0.14
	$RDdens_{3km}$	-302.92	5	616.22	0.17	0.13

TABLE 7.6. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$RDdens_{270}$	-303.06	5	616.50	0.46	0.11
	$RDdens_{1km}$	-303.08	5	616.54	0.50	0.11
	$2RD_{1km}^{c}$	-303.10	5	616.57	0.53	0.11
	$RDdens_{18km}$	-303.11	5	616.59	0.55	0.11
	$2RD_{500}^{c}$	-303.14	5	616.65	0.60	0.10
	$RDdens_{540}$	-303.15	5	616.68	0.63	0.10
	$2RD_{250}^{c}$	-303.17	5	616.71	0.67	0.10
	$WELL_{250}^{c}$	-300.90	5	612.17	0.00	0.56
	$WELL_{500}^{c}$	-301.52	5	613.41	1.23	0.30
	$WELL_{1km}^{c}$	-302.27	5	614.92	2.75	0.14

[a] Variable definitions provided in Table 4.2
[b] Quadratic function (variable + variable^2)
[c] Distance decay function ($e^{(\text{Euclidean distance from feature/-distance parameter})}$)

Basin was 100 km outside of the known range of the species, thus extending its known range.

Medium-sized mammals

We detected 1,255 individuals of 11 mammal species (Table 7.4) on 329 survey blocks. Occurrence was highest for cottontails (44%; for scientific names see Table 7.4), followed by white-tailed jackrabbits (22%), least chipmunks (17%), and thirteen-lined ground squirrels (10%) (Fig. 7.1). Ranking of occurrence by survey block did not follow ranking of total detections. Total detections were highest for cottontails, followed by least chipmunks, white-tailed jackrabbits, and white-tailed prairie dogs. Thirteen-lined and Wyoming ground squirrels occurred on more survey blocks and at higher total detections than Uinta ground squirrels. The least common species were long- and short-tailed weasels, and mammals (red squirrels and golden-mantled ground squirrels) that are not commonly found in shrubland ecosystems. Counts did not differ between years for the two lagomorph species. Counts for least chipmunks and white-tailed prairie dogs were higher in 2005 than in 2006; the reverse was true for the Uinta and thirteen-lined ground squirrels. Total counts were higher on on-road survey blocks for the two lagomorph species compared to the near-roads and far-road survey blocks. The reverse was true for the Uinta ground squirrel. For the thirteen-lined ground squirrels and white-tailed prairie dogs, abundance did not differ among road proximity strata.

Abundance Categories and Detection Probabilities

Survey blocks with no harvester ant mound detections were classified as absent, those with 1-18 harvester ant mounds per site as low abundance and >18 ant mounds per site as high abundance (Fig. 7.1 and 7.2). Thatch ant abundance appeared in three abundance categories based on ant mound density (Fig. 7.3) but only 40 survey blocks were classified as high abundance plots. Thus, we were limited to only modeling occurrence for the thatch ant model.

Only one species of reptile, short-horned lizard, had sufficient distance estimates and detections (n = 64) to assess detection probability using program DISTANCE. Detections were recorded in 1-m intervals, so we grouped detections into three distance bands (0-1.5, 1.5-2.5, and 2.5-3.5 m) with individuals between 0 and 1 m recorded as 1 m. The best model fit was the half-normal cosine with good model fit ($\chi^2_1 = 1.19$, $p < 0.28$) and an estimated probability of detection of 0.52. Only eight of 64 plots had >1 individual detected on a survey block (maximum of three detections), so we used a logistic regression for this species.

We did not have sufficient observations or data that met the assumptions for developing formal detection probability estimates for pygmy rabbits, medium-sized mammals and ants. Our informal analysis indicated that we had a high detection rate for cottontails, with 46% of occurrence survey blocks having detections in both rounds and single detection occurrence blocks occurring primarily during the first survey round. A high proportion of least chipmunk occurrences (0.82) were detected only in the first round of surveys; white-tailed jackrabbit detections were evenly spread between rounds one (0.39) and two (0.48), with only 13% of detections occurring in both.

Model Selection, Spatial Application, and Dose Response

Two variables from the pool of *a priori* variables for all species, mixed shrubland (0.27 km) and riparian (0.27 km), were excluded from model selection because they were present on <20 survey blocks. Slope, precipitation, mean annual maximum temperature, and soil silt content also were removed from consideration for all species owing to correlation with other variables.

Harvester ants

Four *a priori* variables were excluded because they contained values >0 on <20 survey blocks in the least frequent abundance category (high). These variables included proportion of coniferous forest (0.27, 0.54, and 1 km) and mixed shrubland (0.54 km). Coniferous forest (18 km), all sagebrush contagion (5 km), and all sage-

TABLE 7.7. Results of AIC_c-based submodel selection for harvester ant occurrence in the Wyoming Basins Ecoregional Assessment area; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	1	$ALLSAGE_{5km} + NDVI_{1km} + GRASS_{3km} + SALT_{1km} + RIP_{1km} + EDGE_{5km}$	-287.45	9	593.47	0.00	0.20
	2	$ALLSAGE_{5km} + NDVI_{1km} + GRASS_{3km} + SALT_{1km} + RIP_{1km} + EDGE_{5km} + MIX_{5km}$	-285.37	11	593.59	0.12	0.19
	3	$ALLSAGE_{5km} + NDVI_{1km} + GRASS_{3km} + SALT_{1km} + RIP_{1km} + EDGE_{5km} + CFRST_{3km}$	-286.99	10	594.69	1.22	0.11
	4	$ALLSAGE_{5km} + NDVI_{1km} + GRASS_{3km} + SALT_{1km} + EDGE_{5km} + MIX_{5km}$	-287.30	10	595.30	1.83	0.08
Abiotic	1	$ALLSAGE_{5km} + NDVI_{1km} + Tmin + Tmin^2 + CLAY + SAND + SOIL_{cm}$	-276.83	10	574.37	0.00	0.31
	2	$ALLSAGE_{5km} + NDVI_{1km} + Tmin + Tmin^2 + CLAY + SAND + iH2Od_{500}$	-276.85	10	574.39	0.03	0.31
Disturbance	1	$ALLSAGE_{5km} + NDVI_{1km} + PIPE_{1km} + WELL_{250} + AG_{1km}$	-292.76	7	599.87	0.00	0.19
	2	$ALLSAGE_{5km} + NDVI_{1km} + PIPE_{1km} + WELL_{250}$	-293.95	6	600.16	0.29	0.16
	3	$ALLSAGE_{5km} + NDVI_{1km} + PIPE_{1km} + WELL_{250} + AG_{1km} + RDdens_{5km}$	-292.61	8	601.68	1.82	0.08

[a] Variable definitions provided in Table 4.2

brush mean patch size (1, 3, and 5 km) were removed from consideration due to correlation with other variables. Several variables caused instability (i.e., non-convergence of likelihood estimates) in the generalized ordered logistic regression model and were therefore removed from submodel development: grassland (0.27, 0.54, 1, 5, and 18 km), mixed shrubland (1, and 3 km) land cover, elevation, and topographic ruggedness index (survey block, 3 and 5 km). Non-linear relationships were not evident between harvester ant occurrence and the sagebrush variables, although non-linearities with NDVI at all extents were apparent. Also, interactions between sagebrush and NDVI variables were not supported.

The AIC_c-selected top sagebrush/NDVI model consisted of all sagebrush within 5 km ($ALLSAGE_{5km}$) and NDVI within 1 km ($NDVI_{1km}$), Table 7.5). Within a 5-km radius, there was on average 2.1% more sagebrush at high abundance sites (69.5%, SE = 1.8) and 4.5% more at low abundance sites (71.9%, SE = 1.4) compared to unused sites (67.4%, SE = 2.1) (Appendix 7.1).

After assessing individual multi-scale covariates (Table 7.6) and developing submodels, the top vegetation submodel for harvester ants consisted of grassland within 3 km ($GRASSLAND_{3km}$), riparian within 1 km (RIP_{1km}), salt desert shrubland within 1 km ($SALT_{1km}$), and all sagebrush edge density within 5 km ($EDGE_{5km}$) in addition to the sagebrush/NDVI base model (Table 7.7). Soil depth ($SOIL_{cm}$), percent soil clay content (CLAY), percent soil sand content (SAND), and mean minimum temperature in quadratic form ($Tmin + Tmin^2$) were selected as important abiotic predictors of harvester ant occurrence (Table 7.7). Three disturbance factors, 1-km distance decay from agriculture (AG_{1km}), 1-km distance decay from pipelines ($PIPE_{1km}$), and 0.25-km distance decay from oil/gas wells ($WELL_{250}$) were included in the top disturbance submodel (Table 7.7).

The AIC_c-selected top model for harvester ants was a combination of vegetation, abiotic, and disturbance factors. Harvester ants were positively associated with increased minimum temperature, higher percent soil sand content, and proximity to pipelines. In contrast, harvester ants were negatively associated with highly productive habitats, large expanses of sagebrush, and increased percent clay and sand soil content (Table 7.8). However, weight of evidence for the top model was low (w_i = 0.18) indicating there were other suitable candidate models. Variables in the other candidate models with cumulative Akaike weights of just ≥ 0.9 indicate that harvester ant locations also were positively associated with increased sagebrush edge density (all sagebrush types within 5 km), increased soil depth, and proximity to agricultural land, but negatively associated with salt desert shrubland and grassland land cover and proximity to oil/gas development (Table 7.8). The final composite model-averaged linear predictors of occurrence for the low (Eq. 7.1) and high (Eq. 7.2) abundance categories are listed below.

$$Prob_{low} = 1 / (1 + (exp(-(4.07 - 1.88 * ALLSAGE_{5km} - 7.99 * NDVI_{1km} + 0.68 * Tmin + 0.06 * Tmin^2 - 0.02 * CLAY + 0.03 * SAND + 1.21 * PIPE_{1km} - 0.90 * WELL_{250} + 0.005 * EDGE_{5km} + 0.001 * SOIL_{cm} - 0.04 * RIP_{1km} - 0.83 * GRASS_{3km} + 0.10 * AG_{1km} - 0.02 * SALT_{1km})))) \quad (7.1)$$

$$Prob_{high} = 1 / (1 + (exp(-(4.07 - 1.88 * ALLSAGE_{5km} - 7.99 * NDVI_{1km} + 0.48* Tmin + 0.06 * Tmin^2 + -0.02 * CLAY + 0.03 * SAND + 1.21 * PIPE_{1km} - 0.90 * WELL_{250} + 0.001 * EDGE_{5km} + 0.001 * SOIL_{cm} - 0.04 * RIP_{1km} - 0.83 * GRASS_{3km} + 0.10 * AG_{1km} - 0.02 * SALT_{1km})))) \quad (7.2)$$

The model averaged predictor of harvester ant occurrence had excellent model accuracy (ROC AUC = 0.84) when predicting harvester ant presence and was a slight improvement over the AIC_c-selected top model (ROC AUC = 0.83). Our model of harvester ant occurrence had an optimal sensitivity-specificity equality threshold of 0.53 when determining presence/absence, which resulted in correct classification of 79.7% of survey blocks.

Harvester ant occurrence was predicted to be highest in the central part of the WBEA (Fig. 7.4). Based on our optimal cutoff point and a binary presence/absence classification, 99,555 km^2 (34.4%) of suitable harvester ant habitat was predicted within the Wyoming Basins (Fig. 7.5). Roughly one quarter (26.0%) of predicted presence was considered high-density habitat (25,869 km^2, Fig. 7.5). Harvester ants were more likely to occur in areas that contained between 63 and 75% all sagebrush landcover within a 5-km radius (Fig. 7.6).

Thatch ants

Three predictor variables, salt desert shrubland (0.27, 0.54, and 1 km), were excluded because they were present on <20 survey blocks in the least frequent category (absent). Variables excluded owing to correlations with other variables included coniferous forest (3, 5, and 18 km), salt desert shrubland (3 and 5 km), all sagebrush mean patch size (1, 3, and 5 km), and distance decay from perennial water (0.25-, 0.50,- and 1-km distance parameter). We visually inspected sagebrush/NDVI interactions and quadratic functions for the NDVI variables but non-linearities were not apparent for sagebrush.

Based on logistic regression analyses, the AIC_c-selected top sagebrush/NDVI model included all sagebrush within 3 km ($ALLSAGE_{3km}$) and quadratic form of NDVI with 5 km ($NDVI_{5km} + NDVI_{5km}^2$) (Table 7.9). Within 3 km, there was 5.9% more all sagebrush at presence sites (74.5 %, SE = 1.7) than at absence sites (68.6 %, SE = 1.6; Appendix 7.2).

After assessing individual multi-scale covariates (Table 7.10) and developing submodels, the top vegetation submodel for thatch ants consisted of grassland within 0.54-km ($GRASS_{540}$), mixed shrubland within 18-km (MIX_{18km}), riparian within 5-km (RIP_{5km}), all sagebrush contagion within 5km ($CONTAG_{5km}$), and salt desert shrubland within 18-km ($SALT_{18km}$) in addition to the sagebrush/NDVI base model (Table 7.11). Compound Topographic Index (CTI) together with the quadratic form of elevation ($ELEV + ELEV^2$) and solar radiation ($SOLAR + SOLAR^2$) were important abiotic predictors (Table 7.11). Five disturbance factors, 1-km distance decay from agriculture (AG_{1km}), 1-km distance decay from interstate/major highways ($MjRD_{1km}$), 1-km distance decay from power lines ($POWER_{1km}$), 1-km distance decay from oil/gas wells ($WELL_{1km}$), and road density within 18-km ($RDdens_{18km}$) were included in the top disturbance submodel (Table 7.11).

The AIC_c-selected top model for thatch ants was a combination of vegetation and abiotic factors. Thatch ants were positively associated with large expanses of all sagebrush land cover, areas with moderate to high productivity, increased proportion of riparian land cover, increased topographic moisture, and moderate to high elevation and solar radiation, but negatively associated with increased proportion of grassland and mixed shrubland (Table 7.12). The weight of evidence for the AIC_c-selected top model was low (w_i = 0.02) with 217 other models included within the cumulative Akaike weights of just ≥ 0.9. The other candidate models showed that, in addition to factors in the AIC_c-selected top model, thatch ant locations were positively associated with proximity to power lines and agriculture and negatively associated with all sagebrush contagion, salt desert shrubland

TABLE 7.8. Results of AIC_c-based model selection for the combined harvester ant model[a] in the Wyoming Basins Ecoregional Assessment area; the table also shows parameter estimates (beta [SE]) and evaluation statistics (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and cumulative Akaike weight [$\sum w_i$]). Models are shown with cumulative Akaike weight (w_i) of just ≥ 0.9.

Rank	Constant	$ALLSAGE_{5km}$	$NDVI_{1km}$	Tmin	$Tmin^2$	SAND	CLAY	$PIPE_{1km}$
1	present: 4.89 (0.91) high: 2.24 (0.86)	-1.98 (0.75)	-8.07 (1.76)	present: 0.82 (0.22) high: 0.57 (0.21)	0.07 (0.03)	0.04 (0.01)	-0.04 (0.02)	1.33 (0.42)
2	present: 5.74 (1.03) high: 3.05 (0.98)	-3.06 (0.85)	-9.51 (1.76)	present: 0.89 (0.22) high: 0.63 (0.21)	0.08 (0.03)	0.03 (0.01)		1.55 (0.42)
3	present: 4.85 (0.91) high: 2.20 (0.87)	-2.10 (0.75)	-9.38 (1.75)	present: 0.89 (0.22) high: 0.64 (0.21)	0.09 (0.03)	0.03 (0.01)		1.69 (0.43)
4	present: 4.93 (0.92) high: 2.28 (0.88)	-2.17 (0.76)	-10.18 (1.87)	present: 0.82 (0.22) high: 0.56 (0.21)	0.07 (0.03)	0.03 (0.01)		1.42 (0.42)
5	present: 3.06 (1.39) high: 0.40 (1.38)	-1.63 (0.85)	-8.15 (1.80)	present: 0.79 (0.22) high: 0.53 (0.21)	0.07 (0.03)	0.03 (0.01)		1.43 (0.42)
6	present: 4.65 (0.92) high: 2.04 (0.88)	-1.48 (0.76)	-8.63 (1.79)	present: 0.84 (0.21) high: 0.59 (0.21)	0.08 (0.03)		-0.07 (0.02)	1.15 (0.42)
7	present: 4.80 (0.91) high: 2.15 (0.87)	-2.28 (0.74)	-9.13 (1.74)	present: 0.84 (0.22) high: 0.58 (0.21)	0.07 (0.03)	0.03 (0.01)		1.49 (0.42)
8	present: 1.04 (1.29) high: 0.50 (1.35)	-0.99 (0.86)	-8.28 (1.76)			0.03 (0.01)	-0.05 (0.02)	1.30 (0.43)
9	present: 5.17 (0.90) high: 2.59 (0.85)	-2.05 (0.76)	-9.21 (1.77)	present: 0.79 (0.22) high: 0.56 (0.21)	0.07 (0.03)	0.02 (0.01)	-0.08 (0.02)	
10	present: 4.66 (0.92) high: 2.02 (0.88)	-2.30 (0.75)	-9.42 (1.78)	present: 0.86 (0.22) high: 0.61 (0.21)	0.08 (0.03)	0.03 (0.01)		1.49 (0.42)
11	present: 4.74 (0.91) high: 2.09 (0.87)	-2.20 (0.75)	-8.84 (1.77)	present: 0.84 (0.22) high: 0.58 (0.21)	0.07 (0.03)	0.03 (0.01)		1.48 (0.42)
12	present: 5.29 (1.13) high: 2.64 (1.10)	-2.60 (0.86)	-9.79 (1.97)	present: 0.83 (0.22) high: 0.57 (0.21)	0.07 (0.03)	0.03 (0.01)		1.46 (0.42)
13	present: 1.57 (1.36) high: 1.14 (1.41)	-2.04 (0.92)	-9.64 (1.77)			0.03 (0.01)		1.50 (0.43)
14	present: 5.70 (0.90) high: 3.10 (0.84)	-1.94 (0.77)	-10.04 (1.84)	present: 0.70 (0.22) high: 0.46 (0.21)	0.05 (0.03)	0.03 (0.01)	-0.06 (0.02)	
15	present: 3.21 (1.35) high: 0.62 (1.34)	-1.26 (0.86)	-7.39 (1.80)	present: 0.66 (0.22) high: 0.42 (0.21)	0.05 (0.03)	0.04 (0.01)	-0.06 (0.02)	
16	present: 1.35 (1.32) high: 0.84 (1.38)	-1.75 (0.91)	-8.28 (1.76)			0.03 (0.01)	-0.05 (0.02)	1.12 (0.42)
17	present: 0.98 (1.33) high: 0.44 (1.39)	-0.59 (0.90)	-8.69 (1.77)				-0.07 (0.02)	1.11 (0.43)
18	present: 2.80 (1.40) high: 0.23 (1.38)	-0.64 (0.90)	-8.01 (1.81)	present: 0.71 (0.21) high: 0.48 (0.21)	0.07 (0.03)		-0.09 (0.02)	

TABLE 7.8. Extended

$GRASS_{3km}$	$WELL_{250}$	AG_{1km}	$EDGE_{5km}$	$SOIL_{CM}$	RIP_{1km}	$SALT_{1km}$	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
							-274.69	10	570.07	0	0.184
-4.56 (2.26)							-275.02	10	570.73	0.66	0.316
	-4.29 (2.27)						-275.10	10	570.91	0.84	0.437
		1.22 (0.73)					-275.89	10	572.48	2.41	0.492
			0.02 (0.01)				-275.96	10	572.62	2.55	0.543
				0.02 (0.005)			-276.12	10	572.94	2.87	0.587
							-277.3	9	573.17	3.1	0.626
	-4.81 (2.10)		present: 0.04 (0.01) high: 0.01 (0.01)				-276.43	10	573.55	3.48	0.658
				0.01 (0.01)			-276.83	10	574.37	4.3	0.68
				0.004 (0.005)			-276.9	10	574.51	4.43	0.7
					-1.85 (2.50)		-277.02	10	574.74	4.67	0.718
						-1.04 (1.41)	-277.03	10	574.76	4.69	0.735
-4.87 (2.32)	-4.84 (2.13)		present: 0.05 (0.01) high: 0.01 (0.01)				-277.13	10	574.96	4.89	0.751
		1.64 (0.72)					-277.17	10	575.03	4.96	0.766
			0.02 (0.01)				-277.22	10	575.14	5.07	0.781
-4.79 (2.32)			present: 0.05 (0.01) high: 0.02 (0.01)				-277.29	10	575.27	5.2	0.795
	-4.64 (2.10)		present: 0.04 (0.01) high: 0.01 (0.01)	0.02 (0.005)			-277.33	10	575.36	5.29	0.808
			0.02 (0.01)	0.02 (0.005)			-277.37	10	575.44	5.37	0.82

TABLE 7.8. Continued

Rank	Constant	$ALLSAGE_{5km}$	$NDVI_{1km}$	Tmin	$Tmin^2$	SAND	CLAY	$PIPE_{1km}$
19	present: 0.48 (1.33) high: -0.13 (1.39)	-1.03 (0.88)	-8.33 (1.76)			0.02 (0.01)	-0.07 (0.02)	0.98 (0.42)
20	present: 6.40 (1.01) high: 3.81 (0.95)	-2.82 (0.84)	-9.28 (1.77)	present: 0.77 (0.22) high: 0.53 (0.21)	0.06 (0.03)	0.04 (0.01)	-0.05 (0.02)	
21	present: 5.38 (0.92) high: 2.80 (0.86)	-1.45 (0.78)	-10.44 (1.88)	present: 0.75 (0.21) high: 0.51 (0.20)	0.06 (0.03)		-0.08 (0.02)	
22	present: 0.84 (1.32) high: 0.22 (1.38)	-0.88 (0.89)	-8.94 (1.75)			0.02 (0.01)	-0.08 (0.02)	
23	present: 1.01 (1.31) high: 0.46 (1.37)	-0.98 (0.89)	-9.21 (1.87)			0.03 (0.01)	-0.05 (0.02)	1.03 (0.42)
24	present: 1.11 (1.32) high: 0.65 (1.37)	-1.40 (0.85)	-9.48 (1.76)			0.03 (0.01)		1.47 (0.43)
25	present: 2.79 (1.51) high: 2.34 (1.55)	-3.22 (1.06)	-11.24 (2.01)			0.03 (0.01)		1.23 (0.42)
26	present: 1.84 (1.31) high: 1.34 (1.37)	-1.65 (0.92)	-8.98 (1.75)			0.03 (0.01)	-0.06 (0.02)	
27	present: 1.12 (1.34) high: 0.66 (1.39)	-1.22 (0.89)	-10.45 (1.90)			0.03 (0.01)		1.41 (0.43)
28	present: 4.84 (0.93) high: 2.25 (0.88)	-1.73 (0.74)	-9.98 (1.79)	present: 0.90 (0.22) high: 0.65 (0.21)	0.10 (0.03)			1.61 (0.43)
29	present: 5.31 (0.91) high: 2.77 (0.85)	-1.54 (0.76)	-9.64 (1.79)	present: 0.81 (0.21) high: 0.58 (0.21)	0.08 (0.03)		-0.08 (0.02)	
30	present: 0.96 (1.29) high: 0.42 (1.34)	-1.17 (0.85)	-8.18 (1.75)			0.03 (0.01)	-0.05 (0.02)	1.10 (0.42)
31	present: 5.54 (0.88) high: 2.98 (0.83)	-2.13 (0.75)	-8.85 (1.74)	present: 0.72 (0.21) high: 0.49 (0.20)	0.05 (0.03)	0.04 (0.01)	-0.05 (0.02)	
32	present: 0.81 (1.33) high: 0.38 (1.38)	-1.17 (0.87)	-8.83 (1.80)			0.03 (0.01)		1.43 (0.43)
33	present: 5.64 (0.89) high: 3.08 (0.83)	-2.02 (0.75)	-9.08 (1.75)	present: 0.75 (0.22) high: 0.52 (0.21)	0.06 (0.03)	0.03 (0.01)	-0.06 (0.02)	
34	present: 5.19 (0.90) high: 2.65 (0.85)	-1.65 (0.76)	-9.37 (1.78)	present: 0.77 (0.21) high: 0.54 (0.20)	0.07 (0.03)		-0.08 (0.02)	
35	present: 0.77 (1.35) high: 0.15 (1.40)	-0.79 (0.92)	-9.80 (1.86)			0.02 (0.01)	-0.08 (0.02)	
36	present: 1.12 (1.36) high: 0.54 (1.42)	-1.48 (0.94)	-8.88 (1.75)			0.02 (0.01)	-0.08 (0.02)	

[a] Variable definitions provided in Table 4.2

TABLE 7.8. Extended

$GRASS_{3km}$	$WELL_{250}$	AG_{1km}	$EDGE_{5km}$	$SOIL_{CM}$	RIP_{1km}	$SALT_{1km}$	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
			present: 0.04 (0.01) high: 0.02 (0.01)	0.01 (0.01)			-277.44	10	575.58	5.51	0.832
-4.13 (2.27)							-277.89	10	576.48	6.41	0.839
		1.47 (0.74)		0.02 (0.005)			-277.92	10	576.55	6.47	0.847
	-3.56 (1.98)		present: 0.05 (0.01) high: 0.02 (0.01)	0.01 (0.01)			-278.23	10	577.17	7.1	0.852
		1.17 (0.71)	present: 0.04 (0.01) high: 0.01 (0.01)				-278.34	10	577.39	7.32	0.857
	-4.65 (2.12)		present: 0.04 (0.01) high: 0.01 (0.01)				-278.51	10	577.72	7.65	0.861
-6.47 (2.62)			present: 0.05 (0.01) high: 0.02 (0.01)			-3.06 (1.57)	-278.52	10	577.75	7.67	0.865
-5.08 (2.43)	-3.93 (1.98)		present: 0.05 (0.01) high: 0.02 (0.01)				-278.53	10	577.75	7.68	0.869
	-4.65 (2.13)	1.07 (0.72)	present: 0.04 (0.01) high: 0.01 (0.01)				-279.64	9	577.84	7.77	0.872
	-4.52 (2.24)			0.01 (0.004)			-278.58	10	577.87	7.79	0.876
	-3.15 (2.14)			0.02 (0.005)			-278.59	10	577.88	7.81	0.88
			present: 0.04 (0.01) high: 0.01 (0.01)				-278.62	10	577.95	7.88	0.883
							-279.72	9	578.01	7.94	0.887
	-4.67 (2.14)		present: 0.04 (0.01) high: 0.01 (0.01)		-3.51 (2.51)		-279.75	9	578.07	8	0.89
	-2.86 (2.15)						-278.73	10	578.15	8.08	0.893
				0.02 (0.005)			-278.78	10	578.26	8.19	0.896
		1.18 (0.72)	present: 0.05 (0.01) high: 0.02 (0.01)	0.01 (0.01)			-278.8	10	578.3	8.23	0.899
-3.73 (2.41)			present: 0.05 (0.01) high: 0.02 (0.01)	0.01 (0.01)			-279.87	9	578.3	8.23	0.902

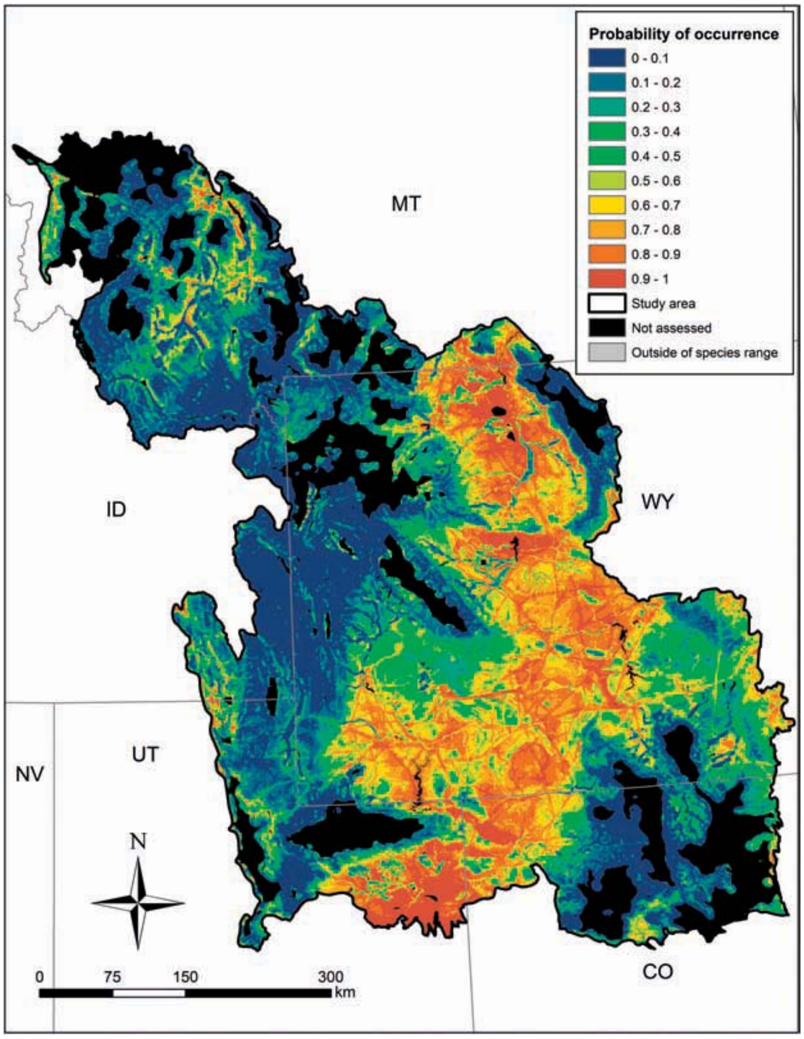

FIG. 7.4. Harvester ant probability of occurrence in the Wyoming Basins Ecoregional Assessment area. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water). Harvester ants are likely to occur in areas with probability > 0.53.

land cover, proximity to oil/gas wells and interstates/major highways (Table 7.12). The final composite probability of occurrence model is below.

(7.3)

$$\text{Prob} = 1 / (1 + (\exp(-(-19.30 + 1.39 * \text{ALLSAGE}_{3km} + 15.22 * \text{NDVI}_{5km} - 9.18 * \text{NDVI}_{5km}{}^{2} - 4.61 * \text{GRASS}_{540} - 40.84 * \text{MIX}_{18km} + 5.65 * \text{RIP}_{5km} + 0.09 * \text{CTI} + 0.006 * \text{ELEV} - 0.000001 * \text{ELEV}^{2} + 0.11 * \text{SOLAR} - 0.0005 * \text{SOLAR}^{2} + 0.26 * \text{POWER}_{1km} - 0.005 * \text{CONTAG}_{5km} - 2.74 * \text{SALT}_{18km} + 0.20 * \text{RDdens}_{18km} - 0.62 * \text{WELL}_{1km} - 0.13 * \text{MjRD}_{1km} + 0.009 * \text{AG}_{1km}))))$$

The composite model of thatch ant occurrence had excellent model accuracy (ROC AUC = 0.81), which was similar to the AIC_c-selected top model only (ROC AUC = 0.81). The optimal cutoff probability for predicting thatch ant occurrence based on

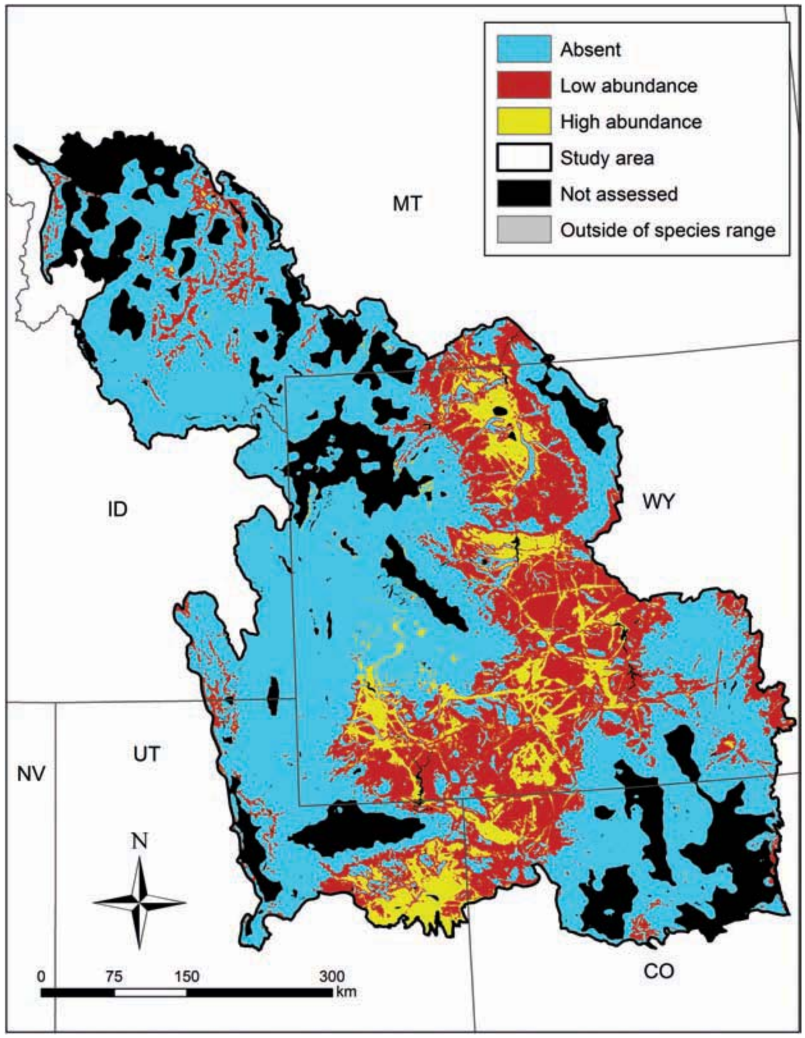

FIG. 7.5. Distribution of harvester ants estimated from ant mound abundance in the Wyoming Basins Ecoregional Assessment area based on optimum probability cutoff threshold of 0.53. Low abundance areas have an expected harvester ant mound abundance between >0 and 2.47 mounds/ha and >2.47 mounds/ha for the high class. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water).

the sensitivity-specificity equality threshold was 0.38 resulting in an overall percent correctly classified accuracy of 70.5%.

Thatch ant occurrence was predicted to be highest in higher elevation shrubland areas of the south east and western portions of the WBEA area (Fig. 7.7). Based on our optimal cutoff point and a binary presence/absence classification, 58.2% (201,031 km^2) of the Wyoming Basins was predicted as thatch ant habitat (Fig. 7.8). Thatch ants were likely to occur across the range of $ALLSAGE_{3km}$ values (Fig. 7.9).

Short-horned lizards

Four predictor variables were excluded because they contained values > 0 on <20 survey blocks in the least frequent abundance category (present). These variables included proportion of coniferous forest

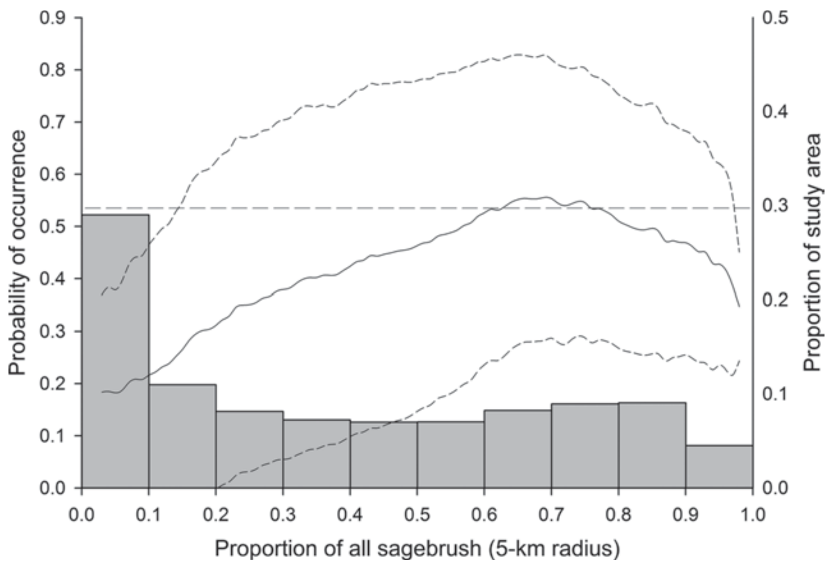

FIG. 7.6. Distribution of harvester ant probability of occurrence within the Wyoming Basins Ecoregional Assessment area in relation to proportion of all sagebrush (*Artemesia* spp.) within a 5-km radius. Mean probability of occurrence (black line, ±1 SD [dashed lines]) values were calculated in each one percent increment of all sagebrush within a 5-km radius moving window. Range of predictions relate to the observed range of sagebrush at study site locations. The dashed horizontal line represents the optimal cutoff threshold (0.53), above which occurrence is predicted. Histogram values represent the proportion of the total study area in each 10% segment of all sagebrush within 5 km.

(0.27, 0.54, and 1 km) and mixed shrubland (0.54 km). Coniferous forest (3, 5, and 18 km), all sagebrush mean patch size (1, 3, and 5 km), and salt desert shrub (3, 5, and 18 km) were removed from consideration owing to correlations with other variables. No interactions or non-linear relationships were evident for sagebrush or NDVI variables.

Based on logistic regression analyses, the AIC_c-selected top sagebrush/NDVI model included all big sagebrush (*A. tridentata*) within 5-km ($ABIGSAGE_{5km}$) and NDVI within 18-km ($NDVI_{18km}$) (Table 7.13). All models with $\Delta AIC_c \leq 2$ contained $NDVI_{18km}$ and either all big sagebrush or all sagebrush as the sagebrush component at multiple scales. Within 5-km, there was

TABLE 7.9. Results of AIC_c-based model selection for thatch ant occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale sagebrush and NDVI; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
1	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2$	-193.12	4	394.49	0.00	0.09
2	$ALLSAGE_{5km} + NDVI_{5km} + NDVI_{5km}^2$	-193.61	4	395.48	0.98	0.05
3	$ALLSAGE_{3km} + NDVI_{5km} + ALLSAGE_{3km}\_NDVI_{5km}$	-193.62	4	395.49	0.99	0.05
4	$ALLSAGE_{5km} + NDVI_{5km} + ALLSAGE_{5km}\_NDVI_{5km}$	-193.76	4	395.78	1.28	0.05
5	$ALLSAGE_{18km} + NDVI_{18km}$	-194.94	3	396.02	1.53	0.04

[a] Variable definitions provided in Table 4.2

TABLE 7.10. Evaluation statistics from AIC_c -based univariate model selection for thatch ant occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale vegetation, abiotic, and disturbance predictor variables (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and Akaike weight [w_i]). We ran logistic models with all sagebrush (3-km radius) and NDVI (5-km radius; in quadratic form) variables as a base model for all variables tested. We used AIC_c to identify the scale at which thatch ants respond to individual variables.

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	$CFRST_{1km}$	-193.12	5	396.61	0.00	0.33
	$CFRST_{270}$	-193.12	5	396.61	0.00	0.33
	$CFRST_{540}$	-193.12	5	396.61	0.00	0.33
	$GRASS_{540}$	-190.79	5	391.95	0.00	0.32
	$GRASS_{1km}$	-190.89	5	392.15	0.21	0.28
	$GRASS_{270}$	-190.97	5	392.32	0.37	0.26
	$GRASS_{3km}$	-192.38	5	395.14	3.19	0.06
	$GRASS_{5km}$	-192.81	5	396.00	4.05	0.04
	$GRASS_{18km}$	-193.02	5	396.42	4.48	0.03
	MIX_{18km}	-189.32	5	389.02	0.00	0.77
	MIX_{5km}	-190.92	5	392.22	3.20	0.16
	MIX_{3km}	-192.42	5	395.22	6.20	0.03
	MIX_{540}	-193.01	5	396.40	7.38	0.02
	MIX_{1km}	-193.10	5	396.57	7.55	0.02
	RIP_{5km}	-187.33	5	385.03	0.00	0.35
	RIP_{18km}	-187.34	5	385.05	0.03	0.34
	RIP_{3km}	-188.20	5	386.77	1.75	0.14
	RIP_{1km}	-188.28	5	386.94	1.92	0.13
	RIP_{540}	-189.53	5	389.44	4.41	0.04
	$CONTAG_{5km}$	-192.37	5	395.11	0.00	0.31
	$CONTAG_{1km}$	-192.58	5	395.53	0.43	0.28
	$EDGE_{3km}$	-192.74	5	395.85	0.74	0.24
	$EDGE_{1km}$	-192.83	5	396.04	0.93	0.22
	$EDGE_{5km}$	-192.93	5	396.24	1.13	0.20
	$CONTAG_{3km}$	-193.02	5	396.42	1.32	0.18
	$SALT_{18km}$	-191.07	5	392.51	0.00	1.00
Abiotic	CLAY	-193.00	5	396.38	0.00	0.68
	$CLAY^{2}$[b]	-192.69	6	397.91	1.52	0.32
	CTI	-190.83	5	392.04	0.00	1.00
	$ELEV^{2}$[b]	-187.78	6	388.09	0.00	0.91
	ELEV	-191.20	5	392.77	4.68	0.09
	$iH2Od_{1km}$[c]	-192.39	5	395.15	0.00	0.45
	$iH2Od_{500}$[c]	-192.71	5	395.80	0.65	0.32
	$iH2Od_{250}$[c]	-193.08	5	396.53	1.39	0.22

TABLE 7.10. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$SOIL_{cm}$	-192.99	5	396.35	0.00	1.00
	SAND	-193.03	5	396.43	0.00	0.70
	$SAND^{2b}$	-192.78	6	398.09	1.67	0.30
	$SOLAR^{2b}$	-186.66	6	385.84	0.00	0.79
	SOLAR	-189.04	5	388.45	2.61	0.21
	Tmin	-190.17	5	390.72	0.00	1.00
	TRI_{270}	-190.11	5	390.59	0.00	0.25
	TRI	-190.29	5	390.95	0.36	0.21
	TRI_{18km}	-190.50	5	391.38	0.79	0.17
	TRI_{540}	-190.58	5	391.53	0.94	0.16
	TRI_{5km}	-191.09	5	392.56	1.97	0.10
	TRI_{1km}	-191.64	5	393.65	3.06	0.06
	TRI_{3km}	-191.70	5	393.77	3.18	0.05
Disturbance	AG_{1km}^{c}	-192.16	5	394.69	0.00	0.42
	AG_{500}^{c}	-192.44	5	395.25	0.56	0.32
	AG_{250}^{c}	-192.65	5	395.67	0.98	0.26
	$MjRD_{1km}^{c}$	-192.71	5	395.79	0.00	0.37
	$MjRD_{500}^{c}$	-192.74	5	395.86	0.07	0.36
	$MjRD_{250}^{c}$	-193.02	5	396.41	0.62	0.27
	$PIPE_{500}^{c}$	-192.42	5	395.22	0.00	0.37
	$PIPE_{1km}^{c}$	-192.52	5	395.41	0.19	0.33
	$PIPE_{250}^{c}$	-192.61	5	395.60	0.38	0.30
	$POWER_{1km}^{c}$	-191.32	5	393.02	0.00	0.55
	$POWER_{500}^{c}$	-192.04	5	394.46	1.44	0.27
	$POWER_{250}^{c}$	-192.42	5	395.21	2.19	0.18
	$RDdens_{18km}$	-192.55	5	395.48	0.00	0.17
	$RDdens_{3km}$	-192.94	5	396.26	0.78	0.12
	$RDdens_{5km}$	-193.01	5	396.40	0.93	0.11
	$2RD_{250}^{c}$	-193.02	5	396.42	0.94	0.11
	$RDdens_{270}$	-193.06	5	396.49	1.01	0.10
	$2RD_{1km}^{c}$	-193.09	5	396.55	1.07	0.10
	$RDdens_{1km}$	-193.11	5	396.60	1.12	0.10
	$2RD_{500}^{c}$	-193.12	5	396.62	1.14	0.10
	$RDdens_{540}$	-193.12	5	396.62	1.14	0.10
	$WELL_{1km}^{c}$	-191.03	5	392.43	0.00	0.39
	$WELL_{500}^{c}$	-191.25	5	392.87	0.45	0.31

TABLE 7.10. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$WELL_{250}$[c]	-191.31	5	392.99	0.56	0.30

[a] Variable definitions provided in Table 4.2
[b] Quadratic function (variable + variable^2)
[c] Distance decay function ($e^{(\text{Euclidean distance from feature /-distance parameter})}$)

10.7% more all big sagebrush at presence sites (76.4% SE = 1.8) than at absence sites (65.7% SE = 1.3; Appendix 7.3).

After assessing individual multi-scale covariates (Table 7.14) and developing submodels, the top vegetation submodel for short-horned lizard consisted of sagebrush contagion within 5 km ($CONTAG_{5km}$) in addition to the sagebrush/NDVI base model (Table 7.15). Compound topographic index (CTI) and topographic ruggedness index within 5 km (TRI_{5km}) were important abiotic predictors of short-horned lizard occurrence (Table 7.15). None of the disturbance factors were included in the top disturbance submodel (all big sagebrush/NDVI base model only; Table 7.15).

The AIC_c-selected top model for short-horned lizards was a combination of vegetation and abiotic factors. Short-horned lizards were positively associated with large contiguous expanses of big sagebrush and negatively associated with areas of high productivity, rugged terrain, and increased topographic moisture (Table 7.16). All candidate models with cumulative Akaike weights of just ≥ 0.9 (five total) were subsets of the AIC_c-selected top model (Table 7.16). The final composite probability of occurrence model is below.

$$\text{Prob} = 1 / (1 + (\exp(-(1.03 + 1.23 * ABIGSAGE_{5km} - 4.22 * NDVI_{18km} + 0.012 * CONTAG_{5km} - 0.18 * CTI - 0.04 * TRI_{5km})))) \quad (7.4)$$

The composite model of short-horned lizard occurrence had good model accuracy (ROC AUC = 0.72), which was slightly less than AIC_c-selected top model prediction (ROC AUC = 0.73). The optimal cutoff probability for predicting short-horned lizard occurrence, based on the sensitivity-specificity equality threshold, was 0.22 resulting in an overall percent correctly classified accuracy of 68.3%.

Short-horned lizard occurrence was predicted throughout the central portion of the Wyoming Basins (Fig. 7.10). Based on our optimal cutoff point and a binary presence-absence prediction, 46,648 km^2 (20.6%) of the range of the species in the Wyoming Basins was predicted to be short-horned lizard habitat (Fig. 7.11). Short-horned lizards were likely to occupy sites with >81% all big sagebrush land cover within 5 km (Fig. 7.12).

White-tailed jackrabbits

Four predictor variables were excluded because they contained values > 0 on <20 survey blocks in the least frequent abundance category (present). These variables included proportion of coniferous forest (0.27, 0.54, and 1 km) and mixed shrubland (0.54 km). None of the sagebrush or NDVI variables had non-linear relationships or evidence of interactions.

Based on logistic regression analyses, the AIC_c-selected top sagebrush/NDVI model included big sagebrush (*A. t.* ssp. *tridentata*, *A. t.* ssp. *wyomingensis*) within 0.27 km ($BIGSAGE_{270}$; Table 7.17). All models with $\Delta AIC_c \leq 2$ contained $BIGSAGE_{270}$ with NDVI at multiple radii. There was 13.6% more big sagebrush within 0.27-km at presence sites (70.3%, SE = 3.7) than at absent sites (56.7%, SE = 2.3; Appendix 7.4).

TABLE 7.11. Results of AIC_c -based submodel selection for thatch ant occurrence in the Wyoming Basins Ecoregional Assessment area; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	1	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + GRASS_{540} + RIP_{5km} + SALT_{18km} + MIX_{18km} + CONTAG_{5km}$	-180.61	9	380.36	0.00	0.11
	2	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + GRASS_{540} + RIP_{5km} + SALT_{18km} + MIX_{18km}$	-181.77	8	380.46	0.09	0.10
	3	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + GRASS_{540} + RIP_{5km} + SALT_{18km} + CONTAG_{5km}$	-182.04	8	380.99	0.63	0.08
	4	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + GRASS_{540} + RIP_{5km} + MIX_{18km}$	-183.16	7	381.03	0.67	0.08
	5	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + GRASS_{540} + SALT_{18km} + MIX_{18km} + CONTAG_{5km}$	-182.35	8	381.61	1.24	0.06
	6	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + GRASS_{540} + RIP_{5km} + SALT_{18km}$	-183.59	7	381.88	1.52	0.05
	7	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + GRASS_{540} + RIP_{5km} + SALT_{18km} + MIX_{18km} + CONTAG_{5km} + CFRST_{1km}$	-180.32	10	382.04	1.68	0.05
Abiotic	1	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + CTI$	-179.27	9	377.67	0.00	0.05
	2	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2$	-180.58	8	378.06	0.39	0.04
	3	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + CTI + Tmin$	-178.40	10	378.20	0.53	0.03
	4	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + Tmin$	-179.64	9	378.42	0.75	0.03
	5	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + CTI + SOIL_{cm}$	-178.68	10	378.75	1.08	0.03
	6	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + CTI + SAND$	-178.87	10	379.14	1.47	0.02
	7	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + CTI + iH2Od_{1km}$	-178.89	10	379.17	1.50	0.02
	8	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + CTI + Tmin + SOIL_{cm}$	-177.83	11	379.33	1.66	0.02
	9	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + TRI_{270}$	-180.20	9	379.54	1.87	0.02
	10	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + CTI + Tmin + SAND$	-177.94	11	379.55	1.88	0.02
	11	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + ELEV + ELEV^2 + SOLAR + SOLAR^2 + CTI + Tmin + iH2Od_{1km}$	-177.99	11	379.65	1.98	0.02
Distrubance	1	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + MjRD_{1km} + AG_{1km} + RDdens_{18km}$	-185.45	9	390.03	0.00	0.06
	2	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + MjRD_{1km} + AG_{1km}$	-186.66	8	390.23	0.20	0.05
	3	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + MjRD_{1km} + RDdens_{18km}$	-186.88	8	390.66	0.63	0.04
	4	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + AG_{1km} + RDdens_{18km} + PIPE_{500}$	-185.80	9	390.74	0.71	0.04
	5	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + MjRD_{1km}$	-188.08	7	390.87	0.84	0.04
	6	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + RDdens_{18km}$	-188.13	7	390.97	0.94	0.04
	7	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + MjRD_{1km} + AG_{1km} + RDdens_{18km} + PIPE_{500}$	-184.83	10	391.05	1.01	0.03

TABLE 7.11. Continued

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
	8	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + AG_{1km} + RDdens_{18km}$	-187.10	8	391.11	1.07	0.03
	9	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + AG_{1km} + PIPE_{500}$	-187.17	8	391.25	1.21	0.03
	10	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km}$	-189.36	6	391.26	1.22	0.03
	11	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + RDdens_{18km} + PIPE_{500}$	-187.18	8	391.28	1.24	0.03
	12	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + MjRD_{1km} + WELL_{1km} + AG_{1km} + PIPE_{500}$	-186.12	9	391.38	1.35	0.03
	13	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + AG_{1km}$	-188.35	7	391.39	1.36	0.03
	14	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + AG_{1km} + PIPE_{500}$	-188.42	7	391.54	1.50	0.03
	15	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + WELL_{1km} + AG_{1km} + RDdens_{18km}$	-188.48	7	391.66	1.63	0.02
	16	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + WELL_{1km} + PIPE_{500}$	-188.51	7	391.72	1.69	0.02
	17	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + RDdens_{18km} + WELL_{1km}$	-189.61	6	391.75	1.72	0.02
	18	$ALLSAGE_{3km} + NDVI_{5km} + NDVI_{5km}^2 + POWER_{1km} + PIPE_{500}$	-189.73	6	391.98	1.95	0.02

[a] Variable definitions provided in Table 4.2

After assessing individual multi-scale covariates (Table 7.18) and developing submodels, the top vegetation submodel for white-tailed jackrabbit consisted of grassland within 0.54 km ($GRASS_{540}$) and salt desert shrubland within 3-km ($SALT_{3km}$), in addition to the sagebrush base model (Table 7.19). Topographic ruggedness within 0.54 km (TRI_{540}) was the only important abiotic predictor of white-tailed jackrabbit occurrence (Table 7.19). Four disturbance factors, 1-km distance decay from interstate/major highways ($MjRD_{1km}$), 0.5-km distance decay from pipelines ($PIPE_{500}$), 0.5-km distance decay from power lines ($POWER_{500}$), and road density within 3 km ($RDdens_{3km}$), were included in the top disturbance submodel (Table 7.19).

The AIC_c-selected top model for white-tailed jackrabbits was a combination of vegetation, abiotic, and disturbance factors. White-tailed jackrabbits were positively associated with small-scale big sagebrush and grassland land cover, and large-scale salt desert shrubland land cover, and negatively associated with rugged terrain and proximity to interstates and major highways (Table 7.20). The weight of evidence for the AIC_c-selected top model was low (w_i = 0.07) indicating other candidate models also were suitable. Variables in the other 59 candidate models with cumulative Akaike weights of just ≥ 0.9 showed that, in addition to factors in the top model, white-tailed jackrabbit locations were positively associated with proximity to pipelines and negatively associated with proximity to power lines and areas of high road density (Table 7.20). The final composite model-averaged probability of occurrence is below.

$$Prob = 1 / (1 + (exp(-(-1.55 + 1.12 * BIGSAGE_{270} + 2.16 * GRASS_{540} + 2.07 * SALT_{3km} - 0.02 * TRI_{540} - 1.54 * MjRD_{1km} + 0.34 * PIPE_{500} - 0.773 * POWERDIST_{500} - 0.12 * RDdens_{3km})))) \quad (7.5)$$

TABLE 7.12. Results of AIC_c-based model selection for the combined vegetation, abiotic, and disturbance thatch ant occurrence model[a] in the Wyoming Basins Ecoregional Assessment area; the table also shows parameter estimates (beta [SE]) and evaluation statistics (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and cumulative Akaike weight [$\sum w_i$]). Models are shown with cumulative Akaike weight (w_i) of just ≥ 0.9.

Rank	Intercept	$ALLSAGE_{3km}$	$NDVI_{5km}$	$NDVI_{5km}$[b]	$GRASS_{540}$	MIX_{18km}	RIP_{5km}	CTI	ELEV[c]	ELEV[2d]	SOLAR
1	-23.29 (8.35)	1.18 (1.04)	16.89 (8.58)	-10.88 (9.67)	-4.18 (2.04)	-44.92 (21.18)	10.02 (4.30)	0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.10 (0.09)
2	-21.38 (8.09)	1.31 (1.05)	16.72 (8.55)	-10.94 (9.64)	-4.19 (2.05)	-47.74 (22.02)	9.50 (4.35)	0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.08 (0.09)
3	-22.89 (8.40)	1.31 (1.06)	17.04 (8.64)	-10.66 (9.73)	-4.27 (2.09)	-44.46 (21.40)	9.65 (4.33)	0.13 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
4	-22.24 (8.44)	1.87 (1.22)	15.66 (8.74)	-9.26 (9.92)	-4.41 (2.14)	-40.36 (21.32)	9.87 (4.30)	0.14 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
5	-10.62 (6.74)	1.60 (1.14)	10.54 (7.21)	-4.50 (8.28)	-6.07 (2.56)	-58.50 (22.19)		0.14 (0.06)			0.10 (0.09)
6	-22.06 (8.59)	0.75 (1.15)	15.94 (8.64)	-10.58 (9.69)	-4.69 (2.17)	-45.11 (21.30)	8.77 (4.46)	0.13 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.11 (0.09)
7	-23.65 (8.41)	1.14 (1.04)	17.00 (8.64)	-10.84 (9.74)	-4.13 (2.04)	-44.15 (21.05)	10.28 (4.31)	0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.10 (0.09)
8	-25.38 (8.42)	1.01 (1.05)	16.59 (8.46)	-11.01 (9.55)	-4.34 (2.03)	-39.43 (20.80)	9.48 (4.22)		0.11 (0.05)	-0.02 (0.01)	0.14 (0.09)
9	-23.19 (8.20)	1.17 (1.06)	16.39 (8.45)	-11.02 (9.53)	-4.34 (2.04)	-42.51 (21.72)	8.92 (4.27)		0.11 (0.05)	-0.02 (0.01)	0.11 (0.09)
10	-24.17 (8.64)	1.02 (1.07)	16.78 (8.62)	-10.62 (9.72)	-4.05 (2.04)	-47.31 (21.54)	9.11 (4.52)	0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.11 (0.09)
11	-20.72 (8.98)	1.32 (1.30)	18.49 (8.49)	-13.46 (9.52)	-5.74 (2.46)	-47.26 (21.29)		0.15 (0.07)	0.08 (0.05)	-0.02 (0.01)	0.11 (0.09)
12	-25.29 (8.27)	0.80 (1.04)	21.65 (8.05)	-15.78 (9.14)	-3.79 (2.03)	-65.00 (.0022)		0.11 (0.06)	0.11 (0.05)	-0.03 (0.01)	0.10 (0.09)
13	-23.22 (8.39)	1.19 (1.04)	16.76 (8.76)	-10.82 (9.71)	-4.16 (2.05)	-44.70 (21.38)	10.00 (4.31)	0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.10 (0.09)
14	-12.59 (7.08)	1.47 (1.14)	11.41 (7.17)	-5.23 (8.24)	-6.29 (2.54)	-52.93 (21.25)		0.14 (0.06)			0.13 (0.09)
15	-10.84 (6.81)	1.68 (1.14)	11.13 (7.24)	-4.78 (8.28)	-5.99 (2.57)	-58.38 (22.35)		0.14 (0.06)			0.10 (0.09)
16	-10.73 (6.55)	1.91 (1.09)	10.24 (7.29)	-4.08 (8.36)	-6.06 (2.53)	-44.36 (21.38)	6.49 (4.26)	0.15 (0.06)			0.11 (0.09)
17	-11.38 (6.41)	1.54 (1.01)	9.79 (7.21)	-3.55 (8.23)	-5.26 (2.32)	-47.50 (21.27)	8.27 (4.10)	0.14 (0.06)			0.11 (0.09)
18	-25.00 (8.48)	1.15 (1.07)	16.77 (8.51)	-10.80 (9.60)	-4.40 (2.08)	-38.97 (21.01)	9.13 (4.25)		0.10 (0.05)	-0.02 (0.01)	0.14 (0.09)
19	-21.11 (8.29)	1.95 (1.21)	14.10 (8.70)	-7.35 (9.90)	-4.54 (2.14)		11.82 (4.18)	0.13 (0.06)	0.08 (0.05)	-0.02 (0.01)	0.10 (0.09)
20	-10.96 (6.63)	1.90 (1.08)	13.22 (7.02)	-7.51 (8.02)	-6.58 (2.55)	-50.05 (21.17)		0.15 (0.06)			0.11 (0.09)
21	-22.76 (8.24)	1.30 (1.07)	16.55 (8.49)	-10.81 (9.58)	-4.41 (2.09)	-42.23 (21.95)	8.58 (4.31)		0.10 (0.05)	-0.02 (0.01)	0.11 (0.09)
22	-18.35 (8.74)	1.57 (1.29)	11.72 (8.92)	-5.87 (10.06)	-5.55 (2.41)		9.68 (4.37)	0.14 (0.06)	0.06 (0.05)	-0.01 (0.01)	0.10 (0.09)
23	-9.15 (6.39)	2.06 (1.09)	12.85 (7.03)	-7.30 (8.03)	-6.52 (2.57)	-53.70 (21.85)		0.15 (0.06)			0.09 (0.09)
24	-10.53 (6.79)	1.63 (1.15)	10.02 (7.28)	-3.77 (8.38)	-6.15 (2.59)	-56.93 (22.13)		0.14 (0.06)			0.10 (0.09)
25	-22.35 (8.16)	1.06 (1.03)	15.56 (8.51)	-9.28 (9.61)	-4.22 (2.01)		12.32 (4.16)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
26	-24.43 (8.48)	0.88 (1.08)	16.07 (8.53)	-10.44 (9.61)	-4.07 (2.03)	-48.39 (22.48)	7.02 (4.51)		0.11 (0.05)	-0.02 (0.01)	0.12 (0.09)
27	-22.09 (8.40)	0.53 (1.14)	21.16 (8.07)	-16.59 (9.01)	-4.95 (2.22)	-59.40 (21.80)		0.13 (0.06)	0.11 (0.05)	-0.03 (0.01)	0.09 (0.09)
28	-24.47 (7.98)	1.17 (1.02)	24.14 (7.80)	-18.66 (8.86)	-4.14 (2.05)	-60.86 (21.73)		0.12 (0.06)	0.12 (0.05)	-0.03 (0.01)	0.09 (0.09)
29	-18.99 (8.06)	2.13 (1.22)	13.73 (8.68)	-7.18 (9.86)	-4.57 (2.16)		11.44 (4.21)	0.13 (0.06)	0.08 (0.05)	-0.01 (0.01)	0.07 (0.09)
30	-11.61 (6.50)	1.67 (1.02)	10.61 (7.27)	-3.98 (8.27)	-5.25 (2.34)	-47.60 (21.53)	7.77 (4.13)	0.14 (0.06)			0.11 (0.09)
31	-26.95 (8.40)	0.66 (1.05)	20.76 (7.97)	-15.20 (9.07)	-3.90 (2.02)	-60.06 (21.67)			0.12 (0.05)	-0.03 (0.01)	0.13 (0.09)
32	-9.69 (6.21)	1.68 (1.01)	9.71 (7.21)	-3.67 (8.23)	-5.25 (2.33)	-50.98 (22.02)	7.75 (4.13)	0.14 (0.06)			0.09 (0.08)
33	-11.65 (6.57)	1.05 (1.04)	10.94 (7.12)	-5.03 (8.10)	-5.15 (2.32)	-65.45 (22.14)		0.13 (0.06)			0.11 (0.09)
34	-9.01 (6.33)	2.05 (1.09)	10.19 (7.29)	-4.23 (8.36)	-6.05 (2.55)	-47.83 (22.10)	5.99 (4.29)	0.15 (0.06)			0.08 (0.08)
35	-24.06 (8.67)	0.35 (1.13)	21.80 (8.08)	-17.08 (9.03)	-4.98 (2.22)	-55.77 (21.02)		0.13 (0.06)	0.11 (0.05)	-0.03 (0.01)	0.12 (0.09)
36	-23.99 (8.04)	1.30 (1.04)	24.15 (7.82)	-18.25 (8.89)	-4.27 (2.11)	-59.91 (21.97)		0.12 (0.06)	0.11 (0.05)	-0.03 (0.01)	0.09 (0.09)
37	-10.35 (6.67)	1.67 (1.15)	9.47 (7.37)	-3.28 (8.46)	-5.87 (2.55)	-54.52 (22.80)	3.24 (4.64)	0.14 (0.06)			0.10 (0.09)
38	-21.94 (8.21)	1.18 (1.04)	15.69 (8.57)	-9.02 (9.68)	-4.32 (2.07)		11.87 (4.20)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)

TABLE 7.12. Extended

$SOLAR^{2c}$	$WELL_{1km}$	$POWER_{1km}$	$CONTAG_{5km}$	$SALT_{18km}$	$RDdens_{18km}$	$MjRD_{1km}$	AG_{1km}	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
0.05 (0.03)								-169.09	12	364.16	0.00	0.018
0.04 (0.03)	-1.28 (0.91)							-168.02	13	364.38	0.21	0.034
0.05 (0.03)		0.79 (0.60)						-168.24	13	364.81	0.65	0.048
0.04 (0.03)			-0.01 (0.01)					-168.38	13	365.09	0.93	0.059
0.04 (0.03)	-1.70 (0.95)		-0.02 (0.01)	-8.27 (2.82)	0.91 (0.48)			-168.52	13	365.37	1.21	0.070
0.05 (0.03)				-2.60 (2.72)				-168.59	13	365.51	1.35	0.079
0.05 (0.03)						-0.53 (0.58)		-168.66	13	365.66	1.49	0.089
0.06 (0.03)								-171.16	11	366.01	1.85	0.096
0.05 (0.03)	-1.32 (0.90)							-170.02	12	366.03	1.87	0.104
0.05 (0.03)					0.30 (0.49)			-168.90	13	366.12	1.96	0.112
0.05 (0.03)			-0.02 (0.01)	-5.69 (3.06)				-169.02	13	366.37	2.20	0.118
0.05 (0.03)	-1.82 (0.96)				0.82 (0.48)			-169.02	13	366.38	2.21	0.125
0.05 (0.03)							0.06 (0.88)	-169.08	13	366.50	2.33	0.131
0.05 (0.03)			-0.02 (0.01)	-8.61 (2.83)	0.73 (0.47)			-170.27	12	366.54	2.38	0.137
0.04 (0.03)	-1.68 (0.95)	0.65 (0.61)	-0.02 (0.01)	-8.03 (2.84)	0.87 (0.48)			-167.95	14	366.61	2.44	0.143
0.05 (0.03)			-0.01 (0.01)	-7.06 (2.98)				-170.34	12	366.68	2.51	0.149
0.05 (0.03)				-5.16 (2.56)				-171.51	11	366.70	2.53	0.155
0.06 (0.03)		0.76 (0.59)						-170.36	12	366.71	2.54	0.161
0.04 (0.03)			-0.01 (0.01)					-170.36	12	366.72	2.55	0.167
0.05 (0.03)			-0.02 (0.01)	-8.47 (2.91)				-171.53	11	366.73	2.57	0.173
0.05 (0.03)	-1.33 (0.91)	0.76 (0.59)						-169.21	13	366.74	2.58	0.178
0.04 (0.03)			-0.02 (0.01)	-4.35 (3.08)				-169.21	13	366.74	2.58	0.184
0.04 (0.03)	-1.32 (0.91)		-0.02 (0.01)	-8.20 (2.91)				-170.40	12	366.79	2.63	0.190
0.04 (0.03)	-1.70 (0.94)		-0.02 (0.01)	-8.31 (2.80)	0.92 (0.48)	-0.55 (0.58)		-168.06	14	366.82	2.65	0.196
0.04 (0.03)								-171.60	11	366.88	2.72	0.201
0.05 (0.03)	-1.60 (0.94)				0.61 (0.50)			-169.28	13	366.90	2.74	0.207
0.04 (0.03)	-1.45 (0.93)			-3.93 (2.68)				-169.29	13	366.91	2.75	0.213
0.04 (0.03)	-1.50 (0.93)							-170.50	12	367.00	2.83	0.218
0.03 (0.03)	-1.23 (0.89)		-0.02 (0.01)					-169.34	13	367.02	2.85	0.223
0.05 (0.03)		0.84 (0.60)		-5.14 (2.60)				-170.52	12	367.04	2.87	0.229
0.06 (0.03)	-1.87 (0.95)				0.88 (0.47)			-170.52	12	367.04	2.88	0.234
0.04 (0.03)	-1.20 (0.90)			-5.07 (2.57)				-170.55	12	367.10	2.94	0.239
0.05 (0.03)	-1.75 (0.94)			-6.20 (2.47)	0.88 (0.47)			-170.56	12	367.11	2.95	0.244
0.04 (0.03)	-1.20 (0.91)		-0.01 (0.01)	-6.94 (2.98)				-169.41	13	367.15	2.98	0.249
0.05 (0.03)				-4.13 (2.70)				-170.60	12	367.18	3.02	0.254
0.04 (0.03)	-1.49 (0.94)	0.88 (0.60)						-169.44	13	367.22	3.05	0.259
0.04 (0.03)	-1.57 (0.96)		-0.02 (0.01)	-7.57 (2.97)	0.77 (0.52)			-168.28	14	367.25	3.09	0.264
0.04 (0.03)		0.83 (0.60)						-170.64	12	367.28	3.12	0.269

TABLE 7.12. Continued

Rank	Intercept	$ALLSAGE_{3km}$	$NDVI_{5km}$	$NDVI_{5km}$[b]	$GRASS_{540}$	MIX_{18km}	RIP_{3km}	CTI	ELEV[c]	ELEV[2d]	SOLAR
39	-24.75 (8.77)	0.08 (1.16)	17.95 (8.24)	-13.21 (9.22)	-4.62 (2.18)	-58.51 (21.74)			0.11 (0.05)	-0.03 (0.01)	0.14 (0.09)
40	-25.47 (8.57)	1.13 (1.07)	16.90 (8.60)	-10.60 (9.72)	-4.35 (2.08)	-37.71 (20.94)	9.45 (4.28)		0.11 (0.05)	-0.02 (0.01)	0.14 (0.09)
41	-20.51 (7.94)	1.19 (1.03)	15.19 (8.49)	-9.10 (9.58)	-4.24 (2.02)		11.97 (4.19)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.08 (0.08)
42	-11.39 (6.74)	1.97 (1.08)	13.90 (7.05)	-7.80 (8.02)	-6.44 (2.55)	-50.18 (21.41)		0.15 (0.06)			0.11 (0.09)
43	-25.81 (8.48)	0.97 (1.05)	16.70 (8.52)	-10.98 (9.61)	-4.31 (2.03)	-38.72 (20.72)	9.72 (4.24)		0.11 (0.05)	-0.03 (0.01)	0.14 (0.09)
44	-26.59 (8.28)	1.02 (1.02)	24.90 (7.82)	-19.23 (8.87)	-4.14 (2.04)	-57.61 (20.91)		0.12 (0.06)	0.12 (0.05)	-0.03 (0.01)	0.11 (0.09)
45	-9.90 (6.29)	1.79 (1.02)	10.48 (7.27)	-4.04 (8.26)	-5.26 (2.36)	-51.17 (22.27)	7.28 (4.16)	0.14 (0.06)			0.09 (0.08)
46	-23.57 (8.25)	1.12 (1.05)	16.50 (8.51)	-11.01 (9.59)	-4.30 (2.03)	-41.62 (21.63)	9.16 (4.30)		0.11 (0.05)	-0.03 (0.01)	0.11 (0.09)
47	-24.32 (8.62)	0.64 (1.15)	15.68 (8.52)	-10.67 (9.56)	-4.78 (2.15)	-39.53 (20.91)	8.38 (4.38)		0.10 (0.05)	-0.02 (0.01)	0.14 (0.09)
48	-11.81 (6.67)	1.20 (1.05)	11.66 (7.15)	-5.35 (8.12)	-5.15 (2.35)	-64.74 (22.32)		0.13 (0.06)			0.11 (0.09)
49	-24.76 (8.48)	1.53 (1.22)	15.74 (8.59)	-9.88 (9.74)	-4.51 (2.10)	-35.70 (21.04)	9.34 (4.22)		0.10 (0.05)	-0.02 (0.01)	0.14 (0.09)
50	-22.41 (8.28)	1.71 (1.24)	15.51 (8.57)	-9.87 (9.71)	-4.51 (2.11)	-38.29 (21.99)	8.78 (4.28)		0.10 (0.05)	-0.02 (0.01)	0.11 (0.09)
51	-22.33 (8.29)	1.17 (1.04)	15.86 (8.67)	-8.82 (9.81)	-4.25 (2.08)		12.19 (4.22)	0.12 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
52	-22.80 (8.05)	2.30 (0.98)	15.43 (8.41)	-8.59 (9.45)		-46.13 (21.18)	9.78 (4.23)	0.14 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.09 (0.08)
53	-25.07 (8.99)	0.00 (1.16)	20.00 (8.28)	-14.91 (9.28)	-4.74 (2.20)	-58.32 (21.07)		0.12 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.13 (0.10)
54	-11.03 (6.63)	1.97 (1.09)	10.90 (7.34)	-4.39 (8.38)	-5.95 (2.54)	-44.65 (21.61)	6.27 (4.27)	0.15 (0.06)			0.11 (0.09)
55	-9.51 (6.49)	2.12 (1.09)	13.49 (7.06)	-7.55 (8.04)	-6.40 (2.57)	-53.88 (22.09)		0.15 (0.06)			0.09 (0.09)
56	-26.16 (8.37)	1.16 (1.04)	24.95 (7.84)	-18.83 (8.90)	-4.25 (2.10)	-56.58 (21.16)		0.13 (0.06)	0.11 (0.05)	-0.03 (0.01)	0.11 (0.09)
57	-20.83 (8.33)	1.98 (1.22)	14.32 (8.74)	-7.28 (9.93)	-4.60 (2.18)		11.47 (4.21)	0.13 (0.06)	0.08 (0.05)	-0.01 (0.01)	0.09 (0.09)
58	-26.45 (8.45)	0.81 (1.07)	20.76 (7.99)	-14.82 (9.10)	-4.01 (2.08)	-59.03 (21.86)			0.12 (0.05)	-0.03 (0.01)	0.13 (0.09)
59	-12.89 (7.17)	1.57 (1.14)	12.07 (7.20)	-5.58 (8.25)	-6.18 (2.55)	-52.76 (21.44)		0.14 (0.06)			0.13 (0.10)
60	-22.21 (8.43)	0.81 (1.16)	15.49 (8.52)	-10.67 (9.54)	-4.76 (2.16)	-42.92 (21.83)	7.85 (4.44)		0.10 (0.05)	-0.02 (0.01)	0.12 (0.09)
61	-23.70 (8.74)	0.55 (1.15)	21.95 (8.11)	-16.74 (9.06)	-5.03 (2.26)	-55.10 (21.26)		0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.12 (0.09)
62	-26.58 (8.75)	0.80 (1.08)	16.46 (8.52)	-10.66 (9.61)	-4.19 (2.03)	-42.66 (21.21)	8.33 (4.43)		0.11 (0.05)	-0.02 (0.01)	0.15 (0.09)
63	-24.24 (8.22)	0.91 (1.03)	15.48 (8.42)	-9.62 (9.51)	-4.36 (2.01)		11.60 (4.08)		0.10 (0.05)	-0.02 (0.01)	0.13 (0.09)
64	-23.04 (8.06)	1.94 (1.22)	22.93 (7.92)	-17.07 (9.06)	-4.40 (2.16)	-54.81 (21.98)		0.13 (0.06)	0.11 (0.05)	-0.02 (0.01)	0.08 (0.09)
65	-10.65 (6.80)	1.60 (1.14)	10.59 (7.36)	-4.51 (8.29)	-6.08 (2.59)	-58.57 (22.29)		0.14 (0.06)			0.10 (0.09)
66	-11.62 (6.59)	1.72 (1.02)	9.94 (7.32)	-2.87 (8.36)	-5.23 (2.36)	-45.56 (21.40)	8.30 (4.18)	0.14 (0.06)			0.11 (0.09)
67	-20.95 (7.78)	2.42 (0.98)	15.29 (8.37)	-8.69 (9.41)		-48.95 (22.01)	9.24 (4.28)	0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.06 (0.08)
68	-12.04 (6.74)	1.56 (1.13)	8.85 (7.11)	-3.02 (8.18)	-6.03 (2.52)	-52.78 (21.77)					0.14 (0.09)
69	-20.12 (7.97)	1.30 (1.05)	15.30 (8.55)	-8.83 (9.64)	-4.34 (2.09)		11.54 (4.23)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.08 (0.09)
70	-10.90 (6.49)	1.28 (1.06)	9.17 (7.27)	-3.00 (8.29)	-5.01 (2.32)	-57.14 (22.81)	5.63 (4.43)	0.13 (0.06)			0.10 (0.09)
71	-26.05 (8.51)	1.39 (1.24)	19.27 (8.14)	-13.24 (9.32)	-4.12 (2.11)	-53.95 (21.87)			0.11 (0.05)	-0.02 (0.01)	0.13 (0.09)
72	-12.07 (6.96)	1.60 (1.14)	9.73 (7.35)	-3.35 (8.45)	-5.98 (2.54)	-48.08 (21.69)	4.66 (4.56)	0.14 (0.06)			0.12 (0.09)
73	-21.57 (8.36)	1.96 (1.21)	14.12 (8.79)	-7.14 (10.01)	-4.47 (2.14)		12.07 (4.19)	0.13 (0.06)	0.08 (0.05)	-0.02 (0.01)	0.10 (0.09)
74	-10.67 (6.60)	1.94 (1.09)	9.59 (7.35)	-3.19 (8.45)	-6.14 (2.56)	-42.54 (21.26)	6.78 (4.29)	0.15 (0.06)			0.11 (0.09)
75	-22.16 (8.04)	1.05 (1.04)	15.05 (8.42)	-9.37 (9.49)	-4.37 (2.02)		11.24 (4.12)		0.10 (0.05)	-0.02 (0.01)	0.11 (0.08)
76	-12.55 (7.13)	1.50 (1.14)	10.87 (7.24)	-4.48 (8.34)	-6.39 (2.58)	-51.54 (21.16)		0.15 (0.06)			0.13 (0.09)
77	-27.73 (8.63)	0.69 (1.04)	23.12 (8.03)	-17.08 (9.13)	-3.89 (2.03)	-60.15 (20.96)		0.12 (0.06)	0.12 (0.05)	-0.03 (0.01)	0.13 (0.09)
78	-11.01 (6.74)	2.06 (1.10)	10.14 (7.39)	-3.16 (8.49)	-5.99 (2.57)	-42.16 (21.47)	6.68 (4.32)	0.15 (0.06)			0.11 (0.09)

TABLE 7.12. Extended

$SOLAR^{2c}$	$WELL_{1km}$	$POWER_{1km}$	$CONTAG_{5km}$	$SALT_{18km}$	$RDdens_{18km}$	$MjRD_{1km}$	AG_{1km}	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
0.06 (0.03)	-1.83 (0.95)			-3.56 (2.59)	0.89 (0.48)			-169.47	13	367.28	3.12	0.274
0.06 (0.03)		1 (0.62)				-0.81 (0.62)		-169.48	13	367.30	3.13	0.279
0.04 (0.03)	-1.17 (0.89)							-170.67	12	367.33	3.17	0.284
0.05 (0.03)		0.75 (0.60)	-0.02 (0.01)	-8.18 (2.93)				-170.74	12	367.47	3.30	0.289
0.06 (0.03)						-0.52 (0.58)		-170.76	12	367.52	3.35	0.293
0.05 (0.03)								-171.92	11	367.53	3.36	0.297
0.04 (0.03)	-1.19 (0.91)	0.83 (0.60)		-5.05 (2.60)				-169.60	13	367.53	3.37	0.302
0.05 (0.03)	-1.32 (0.90)					-0.53 (0.58)		-169.60	13	367.54	3.37	0.306
0.06 (0.03)				-2.32 (2.71)				-170.78	12	367.54	3.38	0.311
0.05 (0.03)	-1.71 (0.95)	0.83 (0.60)		-6.10 (2.50)	0.83 (0.47)			-169.61	13	367.55	3.38	0.315
0.06 (0.03)			-0.01 (0.01)					-170.78	12	367.55	3.39	0.320
0.05 (0.03)	-1.33 (0.90)		-0.01 (0.01)					-169.61	13	367.56	3.39	0.324
0.04 (0.03)		1.10 (0.63)				-0.87 (0.62)		-169.62	13	367.57	3.41	0.329
0.04 (0.03)								-171.95	11	367.59	3.42	0.333
0.06 (0.03)				-4.12 (2.64)	0.65 (0.47)			-169.63	13	367.59	3.42	0.338
0.05 (0.03)		0.71 (0.60)	-0.01 (0.01)	-6.83 (3.01)				-169.64	13	367.62	3.45	0.342
0.04 (0.03)	-1.31 (0.92)	0.74 (0.60)	-0.02 (0.01)	-7.92 (2.93)				-169.65	13	367.62	3.46	0.347
0.05 (0.03)		0.89 (0.59)						-170.82	12	367.63	3.47	0.351
0.04 (0.03)		0.72 (0.60)	-0.01 (0.01)					-169.65	13	367.63	3.47	0.356
0.06 (0.03)	-1.87 (0.96)	0.79 (0.59)			0.84 (0.48)			-169.65	13	367.63	3.47	0.360
0.05 (0.03)		0.67 (0.60)	-0.02 (0.01)	-8.35 (2.86)	0.69 (0.47)			-169.65	13	367.64	3.48	0.365
0.05 (0.03)	-1.31 (0.91)			-2.23 (2.70)				-169.66	13	367.65	3.48	0.369
0.05 (0.03)		0.83 (0.60)		-3.93 (2.75)				-169.66	13	367.65	3.49	0.374
0.06 (0.03)					0.39 (0.49)			-170.84	12	367.68	3.51	0.378
0.05 (0.03)								-173.15	10	367.69	3.53	0.383
0.04 (0.03)	-1.50 (0.93)		-0.01 (0.01)					-169.70	13	367.72	3.56	0.387
0.04 (0.03)	-1.70 (0.95)		-0.02 (0.01)	-8.26 (2.82)	0.91 (0.48)		-0.03 (0.86)	-168.52	14	367.74	3.58	0.392
0.05 (0.03)		1.08 (0.63)		-4.90 (2.57)		-0.77 (0.61)		-169.71	13	367.76	3.60	0.396
0.03 (0.03)	-1.26 (0.90)							-170.89	12	367.77	3.60	0.400
0.06 (0.03)	-1.78 (0.94)		-0.02 (0.01)	-7.77 (2.76)	0.99 (0.47)			-170.89	12	367.78	3.61	0.405
0.04 (0.03)	-1.17 (0.89)	0.83 (0.60)						-169.73	13	367.79	3.62	0.409
0.05 (0.03)	-1.52 (0.94)			-5.43 (2.55)	0.64 (0.50)			-169.74	13	367.81	3.65	0.413
0.05 (0.03)	-1.90 (0.95)		-0.01 (0.01)		0.96 (0.48)			-169.74	13	367.82	3.66	0.418
0.05 (0.03)			-0.02 (0.01)	-7.55 (2.99)	0.54 (0.50)			-169.75	13	367.83	3.66	0.422
0.04 (0.03)			-0.02 (0.01)			-0.64 (0.59)		-169.76	13	367.85	3.68	0.426
0.05 (0.03)			-0.02 (0.01)	-7.03 (2.97)		-0.59 (0.58)		-169.82	13	367.97	3.80	0.431
0.05 (0.03)	-1.20 (0.88)							-172.16	11	367.99	3.83	0.435
0.05 (0.03)			-0.02 (0.01)	-8.66 (2.82)	0.74 (0.47)	-0.53 (0.58)		-169.84	13	368.01	3.84	0.439
0.05 (0.03)					0.63 (0.47)			-171.01	12	368.02	3.85	0.443
0.05 (0.03)		0.96 (0.63)	-0.01 (0.01)	-6.71 (2.98)		-0.84 (0.62)		-168.66	14	368.03	3.87	0.447

TABLE 7.12. Continued

Rank	Intercept	ALLSAGE$_{3km}$	NDVI$_{5km}$	NDVI$_{5km}$^{b}	GRASS$_{540}$	MIX$_{18km}$	RIP$_{5km}$	CTI	ELEV^{c}	ELEV^{2d}	SOLAR
79	-11.37 (6.84)	2.04 (1.09)	13.29 (7.11)	-6.77 (8.13)	-6.50 (2.58)	-48.08 (21.27)		0.15 (0.06)			0.11 (0.09)
80	-9.28 (6.39)	2.11 (1.09)	10.82 (7.33)	-4.51 (8.37)	-5.95 (2.55)	-48.20 (22.33)	5.78 (4.30)	0.14 (0.06)			0.08 (0.09)
81	-23.86 (8.27)	1.04 (1.05)	15.61 (8.47)	-9.37 (9.57)	-4.42 (2.06)		11.18 (4.12)		0.10 (0.05)	-0.02 (0.01)	0.13 (0.09)
82	-21.18 (8.38)	0.61 (1.14)	14.55 (8.57)	-8.94 (9.62)	-4.74 (2.15)		11.08 (4.31)	0.12 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
83	-10.88 (6.67)	1.93 (1.08)	12.69 (7.08)	-6.78 (8.11)	-6.69 (2.58)	-48.54 (21.05)		0.16 (0.06)			0.11 (0.09)
84	-9.03 (6.43)	2.09 (1.09)	12.34 (7.09)	-6.59 (8.11)	-6.63 (2.60)	-52.06 (21.74)		0.15 (0.06)			0.09 (0.09)
85	-22.32 (8.07)	2.44 (0.99)	15.63 (8.45)	-8.41 (9.50)		-45.69 (21.41)	9.43 (4.27)	0.14 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.08 (0.08)
86	-26.04 (8.08)	1.05 (1.04)	23.40 (7.71)	-18.29 (8.77)	-4.28 (2.04)	-55.34 (21.36)			0.13 (0.05)	-0.03 (0.01)	0.12 (0.09)
87	-9.43 (6.57)	2.20 (1.09)	12.92 (7.12)	-6.58 (8.13)	-6.46 (2.60)	-51.66 (21.96)		0.15 (0.06)			0.09 (0.09)
88	-25.29 (8.35)	1.77 (1.21)	23.69 (7.94)	-17.62 (9.08)	-4.39 (2.15)	-52.19 (21.11)		0.13 (0.06)	0.11 (0.05)	-0.02 (0.01)	0.10 (0.09)
89	-22.74 (8.22)	1.03 (1.02)	15.74 (8.57)	-9.30 (9.69)	-4.17 (2.01)		12.58 (4.17)	0.11 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.10 (0.09)
90	-9.85 (6.35)	1.84 (1.02)	9.84 (7.32)	-2.98 (8.36)	-5.23 (2.37)	-48.97 (22.17)	7.81 (4.21)	0.14 (0.06)			0.09 (0.09)
91	-12.48 (6.75)	1.25 (1.06)	9.44 (7.25)	-3.07 (8.28)	-5.13 (2.31)	-50.76 (21.66)	6.97 (4.35)	0.14 (0.06)			0.12 (0.09)
92	-26.63 (8.75)	1.49 (1.22)	21.44 (8.21)	-14.86 (9.42)	-4.15 (2.14)	-54.31 (21.05)		0.13 (0.06)	0.11 (0.05)	-0.02 (0.01)	0.12 (0.10)
93	-25.31 (8.48)	1.02 (1.05)	16.48 (8.63)	-10.96 (9.58)	-4.33 (2.04)	-39.23 (21.01)	9.46 (4.23)		0.11 (0.05)	-0.02 (0.01)	0.14 (0.09)
94	-22.94 (8.26)	1.18 (1.06)	16.05 (8.61)	-10.89 (9.56)	-4.29 (2.04)	-41.89 (21.91)	8.84 (4.29)		0.11 (0.05)	-0.02 (0.01)	0.11 (0.09)
95	-10.52 (6.40)	1.72 (1.01)	13.72 (7.00)	-7.69 (7.93)	-5.56 (2.35)	-59.92 (21.98)		0.14 (0.06)			0.10 (0.09)
96	-12.92 (7.29)	1.64 (1.14)	11.49 (7.27)	-4.59 (8.36)	-6.23 (2.58)	-50.76 (21.34)		0.15 (0.07)			0.13 (0.10)
97	-11.37 (6.45)	1.55 (1.01)	9.28 (7.26)	-2.86 (8.30)	-5.27 (2.33)	-46.21 (21.17)	8.64 (4.14)	0.14 (0.06)			0.11 (0.09)
98	-23.95 (8.68)	0.81 (1.16)	15.86 (8.58)	-10.45 (9.62)	-4.81 (2.19)	-39.17 (21.12)	8.11 (4.41)		0.10 (0.05)	-0.02 (0.01)	0.14 (0.09)
99	-12.44 (6.64)	1.57 (1.00)	14.22 (6.99)	-8.02 (7.91)	-5.59 (2.33)	-56.12 (21.27)		0.14 (0.06)			0.12 (0.09)
100	-23.52 (8.31)	1.62 (1.21)	14.40 (8.57)	-8.19 (9.74)	-4.60 (2.10)		11.13 (4.10)		0.09 (0.05)	-0.02 (0.01)	0.13 (0.09)
101	-22.27 (8.08)	2.02 (1.02)	15.11 (8.45)	-8.33 (9.49)		-55.17 (22.78)	7.21 (4.52)	0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.08 (0.08)
102	-10.21 (6.28)	1.58 (1.00)	12.94 (6.97)	-7.38 (7.91)	-5.59 (2.33)	-60.29 (21.72)		0.14 (0.06)			0.10 (0.09)
103	-27.24 (8.71)	0.85 (1.06)	23.18 (8.06)	-16.75 (9.16)	-4.01 (2.09)	-58.91 (21.17)		0.12 (0.06)	0.11 (0.05)	-0.03 (0.01)	0.12 (0.10)
104	-8.90 (6.38)	2.09 (1.09)	9.56 (7.34)	-3.37 (8.44)	-6.13 (2.58)	-45.83 (22)	6.29 (4.32)	0.15 (0.06)			0.08 (0.09)
105	-26.50 (8.43)	1.14 (1.03)	25.20 (7.94)	-18.77 (9.02)	-4.19 (2.11)	-55.68 (21.01)		0.13 (0.06)	0.12 (0.05)	-0.03 (0.01)	0.11 (0.09)
106	-22.73 (8.83)	1.25 (1.28)	13.91 (8.78)	-8.74 (9.87)	-5.25 (2.32)	-34.22 (21.15)	7.71 (4.41)		0.09 (0.05)	-0.02 (0.01)	0.15 (0.09)
107	-20.47 (7.79)	2.56 (1.00)	15.45 (8.41)	-8.50 (9.45)		-48.61 (22.24)	8.91 (4.31)	0.14 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.06 (0.08)
108	-11.02 (6.56)	1.41 (1.07)	9.88 (7.31)	-3.34 (8.32)	-5.03 (2.35)	-56.92 (23)	5.32 (4.45)	0.13 (0.06)			0.10 (0.09)
109	-26.15 (8.81)	0.95 (1.10)	16.59 (8.56)	-10.44 (9.66)	-4.25 (2.07)	-41.95 (21.38)	8.06 (4.45)		0.10 (0.05)	-0.02 (0.01)	0.15 (0.09)
110	-25.56 (8.15)	1.19 (1.05)	23.44 (7.73)	-17.90 (8.80)	-4.38 (2.10)	-54.52 (21.60)			0.12 (0.05)	-0.03 (0.01)	0.12 (0.09)
111	-22.77 (8.15)	2.40 (0.99)	15.65 (8.55)	-8.07 (9.63)		-44.19 (21.27)	9.75 (4.29)	0.14 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.08 (0.09)
112	-21.76 (8.07)	1.17 (1.06)	15.17 (8.46)	-9.12 (9.55)	-4.44 (2.07)		10.83 (4.15)		0.10 (0.05)	-0.02 (0.01)	0.10 (0.08)
113	-24.38 (8.37)	1.02 (1.05)	15.85 (8.57)	-9.27 (9.69)	-4.37 (2.06)		11.46 (4.14)		0.10 (0.05)	-0.02 (0.01)	0.13 (0.09)
114	-23.97 (8.45)	0.49 (1.14)	20.62 (7.98)	-16.33 (8.93)	-5.00 (2.20)	-53.79 (21.43)			0.12 (0.05)	-0.03 (0.01)	0.13 (0.09)
115	-24.49 (8.53)	1.57 (1.23)	16.03 (8.62)	-9.87 (9.77)	-4.54 (2.13)	-35.79 (21.30)	9.05 (4.25)		0.10 (0.05)	-0.02 (0.01)	0.14 (0.09)
116	-25.18 (9.32)	0.74 (1.30)	16 (8.62)	-10.78 (9.71)	-5.44 (2.39)	-44.67 (20.85)			0.09 (0.05)	-0.02 (0.01)	0.17 (0.10)
117	-21.17 (8.14)	1.82 (1.23)	13.94 (8.56)	-7.92 (9.71)	-4.62 (2.12)		10.74 (4.14)		0.09 (0.05)	-0.02 (0.01)	0.10 (0.08)
118	-13.63 (6.88)	0.95 (1.04)	11.84 (7.07)	-5.79 (8.06)	-5.35 (2.31)	-59.64 (21.13)		0.13 (0.06)			0.14 (0.09)

TABLE 7.12. Extended

SOLAR^{2c}	$WELL_{1km}$	$POWER_{1km}$	$CONTAG_{5km}$	$SALT_{18km}$	$RDdens_{18km}$	$MjRD_{1km}$	AG_{1km}	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
0.05 (0.03)		0.98 (0.63)	-0.02 (0.01)	-8.16 (2.92)		-0.79 (0.62)		-169.89	13	368.10	3.94	0.451
0.04 (0.03)	-1.19 (0.91)	0.71 (0.60)	-0.01 (0.01)	-6.71 (3)				-168.73	14	368.15	3.99	0.454
0.05 (0.03)		0.80 (0.59)						-172.25	11	368.18	4.01	0.458
0.05 (0.03)				-2.60 (2.68)				-171.09	12	368.18	4.01	0.462
0.05 (0.03)			-0.02 (0.01)	-8.53 (2.90)		-0.53 (0.58)		-171.10	12	368.18	4.02	0.466
0.04 (0.03)	-1.33 (0.91)		-0.02 (0.01)	-8.25 (2.90)		-0.55 (0.58)		-169.94	13	368.22	4.05	0.470
0.04 (0.03)		0.79 (0.60)						-171.11	12	368.22	4.05	0.473
0.05 (0.03)	-1.53 (0.92)							-172.27	11	368.22	4.05	0.477
0.04 (0.03)	-1.32 (0.91)	0.97 (0.63)	-0.02 (0.01)	-7.88 (2.91)		-0.80 (0.61)		-168.76	14	368.22	4.06	0.481
0.05 (0.03)			-0.01 (0.01)					-171.12	12	368.24	4.07	0.485
0.04 (0.03)						-0.57 (0.58)		-171.12	12	368.24	4.07	0.488
0.04 (0.03)	-1.20 (0.90)	1.07 (0.63)		-4.79 (2.57)		-0.77 (0.61)		-168.77	14	368.24	4.07	0.492
0.05 (0.03)				-5.42 (2.55)	0.42 (0.49)			-171.13	12	368.26	4.10	0.496
0.05 (0.03)			-0.01 (0.01)		0.72 (0.48)			-169.97	13	368.27	4.11	0.500
0.06 (0.03)							0.06 (0.87)	-171.16	12	368.32	4.15	0.504
0.05 (0.03)	-1.34 (0.91)						0.18 (0.87)	-170.00	13	368.33	4.16	0.507
0.04 (0.03)	-1.35 (0.92)	0.92 (0.59)		-5.97 (2.56)				-171.17	12	368.34	4.17	0.511
0.05 (0.03)		0.90 (0.63)	-0.02 (0.01)	-8.33 (2.84)	0.68 (0.47)	-0.78 (0.61)		-168.82	14	368.35	4.18	0.515
0.05 (0.03)				-5.02 (2.54)		-0.46 (0.58)		-171.18	12	368.35	4.18	0.518
0.06 (0.03)		0.74 (0.59)		-2.23 (2.76)				-170.01	13	368.35	4.19	0.522
0.05 (0.03)		0.94 (0.59)		-6.16 (2.56)				-172.34	11	368.37	4.20	0.526
0.05 (0.03)			-0.01 (0.01)					-172.35	11	368.39	4.22	0.529
0.04 (0.03)	-1.57 (0.94)				0.65 (0.50)			-170.03	13	368.40	4.24	0.533
0.04 (0.03)	-1.38 (0.91)			-6.07 (2.53)				-172.37	11	368.41	4.25	0.537
0.05 (0.03)		0.84 (0.60)			0.59 (0.47)			-170.04	13	368.41	4.25	0.540
0.04 (0.03)	-1.20 (0.90)		-0.02 (0.01)	-6.91 (2.97)		-0.60 (0.58)		-168.86	14	368.42	4.26	0.544
0.05 (0.03)		1.11 (0.62)				-0.75 (0.62)		-170.05	13	368.44	4.27	0.548
0.06 (0.03)			-0.01 (0.01)	-3.40 (3.00)				-170.06	13	368.46	4.30	0.551
0.03 (0.03)	-1.26 (0.90)	0.78 (0.61)						-170.07	13	368.46	4.30	0.555
0.04 (0.03)	-1.49 (0.95)	0.79 (0.60)		-5.38 (2.58)	0.60 (0.51)			-168.88	14	368.47	4.30	0.558
0.06 (0.03)		0.74 (0.59)			0.37 (0.49)			-170.07	13	368.48	4.31	0.562
0.05 (0.03)	-1.53 (0.93)	0.85 (0.59)						-171.25	12	368.50	4.34	0.566
0.04 (0.03)		1.06 (0.64)				-0.87 (0.62)		-170.09	13	368.50	4.34	0.569
0.05 (0.03)	-1.20 (0.89)	0.80 (0.59)						-171.26	12	368.51	4.35	0.573
0.05 (0.03)		1.06 (0.62)				-0.85 (0.62)		-171.27	12	368.53	4.36	0.576
0.06 (0.03)	-1.48 (0.92)			-3.58 (2.68)				-171.27	12	368.53	4.36	0.580
0.06 (0.03)		0.70 (0.59)	-0.01 (0.01)					-170.10	13	368.53	4.37	0.584
0.07 (0.03)			-0.02 (0.01)	-5.18 (2.92)	0.82 (0.48)			-170.11	13	368.56	4.40	0.587
0.05 (0.03)	-1.24 (0.88)		-0.01 (0.01)					-171.29	12	368.57	4.40	0.591
0.06 (0.03)				-6.43 (2.47)	0.69 (0.46)			-172.45	11	368.57	4.41	0.594

TABLE 7.12. Continued

Rank	Intercept	$ALLSAGE_{3km}$	$NDVI_{5km}$	$NDVI_{5km}^{b}$	$GRASS_{540}$	MIX_{18km}	RIP_{3km}	CTI	$ELEV^{c}$	$ELEV^{2d}$	SOLAR
119	-12.07 (6.50)	1.42 (0.99)	13.37 (6.95)	-7.67 (7.89)	-5.64 (2.31)	-56.54 (20.99)		0.14 (0.06)			0.12 (0.09)
120	-20.85 (7.98)	1.15 (1.03)	15.37 (8.56)	-9.12 (9.66)	-4.18 (2.02)		12.24 (4.21)	0.11 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.08 (0.09)
121	-24.99 (7.99)	1.70 (0.99)	20.01 (7.84)	-13.44 (8.86)		-66.81 (22.05)		0.12 (0.06)	0.11 (0.05)	-0.03 (0.01)	0.08 (0.08)
122	-24.77 (7.99)	1.14 (1.02)	24.34 (7.87)	-18.75 (8.92)	-4.10 (2.05)	-60.32 (21.61)		0.12 (0.06)	0.12 (0.05)	-0.03 (0.01)	0.09 (0.09)
123	-9.64 (6.24)	1.69 (1.01)	9.21 (7.26)	-2.99 (8.30)	-5.26 (2.34)	-49.53 (21.94)	8.13 (4.17)	0.14 (0.06)			0.09 (0.08)
124	-11.82 (6.74)	1.24 (1.05)	11.28 (7.21)	-4.66 (8.21)	-5.14 (2.36)	-63.27 (22.27)		0.13 (0.06)			0.11 (0.09)
125	-20.82 (8.43)	0.77 (1.16)	14.71 (8.63)	-8.67 (9.68)	-4.79 (2.20)		10.75 (4.34)	0.12 (0.06)	0.08 (0.05)	-0.02 (0.01)	0.10 (0.09)
126	-13.86 (7.00)	1.13 (1.05)	12.67 (7.11)	-6.20 (8.08)	-5.32 (2.33)	-58.89 (21.36)		0.13 (0.06)			0.14 (0.09)
127	-22.16 (8.12)	2.95 (1.18)	14.40 (8.53)	-7.17 (9.66)		-42.24 (21.33)	9.63 (4.24)	0.15 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.08 (0.08)
128	-12.62 (6.83)	1.40 (1.07)	10.24 (7.30)	-3.49 (8.31)	-5.13 (2.34)	-50.50 (21.87)	6.61 (4.37)	0.14 (0.06)			0.12 (0.09)
129	-19.49 (8.18)	0.75 (1.15)	14.22 (8.55)	-8.73 (9.60)	-4.72 (2.16)		10.82 (4.34)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.08 (0.09)
130	-27.35 (8.45)	0.62 (1.05)	21.02 (8.04)	-15.37 (9.14)	-3.86 (2.02)	-59.61 (21.65)			0.13 (0.05)	-0.03 (0.01)	0.13 (0.09)
131	-24.42 (8.71)	0.29 (1.14)	21.95 (8.14)	-17.14 (9.10)	-4.97 (2.22)	-55.10 (20.89)		0.13 (0.06)	0.11 (0.05)	-0.03 (0.01)	0.12 (0.09)
132	-25.06 (8.43)	1.79 (1.22)	23.87 (7.96)	-17.45 (9.09)	-4.47 (2.19)	-51.87 (21.39)		0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.10 (0.09)
133	-12.27 (6.82)	1.65 (1.13)	9.50 (7.13)	-3.35 (8.18)	-5.94 (2.53)	-52.79 (21.95)					0.14 (0.09)
134	-22.21 (8.14)	1.16 (1.06)	15.43 (8.56)	-9.04 (9.67)	-4.38 (2.08)		11.11 (4.18)		0.10 (0.05)	-0.02 (0.01)	0.10 (0.09)
135	-12.74 (7.14)	1.48 (1.13)	11.70 (7.33)	-5.32 (8.25)	-6.36 (2.57)	-53.39 (21.39)		0.15 (0.06)			0.13 (0.09)
136	-12.75 (6.58)	1.07 (1.03)	9.31 (7.02)	-3.61 (8.01)	-5.17 (2.31)	-59.66 (21.75)					0.15 (0.09)
137	-21.62 (8.48)	1.87 (1.22)	13.89 (8.75)	-7.01 (9.97)	-4.47 (2.14)		11.26 (4.38)	0.13 (0.06)	0.08 (0.05)	-0.02 (0.01)	0.10 (0.09)
138	-21.55 (8.74)	1.28 (1.30)	18.10 (8.32)	-13.60 (9.32)	-5.56 (2.40)	-45.91 (21.80)			0.10 (0.05)	-0.02 (0.01)	0.12 (0.09)
139	-20.16 (7.86)	3.11 (1.19)	14.26 (8.49)	-7.28 (9.61)		-44.53 (22.18)	9.10 (4.28)	0.14 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.06 (0.08)
140	-23.27 (8.11)	2.24 (0.98)	15.48 (8.46)	-8.49 (9.52)		-45.19 (21.05)	10.03 (4.25)	0.14 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.09 (0.08)
141	-25.21 (8.54)	1.52 (1.22)	15.74 (8.66)	-9.69 (9.83)	-4.47 (2.10)	-34.70 (20.93)	9.59 (4.24)		0.11 (0.05)	-0.02 (0.01)	0.14 (0.09)
142	-10.93 (6.64)	1.92 (1.09)	10.57 (7.42)	-4.16 (8.37)	-6.13 (2.56)	-44.85 (21.48)	6.59 (4.28)	0.15 (0.06)			0.11 (0.09)
143	-21.34 (8.67)	1.30 (1.28)	12.36 (8.77)	-6.94 (9.87)	-5.43 (2.33)		9.27 (4.30)		0.08 (0.05)	-0.02 (0.01)	0.14 (0.09)
144	-28.45 (8.36)	0.88 (1.03)	24.16 (7.72)	-18.87 (8.78)	-4.29 (2.04)	-51.82 (20.47)			0.13 (0.05)	-0.03 (0.01)	0.15 (0.09)
145	-27.43 (9.03)	-0.10 (1.16)	19.32 (8.19)	-14.50 (9.19)	-4.79 (2.18)	-52.90 (20.65)			0.11 (0.05)	-0.03 (0.01)	0.17 (0.10)
146	-12.27 (7.04)	1.69 (1.14)	10.37 (7.39)	-3.68 (8.46)	-5.88 (2.54)	-47.98 (21.87)	4.61 (4.57)	0.14 (0.06)			0.12 (0.09)
147	-26.20 (8.86)	1.35 (1.23)	15.45 (8.67)	-9.28 (9.84)	-4.35 (2.10)	-38.94 (21.31)	7.94 (4.45)		0.10 (0.05)	-0.02 (0.01)	0.15 (0.09)
148	-11.34 (6.47)	1.54 (1.01)	9.73 (7.32)	-3.54 (8.23)	-5.25 (2.32)	-47.39 (21.39)	8.24 (4.14)	0.14 (0.06)			0.11 (0.09)
149	-26.22 (8.68)	0.28 (1.13)	21.23 (7.99)	-16.82 (8.93)	-5.04 (2.20)	-49.93 (20.58)			0.12 (0.05)	-0.03 (0.01)	0.15 (0.09)
150	-25.51 (8.94)	0.34 (1.19)	15.43 (8.59)	-10.25 (9.64)	-4.66 (2.15)	-43.28 (21.34)	6.91 (4.62)		0.10 (0.05)	-0.02 (0.01)	0.16 (0.09)
151	-11.05 (6.70)	1.90 (1.08)	13.38 (7.17)	-7.56 (8.03)	-6.62 (2.58)	-50.30 (21.30)		0.15 (0.06)			0.11 (0.09)
152	-29.81 (8.73)	0.52 (1.05)	22.29 (7.93)	-16.58 (9.03)	-4.02 (2.02)	-54.84 (20.53)			0.13 (0.05)	-0.03 (0.01)	0.16 (0.09)
153	-22.04 (8.16)	1.08 (1.03)	14.92 (8.68)	-9.01 (9.66)	-4.14 (2.01)		12.15 (4.18)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
154	-21.03 (8.30)	1.95 (1.21)	13.90 (8.84)	-7.28 (9.92)	-4.50 (2.15)		11.76 (4.20)	0.13 (0.06)	0.08 (0.05)	-0.02 (0.01)	0.09 (0.09)
155	-24.94 (8.53)	1.15 (1.07)	16.65 (8.69)	-10.75 (9.64)	-4.39 (2.09)	-38.76 (21.23)	9.11 (4.26)		0.10 (0.05)	-0.02 (0.01)	0.14 (0.09)
156	-12.62 (5.95)	2.43 (0.92)	11.96 (7.18)	-4.17 (8.28)	-4.23 (2.19)	-48.59 (21.25)	10.35 (4.01)	0.13 (0.06)			0.11 (0.08)
157	-24.09 (8.08)	2.55 (1.19)	18.45 (7.99)	-11.34 (9.11)		-60.73 (22.16)		0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.08 (0.09)
158	-11.64 (6.60)	1.04 (1.04)	10.64 (7.17)	-4.62 (8.17)	-5.16 (2.33)	-64.67 (22.11)		0.13 (0.06)			0.11 (0.09)

TABLE 7.12. Extended

SOLAR^{2c}	$WELL_{1km}$	$POWER_{1km}$	$CONTAG_{5km}$	$SALT_{18km}$	$RDdens_{18km}$	$MjRD_{1km}$	AG_{1km}	LL	K	AIC_c	ΔAIC_c	Σw_i
0.05 (0.03)				-6.26 (2.52)				-173.61	10	368.61	4.45	0.598
0.04 (0.03)	-1.18 (0.88)					-0.58 (0.58)		-170.16	13	368.65	4.49	0.601
0.04 (0.03)	-1.86 (0.94)				0.93 (0.48)			-171.34	12	368.67	4.50	0.605
0.04 (0.03)	-1.51 (0.93)					-0.47 (0.58)		-170.17	13	368.67	4.51	0.608
0.04 (0.03)	-1.21 (0.90)			-4.93 (2.55)		-0.48 (0.57)		-170.20	13	368.74	4.57	0.611
0.05 (0.03)	-1.71 (0.94)	1.04 (0.63)		-5.96 (2.48)	0.81 (0.47)	-0.64 (0.60)		-169.02	14	368.75	4.58	0.615
0.05 (0.03)		0.80 (0.60)		-2.45 (2.72)				-170.21	13	368.75	4.59	0.618
0.06 (0.03)		0.87 (0.59)		-6.33 (2.50)	0.63 (0.46)			-171.38	12	368.76	4.59	0.621
0.04 (0.03)			-0.01 (0.01)					-171.38	12	368.76	4.60	0.625
0.05 (0.03)		0.81 (0.60)		-5.38 (2.59)	0.38 (0.49)			-170.21	13	368.76	4.60	0.628
0.04 (0.03)	-1.13 (0.89)			-2.43 (2.66)				-170.22	13	368.78	4.61	0.631
0.06 (0.03)	-1.87 (0.94)				0.88 (0.48)	-0.44 (0.58)		-170.23	13	368.79	4.63	0.635
0.05 (0.03)				-4.16 (2.67)		-0.48 (0.58)		-170.25	13	368.82	4.66	0.638
0.05 (0.03)		0.80 (0.60)	-0.01 (0.01)					-170.25	13	368.83	4.66	0.641
0.06 (0.03)	-1.77 (0.94)	0.68 (0.60)	-0.02 (0.01)	-7.55 (2.79)	0.95 (0.47)			-170.25	13	368.84	4.67	0.645
0.05 (0.03)	-1.21 (0.88)	1.06 (0.63)				-0.86 (0.62)		-170.25	13	368.84	4.67	0.648
0.05 (0.03)			-0.02 (0.01)	-8.60 (2.84)	0.74 (0.47)		-0.17 (0.87)	-170.26	13	368.84	4.68	0.651
0.06 (0.03)	-1.82 (0.93)			-5.92 (2.43)	0.95 (0.46)			-172.60	11	368.88	4.71	0.654
0.04 (0.03)			-0.02 (0.01)		0.20 (0.49)			-170.28	13	368.89	4.73	0.658
0.05 (0.03)	-1.45 (0.92)		-0.01 (0.01)	-4.74 (2.96)				-170.28	13	368.90	4.74	0.661
0.03 (0.03)	-1.27 (0.89)		-0.01 (0.01)					-170.29	13	368.92	4.75	0.664
0.04 (0.03)						-0.57 (0.58)		-171.46	12	368.92	4.76	0.667
0.06 (0.03)			-0.01 (0.01)			-0.56 (0.59)		-170.31	13	368.95	4.79	0.670
0.05 (0.03)			-0.01 (0.01)	-7.01 (2.99)			-0.21 (0.86)	-170.31	13	368.95	4.79	0.674
0.06 (0.03)			-0.02 (0.01)	-3.74 (3.02)				-171.49	12	368.97	4.80	0.677
0.06 (0.03)								-173.79	10	368.97	4.80	0.680
0.07 (0.03)				-3.81 (2.62)	0.71 (0.47)			-171.49	12	368.98	4.82	0.683
0.05 (0.03)		0.67 (0.60)	-0.01 (0.01)	-7.30 (3.02)	0.50 (0.50)			-169.14	14	368.98	4.82	0.686
0.06 (0.03)			-0.01 (0.01)		0.47 (0.50)			-170.34	13	369.01	4.84	0.690
0.05 (0.03)				-5.18 (2.60)			0.04 (0.84)	-171.51	12	369.01	4.84	0.693
0.06 (0.03)				-3.80 (2.69)				-172.66	11	369.01	4.84	0.696
0.06 (0.03)				-2.59 (2.70)	0.45 (0.50)			-170.35	13	369.03	4.86	0.699
0.05 (0.03)			-0.02 (0.01)	-8.46 (2.91)			-0.09 (0.86)	-171.52	12	369.03	4.87	0.702
0.07 (0.03)					0.69 (0.47)			-172.68	11	369.03	4.87	0.705
0.04 (0.03)							0.34 (0.86)	-171.52	12	369.04	4.88	0.709
0.04 (0.03)			-0.01 (0.01)				0.11 (0.89)	-170.36	13	369.04	4.88	0.712
0.06 (0.03)		0.76 (0.59)					0.06 (0.87)	-170.36	13	369.04	4.88	0.715
0.05 (0.03)								-173.83	10	369.05	4.88	0.718
0.04 (0.03)	-1.89 (0.95)		-0.01 (0.01)		1.01 (0.48)			-170.36	13	369.05	4.89	0.721
0.05 (0.03)	-1.75 (0.94)			-6.14 (2.45)	0.88 (0.47)	-0.36 (0.57)		-170.36	13	369.06	4.89	0.724

TABLE 7.12. Continued

Rank	Intercept	$ALLSAGE_{3km}$	$NDVI_{5km}$	$NDVI_{5km}^{b}$	$GRASS_{540}$	MIX_{18km}	RIP_{5km}	CTI	ELEV[c]	ELEV[2d]	SOLAR
159	-24.71 (8.28)	0.87 (1.03)	15.68 (8.48)	-9.68 (9.58)	-4.32 (2.01)		11.82 (4.10)		0.11 (0.05)	-0.02 (0.01)	0.13 (0.09)
160	-21.39 (7.84)	2.37 (0.98)	15.35 (8.43)	-8.62 (9.49)		-47.88 (21.89)	9.49 (4.30)	0.14 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.06 (0.08)
161	-24.80 (8.68)	0.58 (1.15)	15.81 (8.58)	-10.68 (9.63)	-4.75 (2.15)	-38.73 (20.82)	8.59 (4.40)		0.11 (0.05)	-0.02 (0.01)	0.15 (0.09)
162	-23.55 (8.52)	0.67 (1.15)	20.75 (8.01)	-16.01 (8.96)	-5.04 (2.24)	-53.27 (21.66)			0.11 (0.05)	-0.03 (0.01)	0.13 (0.09)
163	-24.06 (8.41)	2.00 (1.03)	15.36 (8.46)	-8.34 (9.52)		-49.57 (21.57)	8.53 (4.44)	0.13 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.10 (0.09)
164	-9.13 (6.46)	2.05 (1.09)	12.82 (7.16)	-7.29 (8.04)	-6.51 (2.59)	-53.65 (21.95)		0.15 (0.06)			0.09 (0.09)
165	-10.15 (6.38)	1.72 (1.09)	10.00 (7.29)	-3.60 (8.37)	-6.31 (2.54)		8.07 (4.17)	0.13 (0.06)			0.10 (0.09)
166	-23.23 (8.41)	0.52 (1.14)	14.52 (8.48)	-9.26 (9.52)	-4.81 (2.13)		10.49 (4.24)		0.10 (0.05)	-0.02 (0.01)	0.14 (0.09)
167	-22.53 (8.28)	1.02 (1.06)	15.51 (8.53)	-9.19 (9.64)	-4.19 (2.02)		12.13 (4.34)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
168	-23.98 (8.01)	1.20 (1.03)	23.43 (8.00)	-18.35 (8.91)	-4.06 (2.05)	-59.45 (21.97)		0.12 (0.06)	0.12 (0.05)	-0.03 (0.01)	0.08 (0.09)
169	-28.07 (8.45)	1.03 (1.05)	24.23 (7.74)	-18.50 (8.81)	-4.37 (2.09)	-50.84 (20.71)			0.12 (0.05)	-0.03 (0.01)	0.15 (0.09)
170	-12.81 (6.03)	2.54 (0.94)	12.76 (7.23)	-4.57 (8.32)	-4.26 (2.23)	-48.41 (21.49)	9.81 (4.04)	0.13 (0.06)			0.10 (0.08)
171	-12.92 (6.69)	1.22 (1.04)	10.07 (7.05)	-3.95 (8.03)	-5.16 (2.33)	-59.05 (21.93)					0.14 (0.09)
172	-12 (7.02)	1.64 (1.15)	9.11 (7.41)	-2.49 (8.55)	-6.06 (2.57)	-46.33 (21.61)	4.95 (4.60)	0.15 (0.06)			0.12 (0.09)
173	-26.49 (8.43)	0.69 (1.06)	20.02 (8.19)	-14.85 (9.13)	-3.81 (2.02)	-58.64 (21.92)			0.12 (0.05)	-0.03 (0.01)	0.13 (0.09)
174	-11.11 (5.74)	2.52 (0.93)	12.05 (7.17)	-4.52 (8.28)	-4.23 (2.20)	-51.56 (22.00)	9.73 (4.04)	0.13 (0.06)			0.09 (0.08)
175	-26.88 (8.31)	0.99 (1.01)	25.07 (7.88)	-19.28 (8.94)	-4.10 (2.04)	-57.13 (20.79)		0.12 (0.06)	0.13 (0.05)	-0.03 (0.01)	0.11 (0.09)
176	-26.98 (8.81)	0.76 (1.08)	16.59 (8.57)	-10.68 (9.68)	-4.15 (2.02)	-41.95 (21.17)	8.59 (4.45)		0.11 (0.05)	-0.03 (0.01)	0.15 (0.09)
177	-23.85 (8.93)	1.06 (1.29)	18.64 (8.33)	-14.01 (9.34)	-5.62 (2.39)	-42.40 (20.94)			0.10 (0.05)	-0.02 (0.01)	0.15 (0.09)
178	-23.23 (8.36)	1.66 (1.22)	14.63 (8.60)	-8.13 (9.77)	-4.64 (2.14)		10.82 (4.13)		0.09 (0.05)	-0.02 (0.01)	0.13 (0.09)
179	-11.23 (6.59)	1.05 (1.04)	10.37 (7.25)	-4.87 (8.13)	-5.06 (2.33)	-64.28 (22.31)		0.13 (0.06)			0.11 (0.09)
180	-24.41 (8.01)	1.86 (1.00)	20.00 (7.85)	-13.07 (8.88)		-65.72 (22.22)		0.12 (0.06)	0.11 (0.05)	-0.02 (0.01)	0.08 (0.09)
181	-25.99 (8.19)	1.17 (1.05)	23.76 (7.82)	-17.94 (8.91)	-4.33 (2.10)	-53.39 (21.53)			0.13 (0.05)	-0.03 (0.01)	0.12 (0.09)
182	-22.57 (8.08)	1.01 (1.04)	15.25 (8.48)	-9.43 (9.57)	-4.32 (2.02)		11.48 (4.14)		0.11 (0.05)	-0.02 (0.01)	0.11 (0.08)
183	-19.17 (8.54)	1.52 (1.30)	11.97 (8.76)	-6.69 (9.84)	-5.41 (2.35)		8.99 (4.33)		0.08 (0.05)	-0.02 (0.01)	0.11 (0.09)
184	-11.60 (6.56)	1.67 (1.02)	10.59 (7.39)	-3.97 (8.27)	-5.25 (2.35)	-47.56 (21.66)	7.76 (4.17)	0.14 (0.06)			0.11 (0.09)
185	-12.52 (6.40)	1.58 (1.00)	8.20 (7.11)	-2.24 (8.14)	-5.35 (2.31)	-40.78 (20.75)	8.18 (4.05)				0.15 (0.09)
186	-20.01 (7.94)	1.22 (1.04)	14.34 (8.66)	-8.76 (9.64)	-4.12 (2.02)		11.71 (4.22)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.07 (0.08)
187	-12.03 (6.78)	1.59 (1.13)	8.33 (7.18)	-2.33 (8.27)	-6.10 (2.55)	-51.42 (21.76)					0.14 (0.09)
188	-14.38 (7.04)	1.42 (1.12)	9.67 (7.05)	-3.72 (8.13)	-6.29 (2.51)	-46.66 (20.72)					0.17 (0.09)
189	-9.53 (6.27)	1.67 (1.01)	9.52 (7.31)	-3.64 (8.23)	-5.22 (2.34)	-50.65 (22.12)	7.64 (4.18)	0.14 (0.06)			0.09 (0.08)
190	-10.52 (6.46)	1.76 (1.01)	13.28 (7.05)	-6.91 (8.01)	-5.56 (2.36)	-58.47 (21.87)		0.14 (0.06)			0.10 (0.09)
191	-20.90 (8.05)	1.07 (1.06)	14.97 (8.53)	-8.77 (9.63)	-4.13 (2.03)		11.33 (4.38)	0.10 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.08 (0.09)
192	-23.73 (8.71)	0.37 (1.14)	21.27 (8.29)	-16.83 (9.08)	-4.92 (2.22)	-54.74 (21.29)		0.13 (0.06)	0.11 (0.05)	-0.02 (0.01)	0.12 (0.09)
193	-21.66 (8.20)	1.20 (1.05)	15.04 (8.75)	-8.74 (9.73)	-4.23 (2.07)		11.70 (4.22)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.09 (0.09)
194	-11.28 (5.79)	2.63 (0.94)	12.79 (7.22)	-4.87 (8.32)	-4.27 (2.24)	-51.52 (22.24)	9.22 (4.08)	0.13 (0.06)			0.08 (0.08)
195	-20.87 (8.17)	1.86 (1.24)	14.17 (8.59)	-7.86 (9.74)	-4.68 (2.16)		10.43 (4.16)		0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
196	-12.48 (6.72)	1.60 (1.00)	13.76 (7.04)	-7.21 (8.00)	-5.59 (2.35)	-54.76 (21.14)		0.14 (0.06)			0.12 (0.09)
197	-9.13 (6.42)	2.05 (1.09)	10.35 (7.40)	-4.26 (8.36)	-6.08 (2.57)	-48.04 (22.17)	6.04 (4.31)	0.15 (0.06)			0.09 (0.09)
198	-25.85 (8.76)	0.48 (1.15)	21.39 (8.01)	-16.50 (8.97)	-5.07 (2.23)	-49.29 (20.81)			0.11 (0.05)	-0.03 (0.01)	0.15 (0.09)

TABLE 7.12. Extended

SOLAR^{2c}	WELL$_{1km}$	POWER$_{1km}$	CONTAG$_{5km}$	SALT$_{18km}$	RDdens$_{18km}$	MjRD$_{1km}$	AG$_{1km}$	LL	K	AIC$_c$	ΔAIC$_c$	Σw_i
0.05 (0.03)						-0.55 (0.58)		-172.69	11	369.06	4.90	0.728
0.03 (0.03)	-1.27 (0.89)					-0.58 (0.58)		-170.37	13	369.07	4.91	0.731
0.06 (0.03)				-2.30 (2.69)		-0.52 (0.58)		-170.37	13	369.07	4.91	0.734
0.05 (0.03)	-1.48 (0.93)	0.80 (0.60)		-3.40 (2.72)				-170.38	13	369.10	4.93	0.737
0.04 (0.03)					0.43 (0.49)			-171.56	12	369.12	4.95	0.740
0.04 (0.03)	-1.33 (0.92)		-0.02 (0.01)	-8.20 (2.91)			0.02 (0.86)	-170.40	13	369.13	4.97	0.743
0.04 (0.03)			-0.02 (0.01)	-7.50 (3.00)				-172.73	11	369.14	4.98	0.747
0.06 (0.03)				-2.33 (2.68)				-172.74	11	369.17	5.01	0.750
0.04 (0.03)					0.08 (0.48)			-171.59	12	369.17	5.01	0.753
0.04 (0.03)	-1.54 (0.94)						0.35 (0.88)	-170.42	13	369.18	5.01	0.756
0.06 (0.03)		0.85 (0.58)						-172.75	11	369.18	5.01	0.759
0.04 (0.03)		0.87 (0.59)						-172.76	11	369.20	5.03	0.762
0.06 (0.03)	-1.79 (0.94)	0.84 (0.59)		-5.84 (2.47)	0.90 (0.47)			-171.60	12	369.20	5.04	0.765
0.05 (0.03)			-0.02 (0.01)	-7.53 (2.97)	0.53 (0.50)	-0.57 (0.58)		-169.25	14	369.20	5.04	0.768
0.05 (0.03)	-1.91 (0.96)				0.88 (0.48)		0.35 (0.87)	-170.44	13	369.22	5.05	0.771
0.04 (0.03)	-1.25 (0.90)							-172.78	11	369.24	5.07	0.774
0.05 (0.03)						-0.44 (0.58)		-171.63	12	369.25	5.08	0.777
0.06 (0.03)					0.38 (0.49)	-0.50 (0.58)		-170.46	13	369.26	5.09	0.780
0.06 (0.03)			-0.01 (0.01)	-5.04 (2.99)				-171.64	12	369.27	5.11	0.783
0.05 (0.03)		0.71 (0.59)	-0.01 (0.01)					-171.64	12	369.28	5.11	0.787
0.05 (0.03)	-1.78 (0.95)			-6.33 (2.49)	0.88 (0.47)		0.34 (0.83)	-170.48	13	369.28	5.12	0.790
0.04 (0.03)	-1.84 (0.95)	0.80 (0.61)			0.90 (0.48)			-170.48	13	369.29	5.12	0.793
0.05 (0.03)	-1.53 (0.92)	1.06 (0.62)				-0.74 (0.61)		-170.50	13	369.33	5.16	0.796
0.05 (0.03)	-1.21 (0.88)					-0.57 (0.58)		-171.67	12	369.33	5.17	0.799
0.05 (0.03)	-1.20 (0.89)		-0.02 (0.01)	-3.53 (2.99)				-170.50	13	369.33	5.17	0.802
0.05 (0.03)		0.84 (0.60)		-5.15 (2.63)			0.01 (0.84)	-170.52	13	369.38	5.21	0.805
0.06 (0.03)				-4.85 (2.53)				-174.00	10	369.39	5.22	0.807
0.03 (0.03)	-1.22 (0.90)						0.46 (0.86)	-170.53	13	369.39	5.23	0.810
0.06 (0.03)	-1.78 (0.93)		-0.02 (0.01)	-7.80 (2.74)	1.00 (0.47)	-0.48 (0.58)		-170.53	13	369.39	5.23	0.813
0.07 (0.03)			-0.02 (0.01)	-8.16 (2.78)	0.80 (0.46)			-172.87	11	369.42	5.25	0.816
0.04 (0.03)	-1.22 (0.91)			-5.13 (2.60)			0.13 (0.84)	-170.54	13	369.42	5.25	0.819
0.04 (0.03)	-1.36 (0.91)	1.13 (0.63)		-5.81 (2.54)		-0.67 (0.61)		-170.54	13	369.42	5.25	0.822
0.04 (0.03)	-1.27 (0.91)				0.24 (0.49)			-170.55	13	369.44	5.27	0.825
0.05 (0.03)				-4.15 (2.71)			0.25 (0.87)	-170.55	13	369.44	5.28	0.828
0.04 (0.03)		0.83 (0.60)					0.33 (0.86)	-170.57	13	369.47	5.31	0.831
0.04 (0.03)	-1.24 (0.90)	0.86 (0.59)						-171.74	12	369.47	5.31	0.834
0.05 (0.03)	-1.25 (0.89)	0.71 (0.59)	-0.01 (0.01)					-170.58	13	369.49	5.33	0.837
0.05 (0.03)		1.14 (0.62)		-6.02 (2.53)		-0.65 (0.61)		-171.75	12	369.49	5.33	0.839
0.04 (0.03)	-1.19 (0.91)		-0.01 (0.01)	-6.92 (2.99)			-0.11 (0.86)	-169.40	14	369.50	5.34	0.842
0.06 (0.03)		0.80 (0.59)		-3.65 (2.74)				-171.76	12	369.50	5.34	0.845

TABLE 7.12. Continued

Rank	Intercept	$ALLSAGE_{3km}$	$NDVI_{5km}$	$NDVI_{5km}{}^{b}$	$GRASS_{540}$	MIX_{18km}	RIP_{5km}	CTI	$ELEV^{c}$	$ELEV^{2d}$	SOLAR
199	-29.39 (8.82)	0.68 (1.07)	22.35 (7.95)	-16.25 (9.07)	-4.11 (2.07)	-53.63 (20.73)			0.12 (0.05)	-0.03 (0.01)	0.16 (0.10)
200	-19.27 (8.83)	1.34 (1.30)	17.48 (8.50)	-12.30 (9.55)	-6.17 (2.50)			0.13 (0.06)	0.07 (0.05)	-0.01 (0.01)	0.10 (0.09)
201	-21.61 (8.44)	0.55 (1.15)	14.74 (8.62)	-8.99 (9.69)	-4.70 (2.15)		11.29 (4.33)	0.12 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
202	-23.81 (8.46)	1.68 (1.23)	14.76 (8.72)	-7.86 (9.92)	-4.58 (2.15)		11.07 (4.15)		0.09 (0.05)	-0.02 (0.01)	0.13 (0.09)
203	-12.77 (6.13)	2.57 (0.93)	11.94 (7.29)	-3.33 (8.42)	-4.25 (2.25)	-46.26 (21.37)	10.35 (4.09)	0.14 (0.06)			0.10 (0.08)
204	-10.63 (6.25)	1.73 (1.00)	8.19 (7.12)	-2.42 (8.14)	-5.33 (2.32)	-44.49 (21.58)	7.63 (4.08)				0.12 (0.08)
205	-10.83 (6.52)	1.30 (1.06)	8.72 (7.32)	-2.39 (8.37)	-5.02 (2.33)	-55.66 (22.78)	6.03 (4.48)	0.13 (0.06)			0.10 (0.09)
206	-25.07 (8.15)	1.65 (1.23)	22.46 (7.81)	-17.06 (8.94)	-4.47 (2.12)	-50.31 (21.72)			0.12 (0.05)	-0.03 (0.01)	0.12 (0.09)
207	-22.08 (8.32)	1.15 (1.08)	15.64 (8.59)	-8.95 (9.70)	-4.29 (2.08)		11.72 (4.37)	0.11 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
208	-21.29 (8.24)	0.68 (1.15)	14.14 (8.48)	-9.01 (9.51)	-4.78 (2.14)		10.22 (4.27)		0.10 (0.05)	-0.02 (0.01)	0.11 (0.09)
209	-24.05 (8.39)	1.62 (1.21)	14.48 (8.65)	-8.08 (9.84)	-4.55 (2.10)		11.35 (4.12)		0.10 (0.05)	-0.02 (0.01)	0.13 (0.09)
210	-12.77 (6.51)	1.71 (1.01)	9.06 (7.17)	-2.68 (8.18)	-5.32 (2.32)	-40.87 (21)	7.69 (4.08)				0.15 (0.09)
211	-12.56 (6.92)	1.47 (1.08)	9.63 (7.36)	-2.48 (8.41)	-5.12 (2.36)	-48.30 (21.80)	7.20 (4.44)	0.14 (0.06)			0.12 (0.09)
212	-11.72 (6.69)	1.63 (1.13)	7.81 (7.27)	-1.84 (8.37)	-5.85 (2.52)	-48.93 (22.41)	3.07 (4.60)				0.14 (0.09)
213	-17.44 (8.65)	1.56 (1.31)	16.94 (8.48)	-11.85 (9.52)	-6.12 (2.51)			0.13 (0.06)	0.07 (0.05)	-0.01 (0.01)	0.08 (0.09)
214	-26.56 (8.11)	1.61 (0.99)	18.86 (7.75)	-12.56 (8.78)		-61.49 (21.68)			0.12 (0.05)	-0.03 (0.01)	0.12 (0.08)
215	-12.01 (6.53)	1.28 (1.05)	7.59 (7.18)	-1.66 (8.21)	-5.06 (2.31)	-51.73 (22.46)	5.24 (4.38)				0.14 (0.09)
216	-21.79 (8.14)	2.98 (1.18)	14.72 (8.57)	-7.21 (9.69)		-42.24 (21.57)	9.34 (4.26)	0.15 (0.06)	0.09 (0.05)	-0.02 (0.01)	0.08 (0.09)
217	-21.62 (8.20)	1.82 (1.23)	14.00 (8.65)	-7.80 (9.82)	-4.57 (2.12)		10.98 (4.16)		0.09 (0.05)	-0.02 (0.01)	0.10 (0.09)
218	-22.27 (8.21)	2.20 (1.02)	15.00 (8.48)	-8.34 (9.47)		-46.31 (21.24)	9.34 (4.39)	0.14 (0.06)	0.10 (0.05)	-0.02 (0.01)	0.09 (0.08)

[a] Variable definitions provided in Table 4.2
[b] values are multiplied by 10^2
[c] values are multiplied by 10
[d] values are multiplied by 10^4

The composite model of white-tailed jackrabbit occurrence had good accuracy (ROC AUC = 0.70) when predicting presence and improved the prediction over the AIC_c-selected top model (ROC AUC = 0.68). The optimal cutoff probability for predicting white-tailed jackrabbit occurrence, based on sensitivity and specificity equality threshold, was 0.25 and resulted in an overall percent correctly classified accuracy of 64.9%.

White-tailed jackrabbit occurrence was highest in the Worland Basin and in areas throughout the southern portion of Wyoming of the WBEA area (Fig. 7.13). Based on our optimal cutoff point and a binary presence-absence prediction, 63,890 km^2 (22.1%) of white-tailed jackrabbit habitat was predicted for the Wyoming Basins (Fig. 7.14). White-tailed jackrabbits were likely to occupy areas with >82% big sagebrush land cover within 0.27 km (Fig. 7.15).

Cottontail rabbits

Two predictor variables, coniferous forest (0.27 and 0.54 km), were excluded because they were present on <20 survey blocks in the least frequent abundance category (present). Coniferous forest (3, 5, and 18 km), salt desert shrubland (0.27 km), all sagebrush mean patch size (1, 3, and 5 km), and all sagebrush contagion (5 km), were removed from consideration because of correlation. Our exploratory data analysis suggested a non-linear relationship between sagebrush and cottontail

TABLE 7.12. Extended

$SOLAR^{2c}$	$WELL_{1km}$	$POWER_{1km}$	$CONTAG_{5km}$	$SALT_{18km}$	$RDdens_{18km}$	$MjRD_{1km}$	AG_{1km}	LL	K	AIC_c	ΔAIC_c	Σw_i
0.07 (0.03)		0.80 (0.59)			0.65 (0.47)			-171.77	12	369.53	5.36	0.848
0.05 (0.03)			-0.02 (0.01)	-6.60 (3.11)				-171.77	12	369.53	5.36	0.851
0.05 (0.03)				-2.62 (2.65)		-0.58 (0.58)		-170.60	13	369.53	5.37	0.854
0.05 (0.03)		0.97 (0.62)	-0.01 (0.01)			-0.88 (0.62)		-170.61	13	369.55	5.38	0.857
0.04 (0.03)		1.13 (0.63)				-0.84 (0.62)		-171.78	12	369.55	5.39	0.859
0.05 (0.03)	-1.25 (0.89)			-4.74 (2.54)				-172.94	11	369.57	5.40	0.862
0.05 (0.03)	-1.51 (0.94)			-5.29 (2.53)	0.62 (0.51)	-0.44 (0.57)		-169.44	14	369.58	5.41	0.865
0.05 (0.03)	-1.53 (0.92)		-0.01 (0.01)					-171.79	12	369.58	5.42	0.868
0.04 (0.03)		0.83 (0.60)			0.06 (0.48)			-170.64	13	369.61	5.44	0.871
0.05 (0.03)	-1.17 (0.88)			-2.15 (2.66)				-171.81	12	369.61	5.44	0.874
0.05 (0.03)			-0.01 (0.01)			-0.60 (0.59)		-171.81	12	369.62	5.45	0.876
0.06 (0.03)		0.84 (0.59)		-4.86 (2.56)				-172.97	11	369.63	5.46	0.879
0.05 (0.03)		1.05 (0.63)		-5.12 (2.57)	0.34 (0.49)	-0.74 (0.61)		-169.47	14	369.64	5.47	0.882
0.06 (0.03)	-1.66 (0.95)		-0.01 (0.01)	-7.11 (2.92)	0.85 (0.51)			-170.67	13	369.67	5.50	0.885
0.04 (0.03)	-1.28 (0.91)		-0.02 (0.01)	-6.23 (3.07)				-170.68	13	369.70	5.54	0.887
0.05 (0.03)	-1.92 (0.94)				0.99 (0.47)			-173.01	11	369.70	5.54	0.890
0.06 (0.03)	-1.60 (0.93)			-5.18 (2.52)	0.72 (0.50)			-171.87	12	369.74	5.58	0.893
0.04 (0.03)		0.71 (0.61)	-0.01 (0.01)					-170.71	13	369.75	5.58	0.896
0.05 (0.03)	-1.26 (0.88)		-0.01 (0.01)			-0.62 (0.59)		-170.71	13	369.76	5.59	0.898
0.04 (0.03)				-0.95 (2.60)				-171.88	12	369.76	5.60	0.901

occurrence, so we assessed sagebrush variables in both linear and quadratic form. There was no evidence of non-linear relationships with NDVI or interactions between the sagebrush and NDVI variables.

Based on logistic regression analyses, the AIC_c-selected top sagebrush/NDVI model included all sagebrush within 5-km in quadratic form ($ALLSAGE_{5km}$) and NDVI within 5 km ($NDVI_{5km}$) (Table 7.21). Within 5-km there was 1.6% more all sagebrush at presence sites (70.6%, SE = 1.3) than at absent sites (69.0%, SE = 1.7) (Appendix 7.5).

After assessing individual multi-scale covariates (Table 7.22) and developing submodels, the top vegetation submodel for cottontail consisted of coniferous forest within 1 km ($CFRST_{1km}$), grassland within 18 km ($GRASS_{18km}$), mixed shrubland within 0.54 km (MIX_{540}), riparian within 0.27 km (RIP_{270}), and all sagebrush edge density within 5 km ($EDGE_{5km}$) in addition to the sagebrush/NDVI base model (Table 7.23). Topographic ruggedness within 0.27 km (TRI_{270}), elevation (ELEV), and 0.25-km distance decay from intermittent water ($iH2Od_{250}$), were important abiotic predictors of cottontail occurrence (Table 7.23). Only one disturbance factor, 1-km distance decay from power lines ($POWER_{1km}$), was included in the top disturbance submodel (Table 7.23).

The AIC_c-selected top cottontail model was a combination of vegetation, abiotic, and disturbance factors. Cottontails were

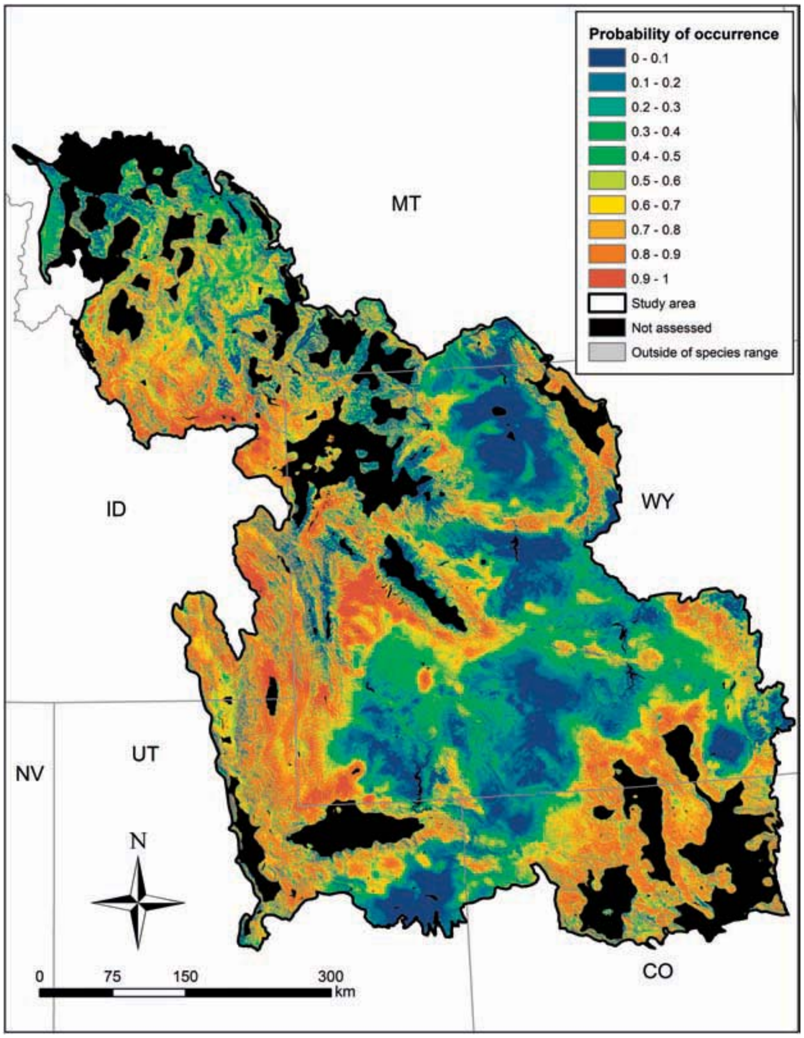

FIG. 7.7. Thatch ant probability of occurrence in the Wyoming Basins Ecoregional Assessment area. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water). Thatch ants are likely to occur in areas with probability > 0.38.

positively associated with moderate levels of all sagebrush, large expanses of coniferous forest, grassland, and mixed shrubland land cover, rugged topography, and proximity to power lines and negatively associated with high productivity and increased elevation (Table 7.24). The weight of evidence for the top model was low (w_i = 0.06) indicating other candidate models were suitable. Variables in the other 62 candidate models with cumulative Akaike weights of just ≥ 0.9 showed that cottontail probability of occurrence also was positively associated with increased all sagebrush edge density, riparian land cover, and proximity to intermittent water (Table 7.24). The final composite probability of occurrence model is below.

$$\text{Prob} = 1 / (1 + (\exp(-(7.56 + 1.33 * \text{ALLSAGE}_{5km} - 1.46 * \text{ALLSAGE}_{5km}^2 - 12.07 * \text{NDVI}_{5km} + 4.92 * \text{CFRST}_{1km} + 6.98 * \tag{7.6}$$

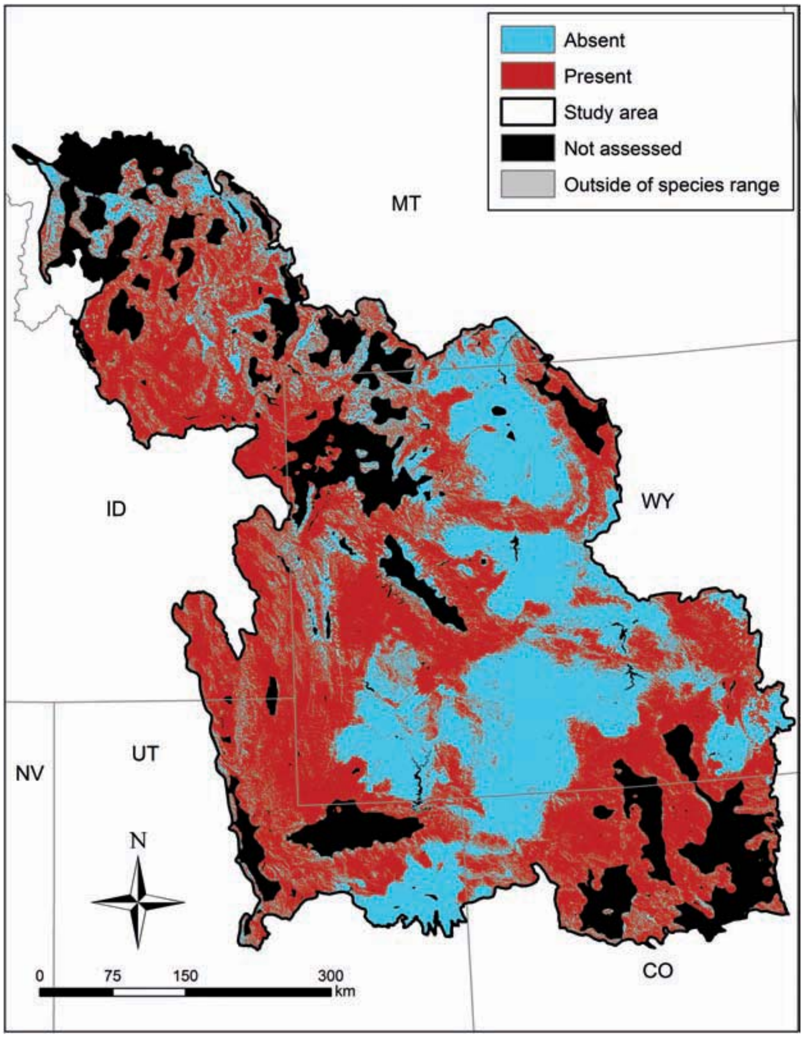

FIG. 7.8. Distribution of thatch ants estimated from ant mound abundance in the Wyoming Basins Ecoregional Assessment area and based on optimum probability cutoff threshold of 0.41. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water).

$GRASS_{18km}$ + 7.18 * MIX_{540} - 0.003 * ELEV + 0.03 * TRI_{270} + 1.52 * $POWER_{1km}$ + 0.284 * $iH2Od_{250}$ + 1.08 * RIP_{270} + 0.0009 *$EDGE_{5km}$))))

Both the composite model and AIC_c-selected top model of cottontail occurrence had excellent accuracy (ROC AUC = 0.84) when predicting cottontail presence. The optimal cutoff probability for predicting cottontail occurrence based on the sensitivity-specificity equality threshold was 0.47 resulting in an overall percent correctly classified accuracy of 76.6%.

Cottontail probability of occurrence was highest near Green River, Wyoming; Vernal, Utah; and throughout the Worland Basin in the WBEA area (Fig. 7.16). Based on our optimal cutoff point and a binary presence-absence prediction, 121,131 km^2

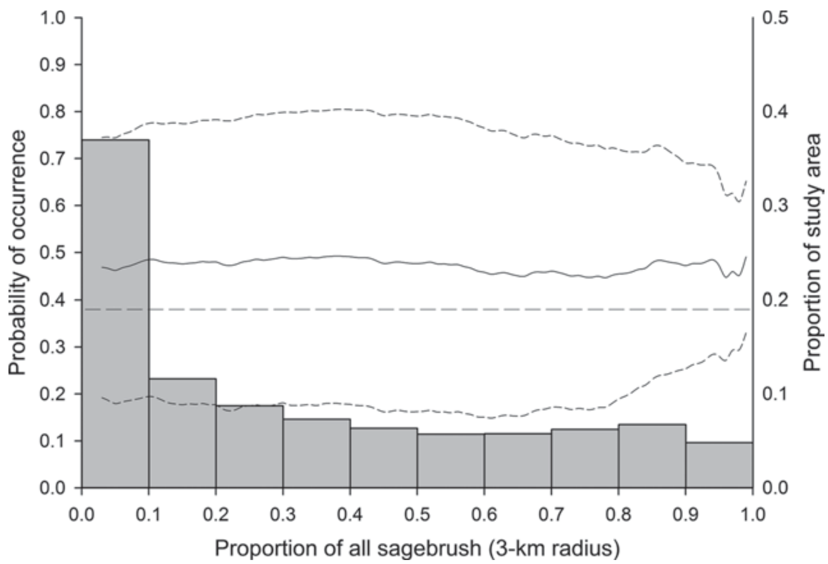

FIG. 7.9. The distribution of thatch ant probability of occurrence within the Wyoming Basins Ecoregional Assessment area in relation to proportion of all sagebrush (*Artemesia* spp.) within a 18-km radius. Mean probability of occurrence (black line, ± 1SD [dashed lines]) values were calculated in each one percent increment of all sagebrush within an 18-km radius moving window. Range of predictions relate to the observed range of sagebrush at study site locations. The dashed horizontal line represents the optimal cutoff threshold (0.41), above which occurrence is predicted. Histogram values represent the proportion of the total study area in each 10% segment of all sagebrush within 18 km.

TABLE 7.13. Results of AIC_c-based model selection for short-horned lizard occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale sagebrush and NDVI; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with ΔAIC_c ≤ 2 are shown.

Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
1	$ABIGSAGE_{5km}$ + $NDVI_{18km}$	-147.23	3	300.54	0.00	0.09
2	$ABIGSAGE_{1km}$ + $NDVI_{18km}$	-147.30	3	300.67	0.14	0.08
3	$ABIGSAGE_{540}$ + $NDVI_{18km}$	-147.39	3	300.85	0.31	0.07
4	$ABIGSAGE_{3km}$ + $NDVI_{18km}$	-147.40	3	300.87	0.33	0.07
5	$ALLSAGE_{1km}$ + $NDVI_{18km}$	-147.57	3	301.21	0.67	0.06
6	$ALLSAGE_{5km}$ + $NDVI_{18km}$	-147.78	3	301.63	1.09	0.05
7	$ALLSAGE_{540}$ + $NDVI_{18km}$	-147.78	3	301.63	1.09	0.05
8	$ALLSAGE_{3km}$ + $NDVI_{18km}$	-147.92	3	301.92	1.38	0.04
9	$ABIGSAGE_{18km}$ + $NDVI_{18km}$	-147.96	3	302.00	1.46	0.04
10	$ALLSAGE_{18km}$ + $NDVI_{18km}$	-147.97	3	302.01	1.48	0.04

[a] Variable definitions provided in Table 4.2

TABLE 7.14. Evaluation statistics from AIC_c-based univariate model selection for short-horned lizard occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale vegetation, abiotic, and disturbance predictor variables (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and Akaike weight [w_i]). We ran logistic regression models with the all big sagebrush (5-km radius) and NDVI (18-km radius) variables as a base model for all variables tested. We used AIC_c to identify the scale at which short-horned lizards respond to individual variables.

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	$GRASS_{1km}$	-146.95	4	301.98	0.00	0.20
	$GRASS_{5km}$	-147.15	4	302.38	0.40	0.17
	$GRASS_{270}$	-147.19	4	302.46	0.48	0.16
	$GRASS_{3km}$	-147.20	4	302.47	0.49	0.16
	$GRASS_{540}$	-147.20	4	302.48	0.50	0.16
	$GRASS_{18km}$	-147.23	4	302.53	0.55	0.15
	MIX_{5km}	-146.53	4	301.14	0.00	0.36
	MIX_{3km}	-146.93	4	301.93	0.80	0.24
	MIX_{18km}	-147.08	4	302.24	1.11	0.21
	MIX_{1km}	-147.17	4	302.42	1.28	0.19
	RIP_{5km}	-146.81	4	301.70	0.00	0.27
	RIP_{1km}	-147.19	4	302.45	0.75	0.19
	RIP_{540}	-147.22	4	302.52	0.82	0.18
	RIP_{3km}	-147.23	4	302.54	0.84	0.18
	RIP_{18km}	-147.23	4	302.54	0.84	0.18
	$SALT_{540}$	-146.82	4	301.72	0.00	0.41
	$SALT_{1km}$	-147.06	4	302.19	0.48	0.32
	$SALT_{270}$	-147.21	4	302.49	0.78	0.27
	$CONTAG_{5km}$	-146.12	4	300.32	0.00	0.31
	$EDGE_{5km}$	-146.44	4	300.96	0.65	0.23
	$CONTAG_{1km}$	-147.03	4	302.13	1.81	0.13
	$EDGE_{1km}$	-147.14	4	302.35	2.03	0.11
	$EDGE_{3km}$	-147.15	4	302.37	2.05	0.11
	$CONTAG_{3km}$	-147.16	4	302.40	2.08	0.11
Abiotic	CLAY	-147.21	4	302.50	0.00	1.00
	CTI	-145.62	4	299.32	0.00	0.71
	CTI^{2}[c]	-145.49	5	301.11	1.79	0.29
	ELEV	-146.35	4	300.78	0.00	0.54
	$ELEV^{2}$[c]	-145.48	5	301.09	0.31	0.46
	$iH2Od_{1km}$[b]	-147.04	4	302.15	0.00	0.34
	$iH2Od_{500}$[b]	-147.05	4	302.17	0.02	0.33
	$iH2Od_{250}$[b]	-147.06	4	302.19	0.05	0.33

TABLE 7.14. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$pH2Od_{250}$[b]	-147.06	4	302.19	0.00	0.37
	$pH2Od_{1km}$[b]	-147.17	4	302.42	0.23	0.33
	$pH2Od_{500}$[b]	-147.23	4	302.53	0.34	0.31
	$SOIL_{cm}$	-147.23	4	302.53	0.00	1.00
	SAND	-147.16	4	302.39	0.00	1.00
	SOLAR	-147.14	4	302.35	0.00	0.65
	SOLAR[2c]	-146.73	5	303.59	1.23	0.35
	Tmin	-146.57	4	301.22	0.00	0.73
	Tmin[2c]	-146.54	5	303.20	1.98	0.27
	TRI_{5km}	-145.67	4	299.42	0.00	0.22
	TRI_{1km}	-145.82	4	299.72	0.30	0.19
	TRI_{18km}	-146.10	4	300.27	0.85	0.14
	TRI_{540}	-146.10	4	300.28	0.86	0.14
	TRI_{3km}	-146.10	4	300.28	0.86	0.14
	TRI_{270}	-146.47	4	301.02	1.60	0.10
	TRI	-146.97	4	302.01	2.59	0.06
Disturbance	AG_{250}[b]	-146.61	4	301.30	0.00	0.43
	AG_{500}[b]	-146.96	4	302.00	0.70	0.30
	AG_{1km}[b]	-147.10	4	302.28	0.98	0.26
	$MjRD_{250}$[b]	-146.63	4	301.34	0.00	0.44
	$MjRD_{500}$[b]	-147.02	4	302.11	0.77	0.30
	$MjRD_{1km}$[b]	-147.18	4	302.44	1.11	0.26
	$PIPE_{1km}$[b]	-146.96	4	301.99	0.00	0.35
	$PIPE_{500}$[b]	-146.99	4	302.05	0.06	0.34
	$PIPE_{250}$[b]	-147.07	4	302.21	0.22	0.31
	$POWER_{500}$[b]	-146.86	4	301.79	0.00	0.35
	$POWER_{1km}$[b]	-146.91	4	301.89	0.11	0.33
	$POWER_{250}$[b]	-146.92	4	301.91	0.12	0.33
	$RDdens_{18km}$	-146.27	4	300.61	0.00	0.17
	$RDdens_{1km}$	-146.57	4	301.22	0.61	0.13
	$2RD_{500}$[b]	-146.64	4	301.36	0.75	0.12
	$2RD_{1km}$[b]	-146.65	4	301.38	0.77	0.12
	$2RD_{250}$[b]	-146.73	4	301.54	0.93	0.11
	$RDdens_{3km}$	-146.85	4	301.78	1.17	0.10
	$RDdens_{5km}$	-146.90	4	301.88	1.27	0.09
	$RDdens_{270}$	-147.02	4	302.12	1.51	0.08

TABLE 7.14. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$RDdens_{540}$	-147.04	4	302.16	1.55	0.08
	$WELL_{250}$[b]	-147.07	4	302.21	0.00	0.35
	$WELL_{1km}$[b]	-147.10	4	302.27	0.06	0.34
	$WELL_{500}$[b]	-147.22	4	302.52	0.30	0.30

[a] Variable definitions provided in Table 4.2
[b] Distance decay function ($e^{(\text{Euclidean distance from feature / -distance parameter})}$)
[c] Quadratic function (variable + variable^2)

(41.9%) of cottontail habitat was predicted for the Wyoming Basins (Fig. 7.17). Cottontails were likely to occupy areas with sagebrush land cover >60% and <75% within 5 km (Fig. 7.18).

Least chipmunk

Seven predictor variables were excluded because they contained values >0 on <20 survey blocks in the least frequent abundance category (present). These variables included proportion of coniferous forest (0.27 and 0.54 km), grassland (0.27 km), mixed shrubland (0.27, 0.5, 1 km), and riparian (0.27 km). Slope, mean annual maximum temperature, precipitation, and soil bulk density were correlated with other variables and excluded. There was no evidence of non-linear relationships between sagebrush or NDVI and least chipmunk occurrence or sagebrush/NDVI interactions.

Based on logistic regression analyses, the AIC_c-selected top sagebrush/NDVI

TABLE 7.15. Results of AIC_c-based submodel selection for short-horned lizard occurrence in the Wyoming Basins Ecoregional Assessment area; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	1	$ABIGSAGE_{5km} + NDVI_{18km} + CONTAG_{5km}$	-146.12	4	300.37	0.00	0.08
	2	$ABIGSAGE_{5km} + NDVI_{18km}$	-147.23	3	300.54	0.17	0.07
	3	$ABIGSAGE_{5km} + NDVI_{18km} + SALT_{5km}$	-146.42	4	300.96	0.59	0.06
	4	$ABIGSAGE_{5km} + NDVI_{18km} + CONTAG_{5km} + SALT_{5km}$	-145.47	5	301.13	0.77	0.05
	5	$ABIGSAGE_{5km} + NDVI_{18km} + CONTAG_{5km} + RIP_{5km}$	-145.50	5	301.19	0.82	0.05
	6	$ABIGSAGE_{5km} + NDVI_{18km} + MIX_{5km}$	-146.53	4	301.19	0.82	0.05
	7	$ABIGSAGE_{5km} + NDVI_{18km} + CONTAG_{5km} + MIX_{5km}$	-145.55	5	301.28	0.92	0.05
	8	$ABIGSAGE_{5km} + NDVI_{18km} + SALT_{5km} + GRASS_{1km}$	-145.58	5	301.35	0.98	0.05
	9	$ABIGSAGE_{5km} + NDVI_{18km} + RIP_{5km}$	-146.81	4	301.75	1.38	0.04
	10	$ABIGSAGE_{5km} + NDVI_{18km} + SALT_{5km} + MIX_{5km}$	-145.82	5	301.83	1.46	0.04
	11	$ABIGSAGE_{5km} + NDVI_{18km} + CONTAG_{5km} + SALT_{5km} + GRASS_{1km}$	-144.83	6	301.94	1.57	0.04
	12	$ABIGSAGE_{5km} + NDVI_{18km} + GRASS_{1km}$	-146.95	4	302.03	1.66	0.03
	13	$ABIGSAGE_{5km} + NDVI_{18km} + CONTAG_{5km} + GRASS_{1km}$	-145.93	5	302.06	1.69	0.03
	14	$ABIGSAGE_{5km} + NDVI_{18km} + CONTAG_{5km} + SALT_{5km} + MIX_{5km}$	-144.97	6	302.20	1.83	0.03

TABLE 7.15. Continued

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
Abiotic	1	$ABIGSAGE_{5km} + NDVI_{18km} + CTI + TRI_{5km}$	-142.80	5	295.80	0.00	0.06
	2	$ABIGSAGE_{5km} + NDVI_{18km} + CTI + TRI_{5km} + ELEV$	-141.79	6	295.85	0.05	0.06
	3	$ABIGSAGE_{5km} + NDVI_{18km} + CTI + TRI_{5km} + pH2Od_{250}$	-142.32	6	296.91	1.11	0.03
	4	$ABIGSAGE_{5km} + NDVI_{18km} + CTI + TRI_{5km} + ELEV + pH2Od_{250}$	-141.45	7	297.25	1.45	0.03
	5	$ABIGSAGE_{5km} + NDVI_{18km} + CTI + TRI_{5km} + Tmin$	-142.66	6	297.58	1.78	0.02
	6	$ABIGSAGE_{5km} + NDVI_{18km} + CTI + TRI_{5km} + iH2Od_{1km}$	-142.70	6	297.66	1.86	0.02
Disturbance	1	$ABIGSAGE_{5km} + NDVI_{18km}$	-147.23	3	300.54	0.00	0.06
	2	$ABIGSAGE_{5km} + NDVI_{18km} + RDdens_{18km}$	-146.27	4	300.66	0.13	0.05
	3	$ABIGSAGE_{5km} + NDVI_{18km} + RDdens_{18km} + AG_{250}$	-145.56	5	301.30	0.77	0.04
	4	$ABIGSAGE_{5km} + NDVI_{18km} + RDdens_{18km} + MjRD_{250}$	-145.57	5	301.33	0.79	0.04
	5	$ABIGSAGE_{5km} + NDVI_{18km} + AG_{250}$	-146.61	4	301.35	0.81	0.04
	6	$ABIGSAGE_{5km} + NDVI_{18km} + MjRD_{250}$	-146.63	4	301.39	0.85	0.04
	7	$ABIGSAGE_{5km} + NDVI_{18km} + POWER_{500}$	-146.86	4	301.84	1.30	0.03
	8	$ABIGSAGE_{5km} + NDVI_{18km} + RDdens_{18km} + POWER_{500}$	-145.85	5	301.90	1.36	0.03
	9	$ABIGSAGE_{5km} + NDVI_{18km} + RDdens_{18km} + WELL_{250}$	-145.91	5	302.01	1.47	0.03
	10	$ABIGSAGE_{5km} + NDVI_{18km} + PIPE_{1km}$	-146.96	4	302.04	1.50	0.03
	11	$ABIGSAGE_{5km} + NDVI_{18km} + WELL_{250}$	-147.07	4	302.26	1.73	0.02
	12	$ABIGSAGE_{5km} + NDVI_{18km} + RDdens_{18km} + AG_{250} + MjRD_{250}$	-145.00	6	302.27	1.73	0.02
	13	$ABIGSAGE_{5km} + NDVI_{18km} + RDdens_{18km} + MjRD_{250} + POWER_{500}$	-145.08	6	302.42	1.88	0.02
	14	$ABIGSAGE_{5km} + NDVI_{18km} + RDdens_{18km} + PIPE_{1km}$	-146.12	5	302.42	1.88	0.02
	15	$ABIGSAGE_{5km} + NDVI_{18km} + AG_{250} + MjRD_{250}$	-146.15	5	302.49	1.96	0.02

[a] Variable definitions provided in Table 4.2

model consisted of big sagebrush (5-km, $BIGSAGE_{5km}$) (Table 7.25). Within 5-km there was 9.7% less big sagebrush at presence sites (46.9%, SE = 4.1) than at absence sites (56.5%, SE = 1.6; Appendix 7.6).

After assessing individual multi-scale covariates (Table 7.27) and developing submodels, the top vegetation submodel for least chipmunk use consisted of grassland within 3 km ($GRASS_{3km}$), mixed shrubland within 18 km (MIX_{18km}), and all sagebrush edge density within 3 km ($EDGE_{3km}$), in addition to the sagebrush/NDVI base model (Table 7.28). Mean minimum temperature (Tmin), topographic ruggedness within 18 km (TRI_{18km}), solar radiation (SOLAR), and percent soil sand content (SAND) were important abiotic predictors (Table 7.28). Four disturbance factors, 1-km distance decay from power lines ($POWER_{1km}$), 0.25-km distance decay from pipelines ($PIPE_{250}$), 1-km distance decay from interstates/major highways ($MjRD_{1km}$), and 0.5-km distance decay from oil/gas wells ($WELL_{500}$), were included in the top disturbance submodel (Table 7.28).

The AIC_c-selected top least chipmunk model was a combination of vegetation, abiotic, and disturbance factors. Least chipmunks were negatively associated with large expanses of big sagebrush

TABLE 7.16. Results of AIC_c-based model selection for the combined short-horned lizard occurrence model[a] in the Wyoming Basins Ecoregional Assessment area; the table also shows parameter estimates (beta [SE]) and evaluation statistics (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and cumulative Akaike weight [Σw_i]). Models shown with cumulative Akaike weight (w_i) of just ≥ 0.9.

Rank	Intercept	$ABIGSAGE_{5km}$	$NDVI_{18km}$	$CONTAG_{5km}$	CTI	TRI_{5km}	LL	K	AIC_c	ΔAIC_c	Σw_i
1	2.00 (1.70)	0.11 (1.54)	-4.50 (2.36)	0.02 (0.01)	-0.21 (0.09)	-0.04 (0.02)	-141.35	6	294.97	0.00	0.441
2	0.39 (1.45)	2.39 (1.17)	-3.09 (2.15)		-0.19 (0.09)	-0.04 (0.02)	-142.80	5	295.80	0.83	0.731
3	0.62 (1.50)	1.28 (1.34)	-6.98 (2.30)	0.02 (0.01)	-0.14 (0.08)		-144.17	5	298.52	3.55	0.806
4	-0.78 (1.34)	3.21 (1.14)	-5.54 (2.05)		-0.13 (0.08)		-145.62	4	299.37	4.40	0.855
5	-1.65 (1.09)	2.40 (1.12)	-2.77 (2.15)			-0.03 (0.02)	-145.67	4	299.47	4.50	0.901

[a] Variable definitions provided in Table 4.2

land cover, increased all sagebrush edge density, increased mean minimum temperature, and proximity to pipelines, but positively associated with proximity to power lines (Table 7.29). The weight of evidence for the top model was low (w_i = 0.04) with 136 models with a cumulative Akaike weight of just ≥ 0.9. Variables in these other candidate models showed that least chipmunk locations also were positively associated with increased solar radiation, and proximity to highways and oil/gas wells, but negatively associated with topographic ruggedness, proportion of mixed shrubland and grassland land cover, and percent soil sand content (Table 7.29). The final composite probability of occurrence model is below.

(7.7)

$$Prob = 1 / (1 + (exp(-(-1.26 - 0.92 * BIGSAGE_{5km} - 0.02 * EDGE_{3km} - 0.25 * Tmin - 0.46 * PIPE_{250} + 0.51 * POWER_{1km} + 0.002 * SOLAR - 0.01 * TRI_{18km} - 0.003 * SAND + 0.15 * MjRD_{1km} - 2.57 * MIX_{18km} + 0.37 * WELL_{500} + -0.41 * GRASS_{3km}))))$$

The composite model of least chipmunk occurrence had good model accuracy (ROC AUC = 0.75). The model accuracy of the composite was a slight improvement over the AIC_c-selected top model (ROC AUC = 0.74). The optimal cutoff probability for predicting least chipmunk occurrence based on sensitivity and specificity equality threshold was 0.18 resulting in an overall percent correctly classified accuracy of 69.4%.

Least chipmunk occurrence was predicted to be highest in high-elevation shrubland areas of the south east and western portions of the Wyoming Basins Ecoregional Assessment area (Fig. 7.19). Within the Wyoming Basins, 44.4% of the area (153,437 km^2) was predicted to be suitable least chipmunk habitat (Fig. 7.20) using our optimal cutoff point and a binary presence/absence classification. Least

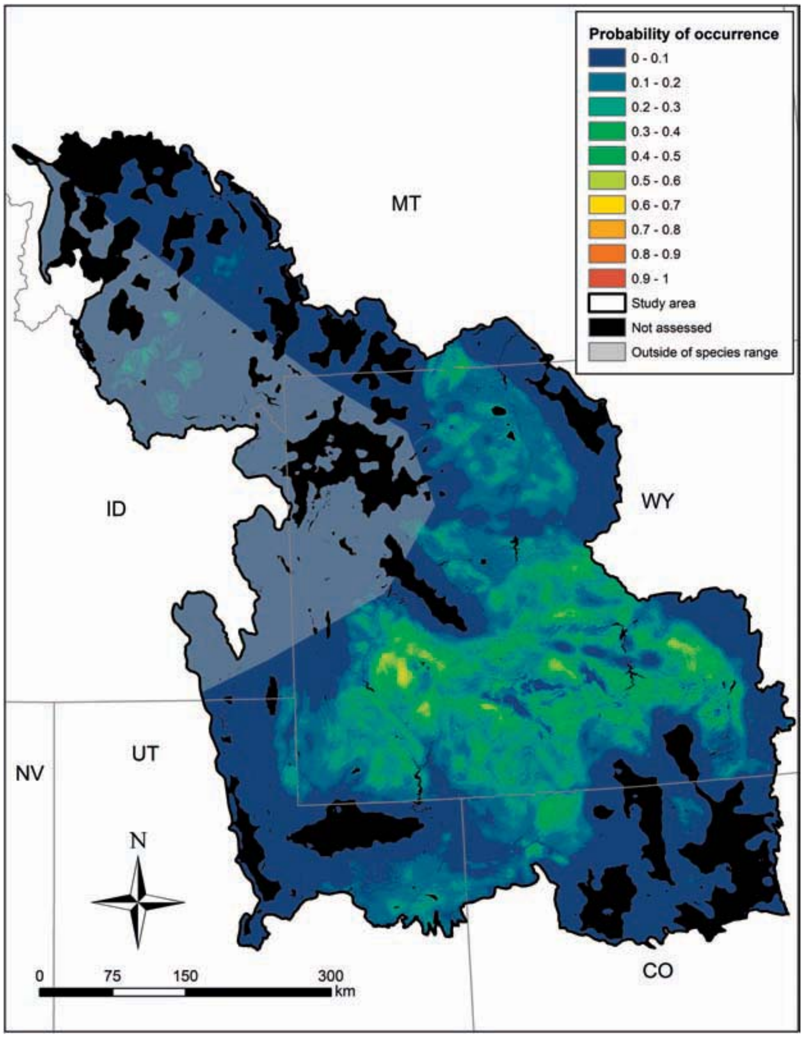

FIG. 7.10. Short-horned lizard probability of occurrence in the Wyoming Basins Ecoregional Assessment area. Semi-transparent grey shaded areas are outside the range of the short-horned lizard; black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water). Short-horned lizards are likely to occur in areas with probability > 0.22.

chipmunks were more likely to occur in areas with <6 or >91% big sagebrush within 5-km (Fig. 7.21).

Model Evaluation

Short-horned lizards were the only species for which we had sufficient data to evaluate models. Our model of short-horned lizard occurrence validated well (Fig. 7.22) with slope of observed versus expected values being close to 1.0 and the intercept close to zero (slope = 0.89, 95% CI = -0.15–1.92; intercept = -0.014, 95% CI = -0.16–0.19, R^2 = 0.426), although fit was only moderate suggesting variation among binned occurrence classes.

DISCUSSION

Understanding the distribution of wildlife species, both common and rare, is important to assessing the integrity of the

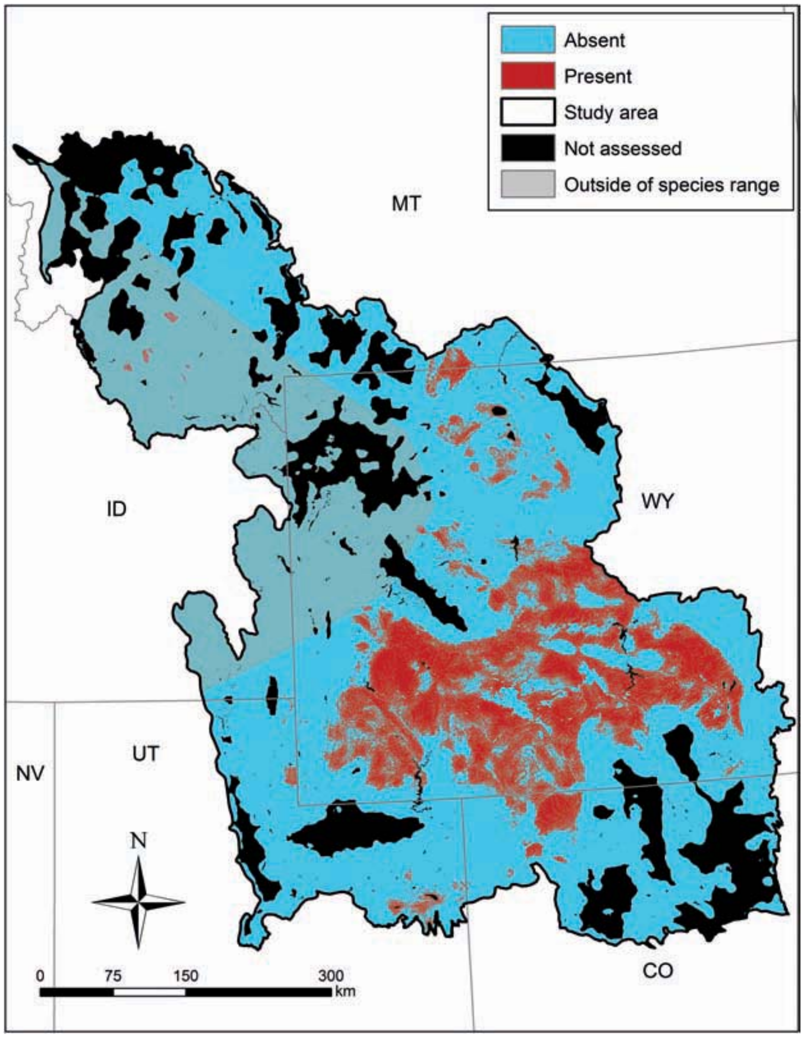

FIG. 7.11. Distribution of short-horned lizards in the Wyoming Basins Ecoregional Assessment area based on optimum probability cutoff threshold of 0.22. Semi-transparent grey shaded areas are outside the range of the short-horned lizard, black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water).

wildlife community of a region. Knowing how sagebrush-associated wildlife species respond to habitat and disturbance characteristics and the spatial distribution of these species provides information useful for resource managers when planning treatments or mitigation efforts. For example, information on the distribution of seed predators may help when planning seed mixes or the timing of the seeding itself, and the distribution of potential prey species can help guide management of predator species of conservation concern, such as the ferruginous hawk. Below, we discuss the key factors influencing abundance or occurrence of each species assessed across the WBEA.

Harvester Ant

Harvester ants were negatively associated with high productivity and large expanses of sagebrush. Areas of high productivity generally have increased soil

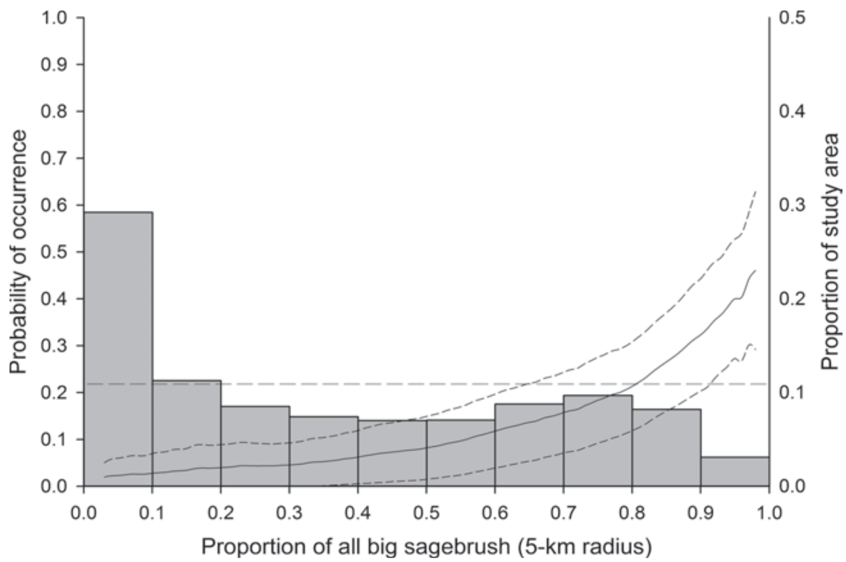

FIG. 7.12. Distribution of short-horned lizard probability of occurrence within the Wyoming Basins Ecoregional Assessment area in relation to proportion of all big sagebrush (*Artemesia tridentata*) within a 5-km radius. Mean probability of occurrence (black line, ±1 SD [dashed lines]) values were calculated in each one percent increment of all big sagebrush within a 5-km radius moving window. Range of predictions relate to the observed range of sagebrush at study site locations. The dashed horizontal line represents the optimal cutoff threshold (0.22), above which occurrence is predicted. Histogram values represent the proportion of the total study area in each 10% segment of all big sagebrush within 5 km.

moisture which can be problematic for harvester ants because high levels of moisture in the nest can lead to germination of cached seed (Cole 1932a). Increases in harvester ant mound abundance has been associated with a reduction in cover of sagebrush (Sneva 1979) and other perennial shrubs (Sharp and Barr 1960). In Oregon, the number of mounds more than doubled following a 95% reduction in sagebrush cover (Sneva 1979). However, harvester ants in Idaho had their highest densities in sagebrush communities (Blom et al. 1991), although there was a high degree of variability in densities that was attributable to differences in soil characteristics.

Several soil characteristics were important predictors of harvester ant occurrence

TABLE 7.17. Results of AIC_c-based model selection for white-tailed jackrabbit occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale sagebrush and NDVI; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
1	$BIGSAGE_{270}$	-165.48	2	335.01	0.00	0.11
2	$BIGSAGE_{270}$ + NDVI	-165.22	3	336.51	1.51	0.05
3	$BIGSAGE_{270}$ + $NDVI_{270}$	-165.28	3	336.64	1.64	0.05
4	$BIGSAGE_{270}$ + $NDVI_{540}$	-165.41	3	336.90	1.90	0.04
5	$BIGSAGE_{270}$ + $NDVI_{18km}$	-165.45	3	336.97	1.96	0.04
6	$BIGSAGE_{270}$ + $NDVI_{3km}$	-165.45	3	336.97	1.97	0.04

[a] Variable definitions provided in Table 4.2

TABLE 7.18. Evaluation statistics from AIC_c-based univariate model selection for white-tailed jackrabbit occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale vegetation, abiotic, and disturbance predictor variables (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and Akaike weight [w_i]). We ran generalized ordered logistic models with the big sagebrush (0.27-km radius) variable as a base model for all variables tested. We used AIC_c to identify the scale at which white-tailed jackrabbits respond to individual variables.

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	$CFRST_{18km}$	-165.34	3	336.72	0.00	0.34
	$CFRST_{5km}$	-165.35	3	336.74	0.02	0.34
	$CFRST_{3km}$	-165.43	3	336.90	0.18	0.31
	$GRASS_{540}$	-163.52	3	333.07	0.00	0.32
	$GRASS_{1km}$	-163.86	3	333.75	0.68	0.22
	$GRASS_{270}$	-163.93	3	333.89	0.82	0.21
	$GRASS_{3km}$	-164.38	3	334.80	1.73	0.13
	$GRASS_{5km}$	-165.13	3	336.30	3.23	0.06
	$GRASS_{18km}$	-165.32	3	336.67	3.60	0.05
	MIX_{5km}	-165.40	3	336.84	0.00	0.21
	MIX_{3km}	-165.44	3	336.92	0.08	0.20
	MIX_{1km}	-165.47	3	336.98	0.14	0.20
	MIX_{18km}	-165.47	3	336.99	0.14	0.20
	MIX_{540}	-165.48	3	336.99	0.15	0.20
	RIP_{1km}	-165.33	3	336.69	0.00	0.18
	RIP_{540}	-165.41	3	336.85	0.16	0.17
	RIP_{18km}	-165.42	3	336.88	0.19	0.17
	RIP_{270}	-165.43	3	336.91	0.22	0.17
	RIP_{3km}	-165.48	3	337.00	0.31	0.16
	RIP_{5km}	-165.48	3	337.00	0.32	0.16
	$SALT_{3km}$	-162.78	3	331.60	0.00	0.40
	$SALT_{5km}$	-163.08	3	332.20	0.59	0.30
	$SALT_{18km}$	-163.87	3	333.78	2.18	0.13
	$SALT_{1km}$	-164.23	3	334.49	2.88	0.09
	$SALT_{540}$	-164.92	3	335.87	4.27	0.05
	$SALT_{270}$	-165.41	3	336.86	5.25	0.03
	$PATCH_{1km}$	-164.11	3	334.25	0.00	0.24
	$EDGE_{3km}$	-164.50	3	335.03	0.78	0.16
	$CONTAG_{5km}$	-164.68	3	335.40	1.16	0.13
	$PATCH_{3km}$	-164.92	3	335.87	1.62	0.10
	$PATCH_{5km}$	-165.01	3	336.05	1.80	0.10
	$EDGE_{5km}$	-165.28	3	336.59	2.34	0.07
	$CONTAG_{1km}$	-165.34	3	336.73	2.48	0.07

TABLE 7.18. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$CONTAG_{3km}$	-165.36	3	336.76	2.51	0.07
	$EDGE_{1km}$	-165.40	3	336.83	2.59	0.06
Abiotic	CTI^{2b}	-164.15	4	336.38	0.00	0.58
	CTI	-165.48	3	337.00	0.62	0.42
	ELEV	-165.33	3	336.69	0.00	0.71
	$ELEV^{2b}$	-165.21	4	338.50	1.81	0.29
	$iH2Od_{1km}$[c]	-165.32	3	336.68	0.00	0.35
	$iH2Od_{500}$[c]	-165.34	3	336.71	0.03	0.34
	$iH2Od_{250}$[c]	-165.42	3	336.89	0.20	0.31
	$pH2Od_{500}$[c]	-164.31	3	334.65	0.00	0.37
	$pH2Od_{1km}$[c]	-164.45	3	334.93	0.29	0.32
	$pH2Od_{250}$[c]	-164.50	3	335.04	0.39	0.31
	$SOLAR^{2b}$	-163.88	4	335.83	0.00	0.56
	SOLAR	-165.13	3	336.29	0.46	0.44
	Tmin	-165.42	3	336.89	0.00	0.71
	$Tmin^{2b}$	-165.31	4	338.69	1.81	0.29
	TRI_{540}	-163.32	3	332.68	0.00	0.33
	TRI_{270}	-163.50	3	333.04	0.36	0.28
	TRI_{1km}	-164.34	3	334.72	2.04	0.12
	TRI	-164.49	3	335.01	2.33	0.10
	TRI_{18km}	-164.89	3	335.82	3.13	0.07
	TRI_{5km}	-165.23	3	336.49	3.81	0.05
	TRI_{3km}	-165.36	3	336.76	4.07	0.04
Disturbance	AG_{250}[c]	-165.00	3	336.04	0.00	0.38
	AG_{500}[c]	-165.13	3	336.29	0.25	0.33
	AG_{1km}[c]	-165.27	3	336.57	0.53	0.29
	$MjRD_{1km}$[c]	-162.73	3	331.49	0.00	0.41
	$MjRD_{500}$[c]	-162.79	3	331.62	0.13	0.38
	$MjRD_{250}$[c]	-163.36	3	332.77	1.27	0.21
	$PIPE_{500}$[c]	-165.30	3	336.64	0.00	0.35
	$PIPE_{1km}$[c]	-165.34	3	336.73	0.08	0.33
	$PIPE_{250}$[c]	-165.40	3	336.84	0.19	0.32
	$POWER_{500}$[c]	-163.83	3	333.70	0.00	0.37
	$POWER_{1km}$[c]	-163.94	3	333.92	0.22	0.33
	$POWER_{250}$[c]	-164.05	3	334.13	0.44	0.30
	$RDdens_{3km}$	-163.86	3	333.76	0.00	0.33

TABLE 7.18. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$RDdens_{5km}$	-164.62	3	335.29	1.52	0.15
	$RDdens_{18km}$	-165.18	3	336.39	2.63	0.09
	$2RD_{500}$[c]	-165.24	3	336.51	2.75	0.08
	$2RD_{1km}$[c]	-165.24	3	336.52	2.76	0.08
	$2RD_{250}$[c]	-165.33	3	336.69	2.93	0.08
	$RDdens_{1km}$	-165.44	3	336.91	3.15	0.07
	$RDdens_{540}$	-165.48	3	337.00	3.24	0.06
	$RDdens_{270}$	-165.48	3	337.00	3.24	0.06
	$WELL_{500}$[c]	-164.93	3	335.90	0.00	0.35
	$WELL_{1km}$[c]	-164.96	3	335.96	0.06	0.34
	$WELL_{250}$[c]	-165.09	3	336.22	0.31	0.30

[a] Variable definitions provided in Table 4.2
[b] Quadratic function (variable + $variable^2$)
[c] Distance decay function ($e^{(\text{Euclidean distance from feature/-distance parameter})}$)

within the Wyoming Basins. Soil sand content and soil depth were positively associated, and soil clay content was negatively associated, with harvester ant occurrence. In Idaho, high harvester ant densities were also associated with increased sand content (Blom et al. 1991). Sand content may improve the ability of harvester ants to build nests and increase availability of pebbles for making nest mounds (Cole 1932a). Harvester ant (*P. occidentalis*) locations in North Dakota, at the eastern edge of the species range, all contained high percent sand content, and no sites were found in clay or silty clay loam soils (DeMers 1993). Increased soil depth may be necessary for proper nest construction because harvester ants use relatively deep reaches of the soil profile (Lavigne 1969, Fitzner et al. 1979, MacKay 1981). In central Oregon, the highest colony densities were found on deep soils with low densities occurring on rocky, shallow soils (Willard and Crowell 1965). Overwintering workers have been found as deep as 2.7 m in Wyoming (Lavigne 1969) and Washington (Fitzner et al. 1979).

Grassland and salt desert shrubland were both negatively associated with harvester ant occurrence, whereas sagebrush edge density was positively associated with harvester ants. Mounds were scarce in shadscale saltbush (*Atriplex confertifolia*) habitats in Idaho and western Wyoming (Cole 1932a, Sharp and Barr 1960, Blom et al. 1991), and densities were lower in crested wheatgrass (*Agropyron cristatum*), Indian ricegrass (*Achnatherum hymenoides*), and basin wildrye (*Leymus cinerus*) communities (Blom et al. 1991). An increase in sagebrush patch edges may provide increased proximity to a variety of food sources, enhancing ant density.

The only other abiotic factor in addition to soil characteristics was a positive association with increased minimum temperatures when predicting harvester ant occurrence. Harvester ants are temperature sensitive and limit daily and seasonal foraging to specific temperature ranges with activity occurring between 25 to 55 C and maximum foraging between 40 to 45 C (Crist and MacMahon 1991). At a grassland site in northeastern Colorado,

TABLE 7.19. Results of AIC_c -based submodel selection for white-tailed jackrabbit occurrence in the Wyoming Basins Ecoregional Assessment area; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	1	$BIGSAGE_{270}$ + $GRASS_{540}$ + $SALT_{3km}$	-160.35	4	328.77	0.00	0.18
	2	$BIGSAGE_{270}$ + $CFRST_{18km}$ + $GRASS_{540}$ + $SALT_{3km}$	-160.22	5	330.57	1.80	0.08
	3	$BIGSAGE_{270}$ + $GRASS_{540}$ + RIP_{1km} + $SALT_{3km}$	-160.31	5	330.74	1.97	0.07
Abiotic	1	$BIGSAGE_{270}$ + TRI_{540}	-163.32	3	332.68	0.00	0.07
	2	$BIGSAGE_{270}$ + $pH2Od_{500}$ + TRI_{540}	-162.81	4	333.69	1.01	0.04
	3	$BIGSAGE_{270}$ + SOLAR + SOLAR2 + TRI_{540}	-161.82	5	333.76	1.08	0.04
	4	$BIGSAGE_{270}$ + ELEV + TRI_{540}	-163.08	4	334.23	1.55	0.03
	5	$BIGSAGE_{270}$ + Tmin + TRI_{540}	-163.16	4	334.39	1.71	0.03
	6	$BIGSAGE_{270}$ + $iH2Od_{1km}$ + TRI_{540}	-163.20	4	334.48	1.80	0.03
	7	$BIGSAGE_{270}$ + ELEV + Tmin + TRI_{540}	-162.21	5	334.54	1.86	0.03
	8	$BIGSAGE_{270}$ + $pH2Od_{500}$	-164.31	3	334.65	1.97	0.03
Disturbance	1	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $RDdens_{3km}$ + $PIPE_{500}$ + $POWER_{500}$	-158.79	6	329.78	0.00	0.05
	2	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $RDdens_{3km}$ + $PIPE_{500}$ + $POWER_{500}$ + AG_{250}	-157.84	7	329.94	0.16	0.04
	3	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $RDdens_{3km}$ + $WELL_{500}$	-159.93	5	329.99	0.21	0.04
	4	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $RDdens_{3km}$ + $PIPE_{500}$ + $POWER_{500}$ + $WELL_{500}$	-157.85	7	329.96	0.19	0.04
	5	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $RDdens_{3km}$ + AG_{250} + $WELL_{500}$	-158.90	6	329.99	0.22	0.04
	6	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $PIPE_{500}$ + $POWER_{500}$	-159.96	5	330.05	0.27	0.04
	7	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $RDdens_{3km}$ + $PIPE_{500}$ + $POWER_{500}$ + AG_{250} + $WELL_{500}$	-156.88	8	330.11	0.33	0.04
	8	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $PIPE_{500}$ + $POWER_{500}$+ AG_{250}	-159.06	6	330.31	0.53	0.04
	9	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $RDdens_{3km}$ + $PIPE_{500}$ + AG_{250} + $WELL_{500}$	-158.04	7	330.34	0.56	0.04
	10	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $PIPE_{500}$ + $RDdens_{3km}$ + $WELL_{500}$	-159.17	6	330.53	0.75	0.03
	11	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $RDdens_{3km}$ + $PIPE_{500}$ + AG_{250}	-159.17	6	330.53	0.76	0.03
	12	$BIGSAGE_{270}$ + $MjRD_{1km}$ + $RDdens_{3km}$ + $POWER_{500}$ + $WELL_{500}$	-159.22	6	330.64	0.86	0.03

TABLE 7.19. Continued

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
	13	$BIGSAGE_{270} + MjRD_{1km} + RDdens_{3km} + PIPE_{500}$	-160.29	5	330.71	0.94	0.03
	14	$BIGSAGE_{270} + AG_{250} + MjRD_{1km} + RDdens_{3km} + POWER_{500} + WELL_{500}$	-158.34	7	330.94	1.16	0.03
	15	$BIGSAGE_{270} + MjRD_{1km} + RDdens_{3km}$	-161.51	4	331.09	1.31	0.02
	16	$BIGSAGE_{270} + AG_{250} + MjRD_{1km} + PIPE_{500}$	-160.51	5	331.15	1.38	0.02
	17	$BIGSAGE_{270} + AG_{250} + RDdens_{3km} + MjRD_{1km}$	-160.54	5	331.20	1.42	0.02
	18	$BIGSAGE_{270} + MjRD_{1km} + PIPE_{500}$	-161.59	4	331.25	1.47	0.02
	19	$BIGSAGE_{270} + RDdens_{3km} + POWER_{500} + WELL_{500}$	-160.61	5	331.35	1.57	0.02
	20	$BIGSAGE_{270} + MjRD_{1km}$	-162.73	3	331.49	1.72	0.02
	21	$BIGSAGE_{270} + MjRD_{1km} + RDdens_{3km} + POWER_{500}$	-160.74	5	331.60	1.83	0.02
	22	$BIGSAGE_{270} + MjRD_{1km} + AG_{250}$	-161.79	4	331.66	1.89	0.02
	23	$BIGSAGE_{270} + MjRD_{1km} + POWER_{500}$	-161.81	4	331.70	1.93	0.02

[a] Variable definitions provided in Table 4.2

harvester ants opened mound entrances when soil surface temperatures reached 24 C, but little activity took place until temperatures reached 28 C (Rogers 1974). Mean minimum temperatures may be low enough within the areas of the WBEA that they limit harvester ant foraging activity, therefore reducing their probability of occurrence and abundance.

Ants were positively associated with two disturbance factors: proximity to agricultural land and pipelines. Soil disturbances associated with these areas may lead to increased seed production by exotic invasive species, leading to increased food resources. In areas with high cover of cheatgrass, harvester ants harvested large quantities of cheatgrass seed (Cole 1932a).

Proximity to oil/gas development was negatively associated with harvester ant occurrence. Disturbance of the soil surface and crested wheatgrass seedings were negatively associated with nest densities in Idaho (Blom et al. 1991). Both are characteristics of active oil and gas fields with crested wheatgrass commonly used in well pad reclamation efforts and subsequently associated with oil/gas well locations (Ch. 10). Also, drilling rigs, pump stations, or condensation tanks at active well pads can cause shadowing which can induce emigration in actively foraging colonies of *P. occidentalis* (Coffin and Lauenroth 1990).

Abundance of harvester ants on survey blocks in the WBEA were similar to previous studies (3-80 mounds/ha; Soule and Knapp 1996). Although we were unable to conduct a formal analysis of detection probability, this comparison is evidence that our abundance estimates were comparable with previous research. This is not a substitute for a detection analysis, and we encourage future efforts account for detectability when possible.

Thatch Ant

Thatch ants were positively associated with large expanses of sagebrush land cover. Thatch ants were most abundant

TABLE 7.20. Results of AIC_c-based model selection for the combined white-tailed jackrabbit occurrence models[a] in the Wyoming Basins Ecoregional Assessment area; the table also shows parameter estimates (beta [SE]) and evaluation statistics (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and cumulative Akaike weight [$\sum w_i$]). Models shown with cumulative Akaike weight (w_i) of just ≥ 0.9.

Rank	Intercept	$BIGSAGE_{270}$	$GRASS_{540}$	$SALT_{3km}$	TRI_{540}	$MjRD_{1km}$
1	-1.66 (0.59)	1.12 (0.55)	3.29 (1.34)	2.82 (1.43)	-0.02 (0.01)	-1.82 (0.78)
2	-1.61 (0.59)	1.11 (0.55)	3.21 (1.34)	2.85 (1.43)	-0.02 (0.01)	-1.58 (0.78)
3	-1.57 (0.59)	1.02 (0.55)	2.97 (1.36)	2.60 (1.45)	-0.02 (0.01)	-1.88 (0.83)
4	-1.34 (0.66)	1.15 (0.56)	3.11 (1.35)	2.67 (1.43)	-0.02 (0.01)	-1.73 (0.78)
5	-1.32 (0.66)	1.14 (0.55)	3.04 (1.35)	2.72 (1.44)	-0.02 (0.01)	-1.51 (0.78)
6	-1.64 (0.59)	1.06 (0.55)	3.15 (1.36)	2.62 (1.45)	-0.02 (0.01)	-2.06 (0.84)
7	-1.21 (0.53)	0.87 (0.52)	3.02 (1.33)		-0.03 (0.01)	-1.90 (0.78)
8	-1.17 (0.53)	0.78 (0.52)	2.69 (1.34)		-0.03 (0.01)	-2.02 (0.83)
9	-1.15 (0.53)	0.86 (0.52)	2.95 (1.33)		-0.03 (0.01)	-1.67 (0.78)
10	-2.51 (0.43)	1.64 (0.50)	3.16 (1.33)	3.53 (1.39)		-1.61 (0.77)
11	-0.86 (0.60)	0.91 (0.53)	2.81 (1.33)		-0.03 (0.01)	-1.79 (0.77)
12	-1.30 (0.66)	1.08 (0.56)	2.95 (1.36)	2.45 (1.46)	-0.02 (0.01)	-1.98 (0.84)
13	-2.47 (0.43)	1.64 (0.50)	3.08 (1.33)	3.59 (1.39)		-1.39 (0.77)
14	-0.83 (0.60)	0.82 (0.53)	2.48 (1.35)		-0.03 (0.01)	-1.94 (0.82)
15	-1.23 (0.53)	0.82 (0.52)	2.85 (1.34)		-0.03 (0.01)	-2.21 (0.84)
16	-2.40 (0.43)	1.52 (0.50)	2.84 (1.34)	3.30 (1.42)		-1.71 (0.82)
17	-0.83 (0.60)	0.90 (0.53)	2.76 (1.33)		-0.03 (0.01)	-1.59 (0.78)
18	-0.87 (0.60)	0.85 (0.53)	2.63 (1.34)		-0.03 (0.01)	-2.12 (0.83)
19	-2.20 (0.51)	1.68 (0.50)	2.98 (1.34)	3.38 (1.39)		-1.52 (0.76)
20	-1.88 (0.58)	1.18 (0.55)	3.01 (1.33)	3.10 (1.42)	-0.02 (0.01)	
21	-1.24 (0.54)	0.70 (0.51)		2.23 (1.42)	-0.02 (0.01)	-1.80 (0.81)
22	-2.18 (0.51)	1.68 (0.50)	2.92 (1.34)	3.46 (1.39)		-1.32 (0.76)
23	-2.48 (0.43)	1.56 (0.51)	3.02 (1.34)	3.30 (1.42)		-1.87 (0.83)
24	-2.09 (0.51)	1.56 (0.50)	2.64 (1.35)	3.13 (1.42)		-1.64 (0.81)
25	-0.55 (0.56)	0.59 (0.50)			-0.03 (0.01)	-1.85 (0.80)
26	-1.26 (0.54)	0.79 (0.51)		2.53 (1.40)	-0.02 (0.01)	-1.47 (0.77)
27	-1.30 (0.54)	0.79 (0.51)		2.47 (1.39)	-0.02 (0.01)	-1.72 (0.77)
28	-0.87 (0.61)	0.75 (0.52)		2.07 (1.42)	-0.02 (0.01)	-1.72 (0.80)
29	-0.92 (0.49)	0.53 (0.49)			-0.03 (0.01)	-1.93 (0.81)
30	-1.51 (0.66)	1.21 (0.55)	2.81 (1.34)	2.95 (1.43)	-0.02 (0.01)	
31	-0.92 (0.61)	0.83 (0.51)		2.30 (1.40)	-0.02 (0.01)	-1.61 (0.76)
32	-0.91 (0.61)	0.83 (0.51)		2.38 (1.40)	-0.02 (0.01)	-1.38 (0.76)
33	-2.15 (0.51)	1.60 (0.51)	2.81 (1.35)	3.12 (1.42)		-1.79 (0.82)
34	-2.60 (0.42)	1.64 (0.49)	2.97 (1.32)	3.71 (1.39)		

TABLE 7.20. Extended

$POWER_{500}$	$PIPE_{500}$	$RDdens_{3km}$	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
			-155.53	6	323.32	0.00	0.069
-1.37 (1.11)			-154.59	7	323.53	0.21	0.132
-1.66 (1.12)	0.83 (0.66)		-153.82	8	324.10	0.78	0.179
		-0.23 (0.22)	-154.94	7	324.24	0.91	0.223
-1.32 (1.12)		-0.22 (0.22)	-154.09	8	324.64	1.32	0.259
	0.53 (0.63)		-155.18	7	324.72	1.40	0.294
			-157.42	5	325.02	1.70	0.323
-1.67 (1.12)	1.00 (0.65)		-155.38	7	325.11	1.79	0.352
-1.35 (1.12)			-156.52	6	325.32	1.99	0.377
			-157.61	5	325.42	2.09	0.402
		-0.27 (0.22)	-156.62	6	325.51	2.19	0.425
	0.58 (0.63)	-0.25 (0.22)	-154.53	8	325.51	2.19	0.448
-1.34 (1.08)			-156.67	6	325.61	2.29	0.470
-1.65 (1.14)	1.04 (0.65)	-0.27 (0.22)	-154.60	8	325.65	2.33	0.492
	0.73 (0.62)		-156.76	6	325.78	2.46	0.513
-1.66 (1.10)	0.88 (0.66)		-155.80	7	325.95	2.63	0.531
-1.28 (1.13)		-0.25 (0.22)	-155.84	7	326.03	2.71	0.549
	0.77 (0.62)	-0.28 (0.22)	-155.89	7	326.14	2.82	0.566
		-0.23 (0.22)	-157.01	6	326.28	2.96	0.582
-1.87 (1.13)			-157.07	6	326.40	3.08	0.597
-1.81 (1.13)	1.00 (0.65)		-156.12	7	326.60	3.28	0.610
-1.28 (1.09)		-0.22 (0.22)	-156.16	7	326.68	3.36	0.623
	0.57 (0.63)		-157.21	6	326.69	3.37	0.636
-1.65 (1.11)	0.93 (0.66)	-0.24 (0.22)	-155.18	8	326.82	3.50	0.648
-1.78 (1.15)	1.18 (0.64)	-0.31 (0.22)	-156.24	7	326.83	3.51	0.660
-1.45 (1.13)			-157.29	6	326.84	3.52	0.672
			-158.34	5	326.87	3.55	0.684
-1.80 (1.15)	1.05 (0.65)	-0.29 (0.22)	-155.21	8	326.88	3.55	0.696
-1.80 (1.13)	1.15 (0.64)		-157.33	6	326.93	3.61	0.707
-1.79 (1.13)		-0.26 (0.22)	-156.35	7	327.06	3.74	0.718
		-0.29 (0.22)	-157.41	6	327.08	3.76	0.728
-1.39 (1.13)		-0.27 (0.22)	-156.48	7	327.31	3.98	0.738
	0.62 (0.63)	-0.25 (0.22)	-156.53	7	327.42	4.10	0.747
-1.76 (1.10)			-158.62	5	327.44	4.12	0.756

TABLE 7.20. Continued

Rank	Intercept	$BIGSAGE_{270}$	$GRASS_{540}$	$SALT_{3km}$	TRI_{540}	$MjRD_{1km}$
35	-0.54 (0.56)	0.66 (0.49)			-0.03 (0.01)	-1.67 (0.76)
36	-0.58 (0.56)	0.61 (0.50)			-0.03 (0.01)	-2.03 (0.82)
37	-1.29 (0.54)	0.73 (0.51)		2.22 (1.41)	-0.02 (0.01)	-2.01 (0.83)
38	-0.90 (0.61)	0.77 (0.52)		2.03 (1.42)	-0.02 (0.01)	-1.91 (0.82)
39	-0.94 (0.49)	0.61 (0.49)			-0.03 (0.01)	-1.80 (0.77)
40	-0.88 (0.49)	0.60 (0.49)			-0.03 (0.01)	-1.56 (0.77)
41	-0.52 (0.56)	0.65 (0.49)			-0.03 (0.01)	-1.46 (0.76)
42	-2.01 (0.36)	1.17 (0.45)		2.88 (1.38)		-1.67 (0.80)
43	-0.97 (0.49)	0.55 (0.49)			-0.03 (0.01)	-2.14 (0.82)
44	-2.03 (0.57)	1.23 (0.55)	3.09 (1.33)	3.08 (1.42)	-0.02 (0.01)	
45	-2.25 (0.51)	1.68 (0.50)	2.78 (1.33)	3.56 (1.39)		
46	-1.88 (0.57)	1.15 (0.55)	2.90 (1.36)	3.03 (1.43)	-0.02 (0.01)	
47	-1.66 (0.44)	1.23 (0.45)		2.72 (1.38)		-1.59 (0.80)
48	-1.60 (0.65)	1.25 (0.55)	2.86 (1.34)	2.90 (1.43)	-0.02 (0.01)	
49	-2.05 (0.36)	1.28 (0.45)		3.21 (1.35)		-1.33 (0.76)
50	-2.09 (0.36)	1.27 (0.45)		3.13 (1.35)		-1.56 (0.76)
51	-1.73 (0.45)	1.33 (0.45)		2.97 (1.36)		-1.45 (0.76)
52	-1.50 (0.65)	1.17 (0.55)	2.66 (1.37)	2.85 (1.44)	-0.02 (0.01)	
53	-2.69 (0.43)	1.64 (0.50)	3.06 (1.32)	3.63 (1.39)		
54	-1.42 (0.52)	0.94 (0.52)	2.72 (1.31)		-0.03 (0.01)	
55	-1.72 (0.44)	1.34 (0.45)		3.06 (1.36)		-1.24 (0.76)
56	-2.10 (0.39)	1.36 (0.48)	2.42 (1.31)			-1.84 (0.82)
57	-2.29 (0.52)	1.68 (0.50)	2.84 (1.33)	3.45 (1.39)		
58	-1.02 (0.60)	0.97 (0.53)	2.50 (1.32)		-0.03 (0.01)	
59	-1.10 (0.60)	0.91 (0.51)		2.60 (1.40)	-0.02 (0.01)	
60	-1.52 (0.53)	0.87 (0.50)		2.78 (1.39)	-0.02 (0.01)	

[a] Variable definitions provided in Table 4.2

in semi-arid habitats, including sagebrush. Mounds were typically centered on a sagebrush shrub (Cole 1932b); thatch ants fulfilled most of their dietary needs by tending aphids on sagebrush (Weber 1935, McIver and Yandell 1998) and were abundant at high elevation sites with increased shrub cover (Mont-Blanc et al. 2007). In our study, thatch ant occurrence was associated with areas of moderate to high productivity. These ants are commonly found on the margin of deciduous woodlands and in river valleys (Weber 1935), which typically have increased productivity. Similarly, thatch ant occurrence in the WBEA area increased with increasing proportions of riparian land cover and topographic moisture; both factors increase vegetation cover.

TABLE 7.20. Extended

$POWER_{500}$	$PIPE_{500}$	$RDdens_{3km}$	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
		-0.31 (0.21)	-158.72	5	327.63	4.31	0.764
	0.88 (0.62)	-0.32 (0.21)	-157.74	6	327.74	4.42	0.771
	0.68 (0.62)		-157.75	6	327.77	4.45	0.779
	0.73 (0.62)	-0.30 (0.22)	-156.74	7	327.85	4.52	0.786
			-159.87	4	327.87	4.55	0.793
-1.42 (1.14)			-158.89	5	327.96	4.64	0.800
-1.34 (1.14)		-0.30 (0.21)	-157.87	6	328.01	4.69	0.807
-1.80 (1.11)	1.03 (0.65)		-157.90	6	328.06	4.73	0.813
	0.85 (0.61)		-158.95	5	328.08	4.76	0.820
			-158.96	5	328.10	4.78	0.826
-1.68 (1.10)		-0.26 (0.22)	-157.92	6	328.11	4.79	0.833
-2.01 (1.17)	0.29 (0.61)		-156.96	7	328.27	4.95	0.838
-1.79 (1.13)	1.08 (0.65)	-0.29 (0.22)	-156.97	7	328.30	4.98	0.844
		-0.30 (0.22)	-158.02	6	328.31	4.99	0.850
-1.42 (1.10)			-159.13	5	328.46	5.13	0.855
			-160.18	4	328.49	5.16	0.860
		-0.29 (0.22)	-159.25	5	328.69	5.37	0.865
-1.98 (1.17)	0.37 (0.61)	-0.27 (0.22)	-156.18	8	328.81	5.49	0.870
			-160.35	4	328.82	5.50	0.874
-1.88 (1.15)			-159.35	5	328.89	5.57	0.878
-1.35 (1.11)		-0.27 (0.22)	-158.33	6	328.92	5.60	0.883
-1.64 (1.09)	1.13 (0.64)		-158.35	6	328.96	5.64	0.887
		-0.29 (0.22)	-159.44	5	329.06	5.74	0.891
-1.78 (1.15)		-0.29 (0.22)	-158.40	6	329.07	5.74	0.895
-1.83 (1.14)		-0.31 (0.22)	-158.43	6	329.13	5.80	0.898
-1.93 (1.14)			-159.47	5	329.14	5.81	0.902

Thatch ant occurrence decreased with increasing abundance of grassland and mixed shrubland land cover. These habitat types may support populations of thatch ants, but the lack of vegetation (sagebrush) that support food sources (aphids) may limit population size. Sagebrush contagion and salt desert shrubland both had negative associations with thatch ant occurrence. The high elevation habitats that these ants inhabit generally have inclusions of coniferous forest, aspen woodlands, and other montane shrub communities that decrease the contagion of sagebrush patches within the area occupied. Also, salt desert shrubland is generally found at low elevations, whereas thatch ants are part of the high elevation ant community (MontBlanc 2007).

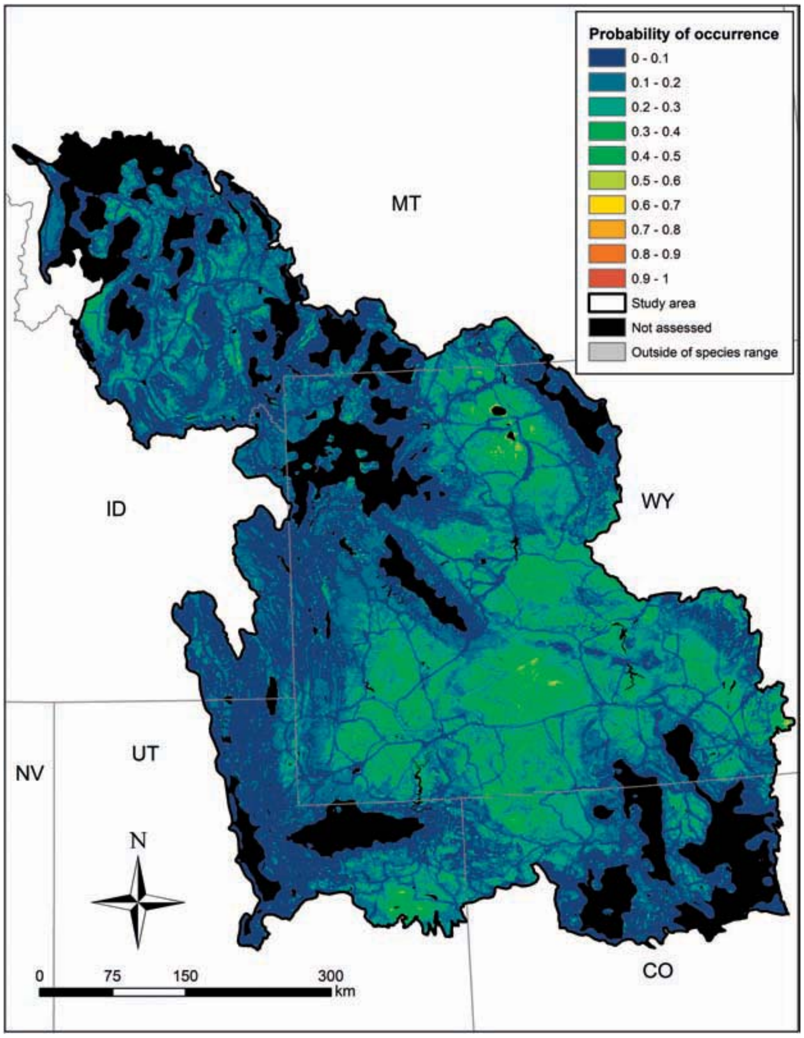

FIG. 7.13. White-tailed jackrabbit probability of occurrence in the Wyoming Basins Ecoregional Assessment area. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water). White-tail jackrabbits are likely to occur in areas with probability > 0.25.

Thatch ants in the WBEA area had an affinity for moderate to high elevation habitats and areas with increased solar radiation. Thatch ants are common between 1,524 to 2,438 m elevation (Cole 1932b, Risch et al. 2008). The most productive thatch ant habitats had increased exposure to sunlight (Weber 1935) and mounds were found predominately on warmer east, south-east and south exposed sites (Risch et al. 2008).

Disturbance factors were additions to the AIC_c-selected top model although the strength of these relationships is questionable given the large error estimates surrounding their coefficients. Raptors use power lines as perches for prey searching, and thereby may indirectly enhance habitat for thatch ants through increased predation on avian, mammalian, and reptilian species which, in turn, prey on thatch ants (Engel et al. 1992, Knight and Kawashima 1993, Steenhof et al. 1993). Proximity to agriculture was also positively associated with thatch ant occurrence in the WBEA.

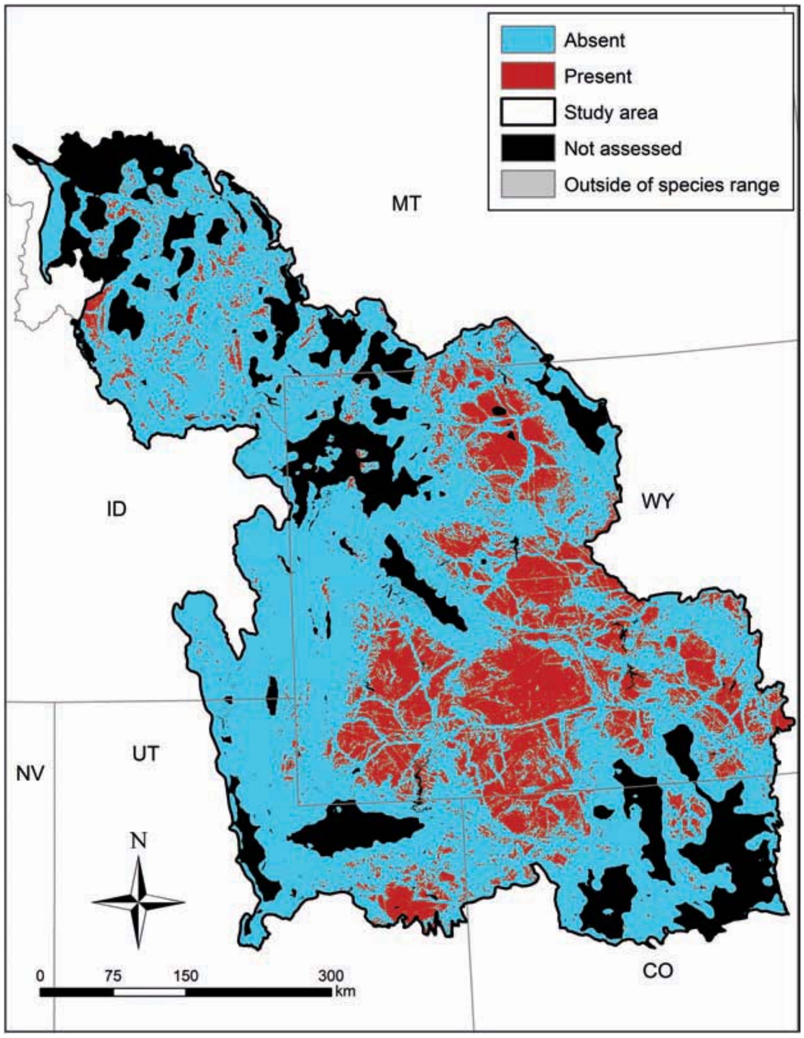

FIG. 7.14. Distribution of white-tailed jackrabbits in the Wyoming Basins Ecoregional Assessment area based on optimum probability cutoff threshold of 0.25. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water).

Cultivation attracts insects (Benton et al. 2002) which are the primary prey of thatch ants (Weber 1935). Correlative abiotic factors, such as soil depth and productivity, which make land suitable for agricultural purposes, may also be beneficial for thatch ants.

Thatch ants were negatively associated with proximity to oil/gas wells and highways but positively associated with road density. However, the direct link between these disturbance factors and thatch ant occurrence was not readily apparent, although oil/gas development and highways both influence the distribution of exotic vegetation (Ch. 10) which may alter food availability for thatch ants in the WBEA area.

The influences of thatch ants on ecosystems include a reduction in the likelihood of pest insect outbreak (McIver et al. 1997), increased plant diversity (Beattie and Culver 1977), and reduced insect diversity and abundance (Hiekkenen 1999). Our thatch ant model for the WBEA improves

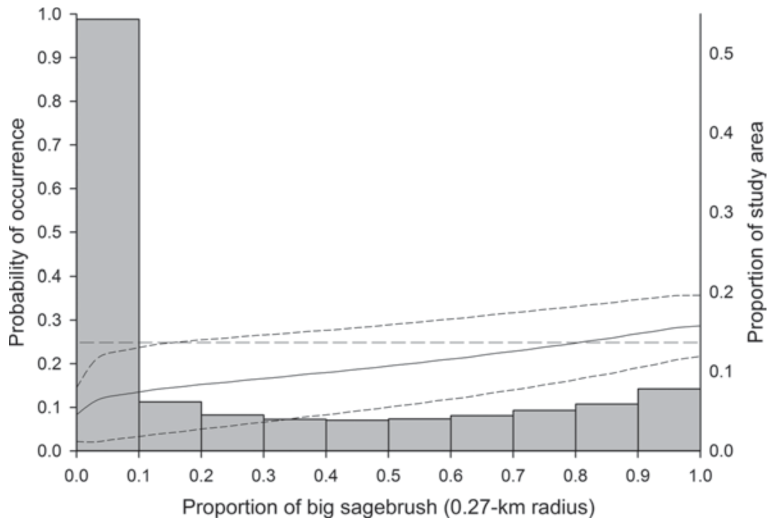

FIG. 7.15. Distribution of white-tailed jackrabbit probability of occurrence within the Wyoming Basins Ecoregional Assessment area in relation to proportion of big sagebrush (*Artemisia tridentata* ssp. *tridentata*, *A. t.* ssp. *wyomingensis*) within a 0.27-km radius. Mean probability of occurrence (black line, ± 1SD [dashed lines]) values were calculated in each one percent increment of big sagebrush within a 0.27-km radius moving window. Range of predictions relate to the observed range of sagebrush at study site locations. The dashed horizontal line represents the optimal cutoff threshold (0.25), above which occurrence is predicted. Histogram values represent the proportion of the total study area in each 10% segment of big sagebrush within 0.27 km.

our understanding of the factors influencing the spatial distribution of thatch ants across the WBEA area and may further work on the distribution of insects, plant diversity, and pest insects in the sagebrush ecosystem.

Abundance of thatch ants on survey blocks in the WBEA was higher than the 0.11–0.17 mound/ha reported in Yellowstone National Park (Risch et al. 2008) but lower than the 73.3 mounds/ha at a super colony site in Oregon (McIver et al. 1997). Although we were unable to conduct a formal analysis of detection probability, this comparison is evidence that our abundance estimates were comparable with previous research. Future data collection and analysis efforts should account for detectability when possible.

Short-horned Lizard

Research on short-horned lizard habitat relationships has been limited (Pianka and Parker 1975; Powell and Russell 1998a, 1998b, James 2004), partly because of their cryptic nature. Short-horned lizard occur-

TABLE 7.21. Results of AIC_c-based model selection for cottontail occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale sagebrush and NDVI; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
1	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km}$	-186.94	4	382.01	0.00	0.23
2	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{3km}$	-187.66	4	383.45	1.43	0.15
3	$ALLSAGE_{540} + ALLSAGE_{540}^2 + NDVI_{3km}$	-187.91	4	383.95	1.94	0.14

[a] Variable definitions provided in Table 4.2

TABLE 7.22. Evaluation statistics from AIC_c-based univariate model selection for cottontail occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale vegetation, abiotic, and disturbance predictor variables (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and Akaike weight [w_i]). We ran logistic models with all sagebrush (5 km, quadratic) and NDVI (5-km) variables as a base model for all variables tested. We used AIC_c to identify the scale at which cottontails respond to individual variables.

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	$CFRST_{1km}$	-184.66	5	379.52	0.00	1.00
	$GRASS_{18km}$	-184.13	5	378.45	0.00	0.86
	$GRASS_{540}$	-184.78	5	379.75	1.30	0.45
	$GRASS_{1km}$	-185.32	5	380.83	2.38	0.26
	$GRASS_{270}$	-186.02	5	382.22	3.77	0.13
	$GRASS_{3km}$	-186.27	5	382.74	4.29	0.10
	$GRASS_{5km}$	-186.72	5	383.64	5.19	0.06
	MIX_{540}	-184.39	5	378.97	0.00	0.56
	MIX_{1km}	-185.35	5	380.88	1.91	0.21
	MIX_{3km}	-185.95	5	382.10	3.13	0.12
	MIX_{5km}	-186.45	5	383.10	4.13	0.07
	MIX_{18km}	-186.94	5	384.07	5.09	0.04
	RIP_{270}	-185.81	5	381.81	0.00	0.25
	RIP_{5km}	-185.96	5	382.10	0.29	0.21
	RIP_{18km}	-186.08	5	382.36	0.55	0.19
	RIP_{3km}	-186.40	5	382.98	1.17	0.14
	RIP_{540}	-186.43	5	383.05	1.24	0.13
	RIP_{1km}	-186.91	5	384.00	2.19	0.08
	$EDGE_{5km}$	-183.44	5	377.07	0.00	0.68
	$EDGE_{3km}$	-184.70	5	379.60	2.53	0.19
	$CONTAG_{1km}$	-185.93	5	382.06	4.99	0.06
	$EDGE_{1km}$	-185.95	5	382.09	5.02	0.05
	$CONTAG_{3km}$	-186.83	5	383.85	6.78	0.02
	$SALT_{270}$	-186.38	5	382.94	0.00	0.35
	$SALT_{540}$	-186.78	5	383.76	0.82	0.24
	$SALT_{18km}$	-186.90	5	384.00	1.06	0.21
	$SALT_{1km}$	-186.94	5	384.08	1.14	0.20
Abiotic	CTI	-186.92	5	384.03	0.00	1.00
	ELEV	-177.38	5	364.95	0.00	1.00
	$iH2Od_{250}$[b]	-184.61	5	379.41	0.00	0.43
	$iH2Od_{1km}$[b]	-184.99	5	380.17	0.76	0.29
	$iH2Od_{500}$[b]	-185.02	5	380.24	0.83	0.28
	$pH2Od_{500}$[b]	-186.65	5	383.48	0.00	0.35

TABLE 7.22. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$pH2Od_{250}$[b]	-186.69	5	383.57	0.08	0.33
	$pH2Od_{1km}$[b]	-186.73	5	383.66	0.18	0.32
	SOLAR	-185.30	5	380.79	0.00	1.00
	Tmin	-179.50	5	369.20	0.00	1.00
	TRI_{270}	-181.47	5	373.13	0.00	0.47
	TRI_{540}	-181.91	5	374.01	0.87	0.30
	TRI_{1km}	-182.90	5	376.00	2.87	0.11
	TRI	-183.23	5	376.66	3.52	0.08
	TRI_{3km}	-184.43	5	379.06	5.93	0.02
	TRI_{5km}	-185.71	5	381.61	8.48	0.01
	TRI_{18km}	-186.24	5	382.66	9.53	0.00
Disturbance	AG_{1km}[b]	-186.46	5	383.11	0.00	0.43
	AG_{500}[b]	-186.83	5	383.85	0.74	0.30
	AG_{250}[b]	-186.94	5	384.07	0.96	0.27
	$MjRD_{500}$[b]	-186.23	5	382.65	0.00	0.35
	$MjRD_{1km}$[b]	-186.27	5	382.73	0.07	0.33
	$MjRD_{250}$[b]	-186.30	5	382.80	0.14	0.32
	$PIPE_{1km}$[b]	-186.58	5	383.36	0.00	0.37
	$PIPE_{500}$[b]	-186.72	5	383.63	0.27	0.32
	$PIPE_{250}$[b]	-186.75	5	383.69	0.34	0.31
	$POWER_{1km}$[b]	-185.10	5	380.40	0.00	0.58
	$POWER_{500}$[b]	-185.82	5	381.83	1.43	0.28
	$POWER_{250}$[b]	-186.52	5	383.23	2.83	0.14
	$2RD_{1km}$[b]	-186.32	5	382.82	0.00	0.16
	$RDdens_{18km}$	-186.49	5	383.17	0.35	0.13
	$2RD_{500}$[b]	-186.53	5	383.25	0.43	0.13
	$RDdens_{540}$	-186.55	5	383.30	0.47	0.12
	$2RD_{250}$[b]	-186.72	5	383.63	0.80	0.10
	$RDdens_{1km}$	-186.79	5	383.76	0.94	0.10
	$RDdens_{270}$	-186.88	5	383.95	1.12	0.09
	$RDdens_{3km}$	-186.93	5	384.05	1.23	0.08
	$RDdens_{5km}$	-186.93	5	384.06	1.23	0.08
	$WELL_{250}$[b]	-186.93	5	384.04	0.00	0.34
	$WELL_{500}$[b]	-186.93	5	384.06	0.01	0.33
	$WELL_{1km}$[b]	-186.94	5	384.07	0.03	0.33

[a] Variable definitions provided in Table 4.2
[b] Distance decay function ($e^{(\text{Euclidean distance from feature/-distance parameter})}$)

rence in the WBEA was positively associated with big sagebrush and aggregation of sagebrush habitats, which corroborates previous research (Pianka and Parker 1975; Reynolds 1979; Montanucci 1981; Werschkul 1982; Powell and Russell 1985, 1998b; Powell et al. 1998; James 2004). Short-horned lizards move through vegetation and forage in more open habitats. Thus, short-horned lizards are found in semi-open, more thinly vegetated habitats. Short-horned lizards rarely occur in thick, grass-dominated habitats, such as crested wheatgrass fields or native grasslands, except when grass patches have been grazed heavily or are interspersed with sagebrush (Reynolds 1979, Werschkul 1982, James 2004). Within the WBEA, short-horned lizards were more likely to occur in low productivity areas, relatively flat habitats, and sites with decreased topographic moisture. These habitat associations fit with the life history and habitat associations of this desert dwelling species (Pianka and Parker 1975, Powell and Russell 1998b, Powell et al. 1998, Sherbrooke 2003). Short-horned lizards were found in all habitat types but riparian near Vernal, Utah (Grant 1986) and typically inhabited upland habitat in areas bisected by riparian vegetation, swales and other topographically moist areas (Pianka and Parker 1975).

Pygmy Rabbit

We were unable to model the distribution of pygmy rabbits in the WBEA area because of a limited number of observations (Ch. 4). Pygmy rabbits often occur in disjunct and isolated populations throughout their range (Green and Flinders 1980, Dobler and Dixon 1990), which may be due to the distribution of suitable habitat. In Idaho, only 17% of the potential habitat for pygmy rabbits was highly suitable (priority rank 1 [Rachlow and Svancara 2003]), and at the Idaho National Laboratory, only 23% of the 1,999-km^2 site was estimated to be suitable for pygmy rabbits (Gabler et al. 2000). Given this distribution pattern, a species-specific sampling scheme stratified by characteristics important for pygmy rabbit occurrence (Rachlow and Svancara 2006) is likely required to assess habitat needs and disturbance responses for pygmy rabbits within the WBEA area.

The known range of pygmy rabbits in Wyoming (Purcell 2006) was recently expanded by >100 km after survey efforts were extended beyond the previously delineated range of the species. Our sampling suggests that potential pygmy rabbit habitat within the WBEA area occurs outside of this updated range, and includes the Worland Basin and the areas east of Riverton, Wyoming. Furthermore, a pygmy rabbit was seen at one survey block within the Worland Basin. To verify these findings, the Worland Basin should be surveyed more intensely.

White-tailed Jackrabbit

Our model predicted white-tailed jackrabbit to be rare throughout the non-mountainous areas of the Wyoming Basins. White-tailed jackrabbits were positively associated with the proportion of big sagebrush within a small radius (0.27 km), which is an area much smaller than the typical home range (2–3 km^2, Jackson 1961). During the day, white-tailed jackrabbits hide at the base of bushes or beside rocks (Dalquest 1948, Rogowitz 1997), while at night they feed in areas with high herbaceous cover, often moving to these areas from adjacent upland habitat (McAdoo et al. 1986). Therefore, our diurnal surveys sampled roosting habitat consisting of small patches of sagebrush in proximity to small-scale grassland land cover (0.54 km) potentially used as foraging habitat. White-tailed jackrabbits in Colorado were most common in crested wheatgrass and alfalfa (*Medicago sativa*) habitats in between areas of four-wing saltbush (*Atriplex canescens*) and prairie sagewort (*Artemisia frigida*) (Flinders and Hansen 1973). Salt desert shrubland (3 km) was the only important large-scale habitat variable, which may be an indica-

TABLE 7.23. Results of AIC_c-based submodel selection for cottontail occurrence in the Wyoming Basins Ecoregional Assessment area; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	1	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + CFRST_{1km} + MIX_{540} + GRASS_{18km} + RIP_{270} + EDGE_{5km}$	-176.52	9	371.63	0.00	0.09
	2	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + CFRST_{1km} + MIX_{540} + GRASS_{18km} + EDGE_{5km}$	-177.76	8	371.98	0.35	0.08
	3	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + CFRST_{1km} + MIX_{540} + RIP_{270} + EDGE_{5km}$	-177.91	8	372.28	0.66	0.07
	4	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + CFRST_{1km} + MIX_{540} + EDGE_{5km}$	-179.10	7	372.55	0.93	0.06
	5	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + GRASS_{18km} + MIX_{540} + RIP_{270} + EDGE_{5km}$	-178.45	8	373.35	1.73	0.04
	6	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + CFRST_{1km} + MIX_{540} + EDGE_{5km} + SALT_{270}$	-178.46	8	373.38	1.75	0.04
	7	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + CFRST_{1km} + MIX_{540} + RIP_{270} + EDGE_{5km} + SALT_{270}$	-177.42	9	373.42	1.80	0.04
	8	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + CFRST_{1km} + MIX_{540} + GRASS_{18km} + RIP_{270} + EDGE_{5km} + SALT_{270}$	-176.39	10	373.48	1.86	0.04
	9	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + CFRST_{1km} + MIX_{540} + GRASS_{18km} + RIP_{270}$	-178.55	8	373.57	1.94	0.03
Abiotic	1	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250}$	-168.83	7	352.02	0.00	0.07
	2	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250} + SOLAR$	-167.85	8	352.16	0.14	0.06
	3	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250} + SOLAR + pH2Od_{500}$	-166.94	9	352.46	0.44	0.05
	4	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250} + Tmin$	-168.09	8	352.64	0.62	0.05
	5	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250} + SOLAR + pH2Od_{500} + Tmin$	-165.99	10	352.68	0.66	0.05
	6	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + SOLAR$	-169.18	7	352.71	0.69	0.05
	7	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250} + SOLAR + Tmin$	-167.07	9	352.71	0.70	0.05
	8	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270}$	-170.27	6	352.80	0.79	0.05
	9	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250} + pH2Od_{500}$	-168.22	8	352.89	0.88	0.04
	10	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250} + pH2Od_{500} + Tmin$	-167.34	9	353.27	1.25	0.04
	11	$ALLSAGE_{5km} + ALLSAGE_{5km}{}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250} + CTI$	-168.49	8	353.44	1.42	0.03

TABLE 7.23. Continued

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
	12	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + ELEV + TRI_{270} + SOLAR + pH2Od_{500}$	-168.52	8	353.51	1.49	0.03
	13	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + ELEV + TRI_{270} + CTI$	-169.61	7	353.58	1.57	0.03
	14	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + ELEV + TRI_{270} + SOLAR + CTI$	-168.60	8	353.66	1.64	0.03
	15	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + ELEV + TRI_{270} + iH2Od_{250} + SOLAR + CTI$	-167.55	9	353.68	1.67	0.03
	16	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + ELEV + TRI_{270} + SOLAR + Tmin$	-168.62	8	353.71	1.69	0.03
	17	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + ELEV + TRI_{270} + Tmin$	-169.76	7	353.89	1.87	0.03
Disturbance	1	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + POWER_{1km}$	-185.10	5	380.40	0.00	0.09
	2	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + POWER_{1km} + 2RD_{1km}$	-184.51	6	381.29	0.90	0.06
	3	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + POWER_{1km} + AG_{1km}$	-184.63	6	381.52	1.13	0.05
	4	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + POWER_{1km} + MjRD_{500}$	-184.72	6	381.71	1.31	0.05
	5	$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km}$	-186.94	4	382.01	1.62	0.04
		$ALLSAGE_{5km} + ALLSAGE_{5km}^2 + NDVI_{5km} + POWER_{1km} + PIPE_{1km}$	-185.04	6	382.35	1.95	0.03

[a] Variable definitions provided in Table 4.2

TABLE 7.24. Results of AIC_c-based model selection for the combined cottontail occurrence models[a] in the Wyoming Basins Ecoregional Assessment area; the table also shows parameter estimates (beta [SE]) and evaluation statistics (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and cumulative Akaike weight [$\sum w_i$]). Models shown with cumulative Akaike weight (w_i) of just ≥ 0.9.

Model	Constant	$ALLSAGE_{5km}$	$ALLSAGE_{5km}^2$	$NDVI_{5km}$	$CFRST_{1km}$	$GRASS_{18km}$	MIX_{540}	ELEV[b]
1	7.24 (2.17)	2.53 (4.82)	-2.14 (3.76)	-12.18 (2.35)	6.03 (2.59)	9.61 (5.04)	11.91 (8.59)	-0.27 (0.06)
2	7.47 (2.19)	1.81 (4.85)	-1.61 (3.80)	-12.59 (2.39)	6.05 (2.61)	9.83 (5.04)	12.06 (8.58)	-0.27 (0.06)
3	6.98 (2.16)	2.13 (4.80)	-1.99 (3.75)	-11.95 (2.34)	5.67 (2.60)	9.25 (5.08)	11.76 (8.49)	-0.26 (0.06)
4	7.54 (2.17)	2.30 (4.82)	-1.78 (3.75)	-12.27 (2.35)	6.28 (2.59)	10.12 (5.01)		-0.28 (0.06)
5	7.78 (2.19)	1.59 (4.86)	-1.24 (3.79)	-12.66 (2.39)	6.31 (2.62)	10.37 (5.01)		-0.28 (0.06)
6	7.29 (2.16)	1.91 (4.80)	-1.63 (3.74)	-12.03 (2.34)	5.92 (2.60)	9.81 (5.04)		-0.27 (0.06)
7	7.22 (2.19)	1.65 (4.83)	-1.59 (3.78)	-12.30 (2.40)	5.77 (2.62)	9.46 (5.07)	11.97 (8.52)	-0.26 (0.06)
8	7.34 (2.18)	3.27 (4.82)	-3.46 (3.70)	-12.39 (2.39)	5.58 (2.58)		12.63 (8.43)	-0.25 (0.06)
9	7.64 (2.19)	3.76 (4.85)	-3.70 (3.71)	-12.65 (2.40)	5.94 (2.57)		12.70 (8.51)	-0.27 (0.06)
10	7.53 (2.19)	1.43 (4.84)	-1.23 (3.78)	-12.37 (2.39)	6.02 (2.62)	10.03 (5.04)		-0.27 (0.06)
11	7.84 (2.21)	3.17 (4.89)	-3.27 (3.75)	-13.04 (2.45)	6.01 (2.60)		12.92 (8.52)	-0.27 (0.06)
12	7.14 (2.27)	1.95 (6.05)	-1.56 (5.27)	-12.01 (2.58)	6.02 (2.59)	9.46 (5.13)	11.87 (8.59)	-0.27 (0.06)
13	7.36 (2.30)	1.21 (6.10)	-1.00 (5.32)	-12.41 (2.63)	6.05 (2.61)	9.67 (5.14)	12.04 (8.57)	-0.27 (0.06)
14	7.69 (2.18)	3.13 (4.84)	-3.17 (3.70)	-12.50 (2.39)	5.85 (2.58)			-0.27 (0.06)
15	7.99 (2.19)	3.60 (4.86)	-3.40 (3.71)	-12.76 (2.40)	6.21 (2.57)			-0.28 (0.06)
16	7.00 (2.26)	2.24 (6.03)	-2.11 (5.27)	-11.98 (2.59)	5.67 (2.60)	9.27 (5.16)	11.76 (8.49)	-0.26 (0.06)
17	7.42 (2.27)	1.65 (6.05)	-1.12 (5.26)	-12.07 (2.58)	6.27 (2.59)	9.95 (5.10)		-0.28 (0.06)
18	7.54 (2.21)	2.90 (4.86)	-3.16 (3.73)	-12.71 (2.44)	5.69 (2.60)		12.87 (8.47)	-0.26 (0.06)
19	7.82 (2.12)	-2.63 (4.28)	1.04 (3.48)	-10.44 (2.10)		8.90 (4.94)	12.63 (8.60)	-0.23 (0.06)
20	7.66 (2.29)	0.92 (6.10)	-0.56 (5.31)	-12.46 (2.62)	6.30 (2.61)	10.19 (5.11)		-0.28 (0.06)
21	8.20 (2.22)	3.02 (4.91)	-2.97 (3.75)	-13.14 (2.45)	6.28 (2.60)			-0.28 (0.06)
22	7.29 (2.26)	1.95 (6.04)	-1.67 (5.27)	-12.04 (2.58)	5.92 (2.60)	9.82 (5.13)		-0.27 (0.06)
23	8.20 (2.13)	-2.55 (4.32)	1.11 (3.50)	-10.59 (2.10)		9.27 (4.90)	12.86 (8.72)	-0.24 (0.06)
24	8.39 (2.16)	-3.22 (4.37)	1.62 (3.54)	-10.97 (2.15)		9.55 (4.91)	13.01 (8.71)	-0.24 (0.06)
25	7.20 (2.29)	1.56 (6.09)	-1.50 (5.33)	-12.27 (2.63)	5.77 (2.62)	9.44 (5.16)	11.97 (8.53)	-0.26 (0.06)
26	8.19 (2.12)	-3.09 (4.28)	1.57 (3.47)	-10.47 (2.10)		9.49 (4.90)		-0.24 (0.06)
27	7.25 (2.30)	1.83 (6.10)	-1.74 (5.28)	-12.04 (2.64)	5.91 (2.56)		12.55 (8.48)	-0.26 (0.06)
28	8.03 (2.15)	-3.13 (4.33)	1.45 (3.52)	-10.73 (2.14)		9.14 (4.94)	12.85 (8.63)	-0.23 (0.06)
29	7.90 (2.21)	2.76 (4.88)	-2.87 (3.73)	-12.81 (2.44)	5.97 (2.61)			-0.27 (0.06)
30	7.11 (2.29)	2.10 (6.07)	-2.27 (5.28)	-12.02 (2.65)	5.56 (2.57)		12.55 (8.42)	-0.25 (0.06)
31	7.43 (2.33)	1.12 (6.15)	-1.19 (5.33)	-12.39 (2.69)	5.97 (2.59)		12.78 (8.49)	-0.26 (0.06)
32	8.57 (2.13)	-3.01 (4.33)	1.64 (3.49)	-10.63 (2.10)		9.80 (4.87)		-0.26 (0.06)
33	8.77 (2.16)	-3.69 (4.37)	2.16 (3.53)	-11.00 (2.14)		10.11 (4.87)		-0.26 (0.06)
34	7.50 (2.28)	1.28 (6.09)	-1.07 (5.32)	-12.33 (2.62)	6.02 (2.62)	9.99 (5.13)		-0.27 (0.06)
35	8.18 (2.16)	-1.57 (4.33)	-0.39 (3.43)	-10.76 (2.13)			13.53 (8.55)	-0.23 (0.06)
36	7.57 (2.30)	1.49 (6.11)	-1.27 (5.27)	-12.09 (2.64)	6.17 (2.57)			-0.28 (0.06)

TABLE 7.24. Extended

TRI_{270}	$POWER_{1km}$	RIP_{270}	$iH2Od_{250}$	$EDGE_{5km}^{c}$	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
0.03 (0.01)	1.63 (0.66)				-161.08	10	342.87	0.00	0.060
0.03 (0.01)	1.60 (0.66)	2.78 (2.09)			-160.04	11	342.94	0.06	0.118
0.03 (0.01)	1.61 (0.66)		0.67 (0.50)		-160.17	11	343.20	0.32	0.168
0.03 (0.01)	1.61 (0.66)				-162.34	9	343.27	0.39	0.218
0.03 (0.01)	1.58 (0.66)	2.73 (2.09)			-161.35	10	343.41	0.54	0.263
0.03 (0.01)	1.59 (0.66)		0.66 (0.50)		-161.44	10	343.58	0.71	0.305
0.03 (0.01)	1.59 (0.66)	2.21 (2.10)	0.52 (0.52)		-159.53	12	344.07	1.20	0.338
0.03 (0.01)	1.63 (0.66)		0.71 (0.49)		-161.87	10	344.44	1.56	0.365
0.03 (0.01)	1.65 (0.66)				-162.94	9	344.46	1.59	0.392
0.03 (0.01)	1.57 (0.66)	2.15 (2.11)	0.52 (0.51)		-160.84	11	344.53	1.66	0.418
0.03 (0.01)	1.62 (0.66)	2.60 (2.04)			-161.99	10	344.69	1.82	0.442
0.03 (0.01)	1.62 (0.67)			0.03 (0.02)	-161.07	11	344.99	2.12	0.463
0.03 (0.01)	1.59 (0.66)	2.78 (2.08)		0.03 (0.02)	-160.03	12	345.07	2.20	0.483
0.03 (0.01)	1.61 (0.66)		0.70 (0.49)		-163.38	9	345.33	2.46	0.501
0.03 (0.01)	1.63 (0.66)				-164.44	8	345.34	2.46	0.518
0.03 (0.01)	1.61 (0.66)		0.67 (0.50)	-0.01 (0.02)	-160.17	12	345.35	2.48	0.535
0.03 (0.01)	1.60 (0.66)			0.03 (0.02)	-162.33	10	345.36	2.49	0.552
0.03 (0.01)	1.60 (0.66)	2.01 (2.03)	0.59 (0.51)		-161.31	11	345.47	2.60	0.569
0.03 (0.01)	1.55 (0.65)		0.75 (0.49)		-162.39	10	345.49	2.62	0.585
0.03 (0.01)	1.57 (0.66)	2.73 (2.09)		0.03 (0.02)	-161.33	11	345.52	2.65	0.601
0.03 (0.01)	1.59 (0.66)	2.53 (2.04)			-163.55	9	345.68	2.80	0.615
0.03 (0.01)	1.59 (0.66)		0.66 (0.50)	0.01 (019)	-161.44	11	345.73	2.85	0.630
0.03 (0.01)	1.57 (0.65)				-163.59	9	345.76	2.89	0.644
0.03 (0.01)	1.54 (0.65)	2.76 (2.05)			-162.54	10	345.79	2.91	0.658
0.03 (0.01)	1.59 (0.66)	2.21 (2.10)	0.52 (0.52)	0.01 (0.19)	-159.53	13	346.24	3.37	0.669
0.03 (0.01)	1.52 (0.65)		0.75 (0.49)		-163.85	9	346.27	3.40	0.680
0.03 (0.01)	1.61 (0.67)			0.09 (0.18)	-162.80	10	346.32	3.44	0.691
0.03 (0.01)	1.53 (0.65)	2.10 (2.06)	0.62 (0.51)		-161.80	11	346.45	3.57	0.701
0.03 (0.01)	1.58 (0.66)	1.92 (2.03)	0.58 (0.50)		-162.87	10	346.45	3.58	0.711
0.03 (0.01)	1.60 (0.67)		0.69 (0.50)	0.06 (0.18)	-161.81	11	346.48	3.61	0.720
0.03 (0.01)	1.57 (0.67)	2.61 (2.03)		0.01 (0.18)	-161.84	11	346.53	3.66	0.730
0.03 (0.01)	1.54 (0.65)				-165.05	8	346.56	3.68	0.739
0.03 (0.01)	1.51 (0.65)	2.70 (2.06)			-164.05	9	346.67	3.80	0.748
0.03 (0.01)	1.57 (0.66)	2.15 (2.11)	0.51 (0.52)	0.01 (0.19)	-160.84	12	346.69	3.81	0.757
0.04 (0.01)	1.56 (0.65)		0.79 (0.49)		-164.06	9	346.69	3.81	0.766
0.03 (0.01)	1.58 (0.67)			0.01 (0.18)	-164.28	9	347.13	4.25	0.773

TABLE 7.24. Continued

Model	Constant	$ALLSAGE_{5km}$	$ALLSAGE_{5km}^2$	$NDVI_{5km}$	$CFRST_{1km}$	$GRASS_{18km}$	MIX_{540}	$ELEV^b$
37	8.40 (2.15)	-3.59 (4.33)	1.98 (3.51)	-10.75 (2.14)		9.74 (4.90)		-0.25 (0.06)
38	7.17 (2.16)	3.01 (4.82)	-2.66 (3.76)	-12.67 (2.35)	5.78 (2.59)	9.83 (4.96)	12.08 (8.86)	-0.26 (0.06)
39	8.60 (2.17)	-1.41 (4.39)	-0.42 (3.47)	-10.91 (2.14)			13.67 (8.66)	-0.24 (0.06)
40	7.43 (2.29)	1.78 (6.09)	-1.80 (5.28)	-12.07 (2.65)	5.84 (2.58)			-0.26 (0.06)
41	7.76 (2.33)	0.79 (6.17)	-0.71 (5.33)	-12.44 (2.69)	6.24 (2.59)			-0.28 (0.06)
42	7.26 (2.32)	1.47 (6.14)	-1.70 (5.34)	-12.27 (2.69)	5.68 (2.60)		12.78 (8.45)	-0.25 (0.06)
43	6.91 (2.13)	3.75 (4.77)	-3.21 (3.72)	-12.24 (2.30)	5.74 (2.56)	9.64 (4.97)	11.96 (8.87)	-0.26 (0.06)
44	8.78 (2.20)	-1.99 (4.44)	0.00 (3.50)	-11.26 (2.18)			13.90 (8.66)	-0.24 (0.06)
45	7.85 (2.22)	-2.48 (5.61)	0.89 (5.05)	-10.49 (2.35)		8.95 (5.04)	12.64 (8.60)	-0.23 (0.06)
46	7.49 (2.15)	2.77 (4.83)	-2.30 (3.76)	-12.73 (2.35)	6.01 (2.59)	10.31 (4.93)		-0.27 (0.06)
47	6.69 (2.12)	3.30 (4.76)	-3.04 (3.71)	-12.00 (2.29)	5.36 (2.57)	9.27 (5.01)	11.80 (8.81)	-0.24 (0.06)
48	7.22 (2.13)	3.52 (4.78)	-2.86 (3.72)	-12.30 (2.30)	5.97 (2.56)	10.09 (4.94)		-0.27 (0.06)
49	8.37 (2.19)	-1.98 (4.38)	-0.08 (3.47)	-11.01 (2.17)			13.78 (8.59)	-0.23 (0.06)
50	8.09 (2.23)	-3.16 (5.63)	1.73 (5.04)	-10.42 (2.33)		9.10 (5.01)	12.82 (8.71)	-0.24 (0.06)
51	8.28 (2.26)	-3.81 (5.69)	2.21 (5.10)	-10.81 (2.38)		9.39 (5.02)	12.98 (8.70)	-0.24 (0.06)
52	6.99 (2.12)	3.08 (4.76)	-2.68 (3.70)	-12.06 (2.29)	5.59 (2.57)	9.78 (4.97)		-0.26 (0.06)
53	8.62 (2.16)	-2.00 (4.36)	0.09 (3.44)	-10.80 (2.13)				-0.24 (0.06)
54	6.94 (2.15)	2.81 (4.80)	-2.63 (3.75)	-12.37 (2.35)	5.48 (2.60)	9.47 (4.99)	12.00 (8.83)	-0.25 (0.06)
55	8.21 (2.22)	-3 .00(5.62)	1.48 (5.04)	-10.50 (2.34)		9.52 (5)		-0.24 (0.06)
56	7.59 (2.32)	1.16 (6.15)	-1.24 (5.34)	-12.31 (2.68)	5.95 (2.60)			-0.27 (0.06)
57	8.03 (2.25)	-3.13 (5.68)	1.45 (5.11)	-10.73 (2.38)		9.14 (5.04)	12.85 (8.63)	-0.23 (0.06)
58	9.04 (2.18)	-1.85 (4.42)	0.07 (3.47)	-10.96 (2.14)				-0.26 (0.06)
59	8.44 (2.23)	-3.70 (5.64)	2.33 (5.04)	-10.44 (2.32)		9.61 (4.98)		-0.26 (0.06)
60	7.26 (2.15)	2.58 (4.81)	-2.27 (3.74)	-12.43 (2.35)	5.71 (2.60)	9.99 (4.96)		-0.26 (0.06)
61	7.95 (2.27)	-2.78 (5.66)	0.84 (5.06)	-10.39 (2.38)			13.45 (8.54)	-0.23 (0.06)
62	8.65 (2.25)	-4.34 (5.70)	2.81 (5.09)	-10.82 (2.37)		9.92 (4.98)		-0.25 (0.06)
63	9.23 (2.21)	-2.43 (4.47)	0.50 (3.51)	-11.30 (2.18)				-0.26 (0.06)

[a] Variable definitions provided in Table 4.2
[b] Coefficients and standard errors multiplied by 10^2
[c] Coefficients and standard errors multiplied by 10

tor of the regional context or conditions for white-tailed jackrabbit occurrence. White-tailed jackrabbit occurrence was associated with less rugged terrain, the only abiotic influence. Habitats of white-tailed jackrabbits are generally flat or gently sloping shrub and grassland habitats (Svihla 1931, Kim 1987), which are typically less rugged.

Several disturbance factors influenced the distribution of white-tailed jackrabbits in the Wyoming Basins. Rabbit occurrence was positively associated with proximity to pipelines which may be a function of revegetation efforts on pipeline rights-of-way, ultimately leading to short-term grassland habitat (Booth and

TABLE 7.24. Extended

TRI_{270}	$POWER_{1km}$	RIP_{270}	$iH2Od_{250}$	$EDGE_{5km}^{c}$	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
0.03 (0.01)	1.50 (0.65)	2.03 (2.06)	0.61 (0.51)		-163.30	10	347.30	4.43	0.780
0.03 (0.01)		2.95 (2.11)			-163.30	10	347.30	4.43	0.786
0.04 (0.01)	1.58 (0.65)				-165.42	8	347.31	4.43	0.793
0.03 (0.01)	1.58 (0.66)		0.68 (0.49)	0.07 (0.18)	-163.31	10	347.33	4.45	0.799
0.03 (0.01)	1.54 (0.66)	2.53 (2.03)		0.11 (0.18)	-163.37	10	347.45	4.58	0.805
0.03 (0.01)	1.57 (0.66)	2.04 (2.03)	0.56 (0.51)	0.07 (0.18)	-161.24	12	347.48	4.61	0.811
0.03 (0.01)					-164.45	9	347.48	4.61	0.817
0.04 (0.01)	1.55 (0.65)	2.55 (2.01)			-164.49	9	347.55	4.68	0.823
0.03 (0.01)	1.55 (0.65)		0.76 (0.50)	-0.01 (0.18)	-162.39	11	347.64	4.76	0.828
0.03 (0.01)		2.92 (2.11)			-164.53	9	347.64	4.77	0.834
0.03 (0.01)			0.68 (0.50)		-163.49	10	347.68	4.80	0.839
0.03 (0.01)					-165.65	8	347.76	4.89	0.845
0.04 (0.01)	1.54 (0.65)	1.88 (1.99)	0.68 (0.50)		-163.55	10	347.81	4.94	0.850
0.03 (0.01)	1.55 (0.65)			0.03 (0.02)	-163.58	10	347.86	4.99	0.855
0.03 (0.01)	1.52 (0.65)	2.75 (2.05)		0.03 (0.02)	-162.53	11	347.90	5.03	0.859
0.03 (0.01)			0.68 (0.49)		-164.68	9	347.93	5.06	0.864
0.04 (0.01)	1.53 (0.65)		0.78 (0.48)		-165.77	8	348.01	5.14	0.869
0.03 (0.01)		2.37 (2.11)	0.53 (0.51)		-162.75	11	348.36	5.48	0.873
0.03 (0.01)	1.52 (0.65)		0.75 (0.49)	0.01 (0.18)	-163.85	10	348.40	5.53	0.876
0.03 (0.01)	1.55 (0.66)	1.96 (2.03)	0.55 (0.51)	0.08 (0.18)	-162.78	11	348.41	5.54	0.880
0.03 (0.01)	1.53 (0.65)	2.10 (2.06)	0.62 (0.51)	0.01 (0.18)	-161.80	12	348.60	5.73	0.884
0.04 (0.01)	1.55 (0.65)				-167.13	7	348.62	5.75	0.887
0.03 (0.01)	1.53 (0.65)			0.03 (0.02)	-165.03	9	348.64	5.76	0.890
0.03 (0.01)		2.32 (2.12)	0.53 (0.51)		-163.98	10	348.67	5.80	0.894
0.04 (0.01)	1.53 (0.65)		0.77 (0.49)	0.06 (0.18)	-164.00	10	348.71	5.83	0.897
0.03 (0.01)	1.50 (0.65)	2.70 (2.06)		0.03 (0.02)	-164.03	10	348.77	5.89	0.900
0.04 (0.01)	1.51 (0.65)	2.47 (2.01)			-166.27	8	348.99	6.12	0.903

Cox 2009). Grasslands were a preferred foraging habitat for white-tailed jackrabbits (Flinders and Hansen 1973). Proximity to interstates and major highways and power lines in the WBEA area had a negative influence on white-tailed jackrabbit occurrence. Power lines can increase raptor populations by increasing local availability of nesting and perching platforms (Knight and Kawashima 1993, Steenhof et al. 1993). White-tailed jackrabbits are common prey (McGahan 1967) of raptors, such as golden eagles, that may forage long distances (>3 km) from nest sites in search of prey (Marzluff et al. 1997). The negative association between jackrabbit occurrence

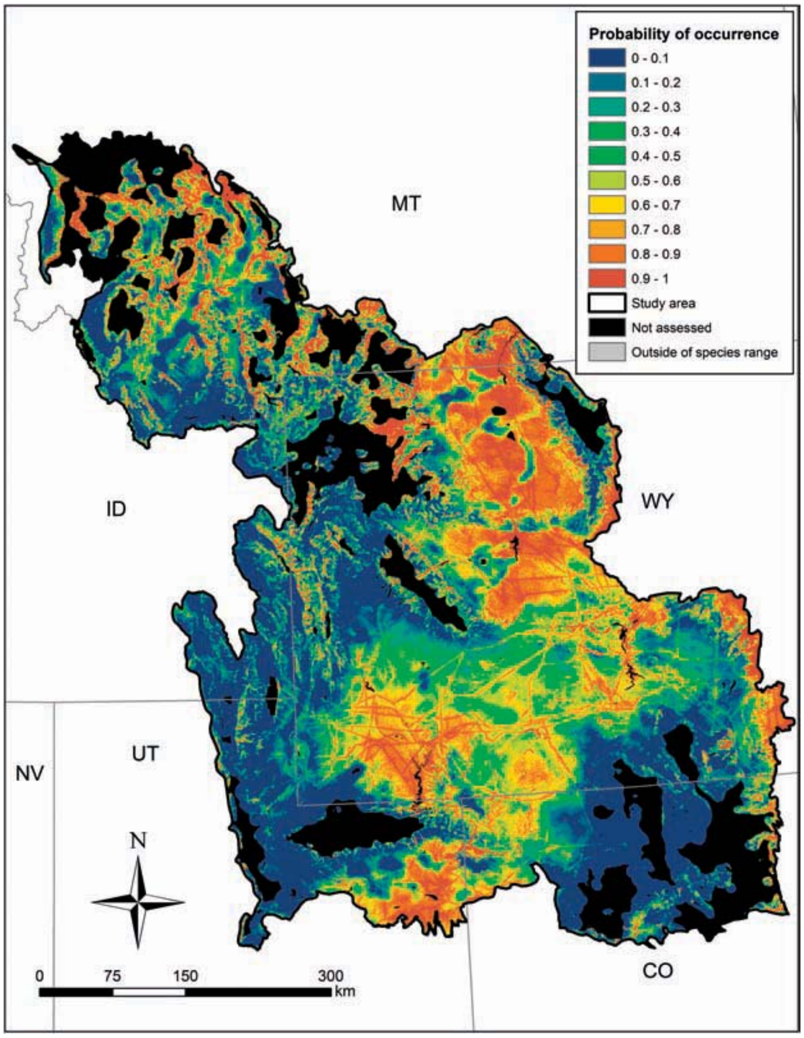

FIG. 7.16. Cottontail probability of occurrence in the Wyoming Basins Ecoregional Assessment area. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water). Cottontails are likely to occur in areas with probability > 0.47.

and interstates and major highways may be due to direct mortality or increased abundance of synanthropic predators (Johnston 2001, Leu et al. 2008).

Our model did not perform well using internal validation tests and we were unable to obtain independent data in order to validate this model. Therefore, caution should be taken when using our white-tailed jackrabbit model. Clearly further research is needed to fully understand how vegetation, abiotic, and disturbance factors influence the distribution of white-tailed jackrabbits.

Cottontail

Cottontails were associated with moderate levels of sagebrush but were predicted to occur over the entire range of sagebrush, indicating that other factors were important in determining their distribution. Cotton-

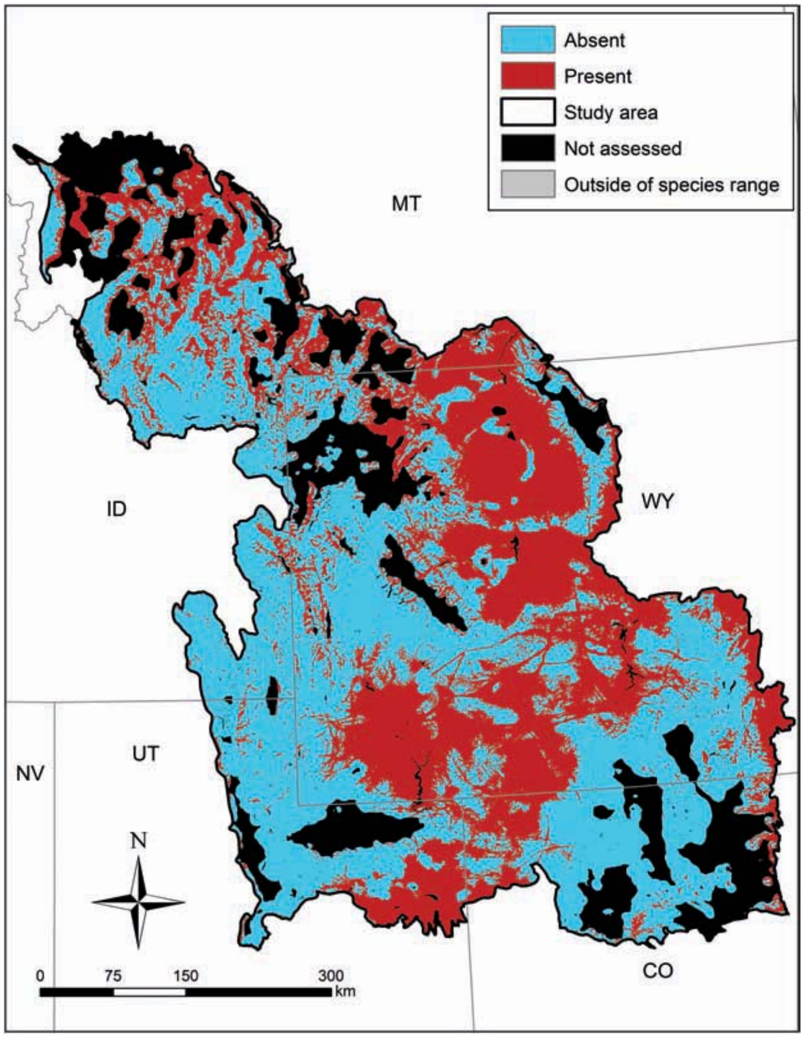

FIG. 7.17. Distribution of cottontail rabbits in the Wyoming Basins Ecoregional Assessment area based on optimum probability cutoff threshold of 0.47. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water).

tails are found in a variety of habitats and this was apparent from the large number of land cover types positively associated with cottontail occurrence in the WBEA, including coniferous forest, grassland, mixed shrubland, and riparian, as well as sagebrush edge. In a large-scale context, shrub and grassland habitats commonly associated with cottontails have low productivity. The generalist tendency of cottontails also is illustrated by the wide variety of plants they consume (Turkowski 1975, Hansen and Gold 1977, DeCalesta 1979).

Abiotic factors associated with cottontail occurrence included proximity to intermittent water and increased topographic ruggedness, while increased elevation had a negative influence. Areas of intermittent water may increase cover of forbs, which are a primary food source

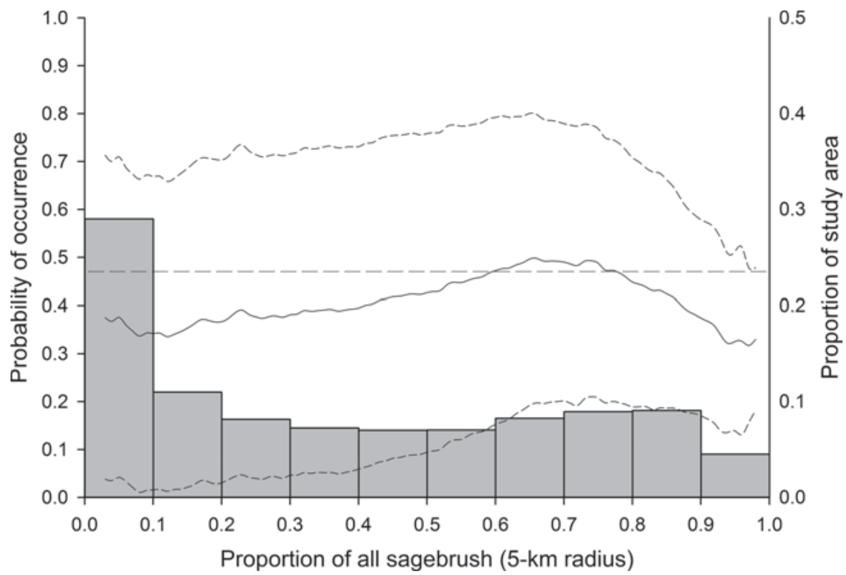

FIG. 7.18. Distribution of cottontail probability of occurrence within the Wyoming Basins Ecoregional Assessment area in relation to proportion of all big sagebrush (*Artemisia tridentata*) within a 5-km radius. Mean probability of occurrence (black line, ±1 SD [dashed lines]) values were calculated in each one percent increment of all big sagebrush within a 5-km radius moving window. Range of predictions relate to the observed range of sagebrush at study site locations. The dashed horizontal line represents the optimal cutoff threshold (0.47), above which occurrence is predicted. Histogram values represent the proportion of the total study area in each 10% segment of all big sagebrush within 5 km.

during the growing season (MacCracken and Hansen 1984).

Cottontails had a non-intuitive positive association with distance to power lines. We expected that cottontails would have a negative association because of the potential for increased predation due to the increased raptor densities (Steenhof et al. 1993). Food resources or other environmental conditions may increase the likeli-

TABLE 7.25. Results of AIC_c-based model selection for least chipmunk occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale sagebrush and NDVI; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_cvalue from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
1	$BIGSAGE_{5km}$	-143.05	2	290.14	0.00	0.04
2	$BIGSAGE_{18km}$	-143.42	2	290.88	0.75	0.03
3	$BIGSAGE_{3km}$	-143.68	2	291.40	1.26	0.02
4	$NDVI_{5km}$	-143.92	2	291.89	1.75	0.02
5	$NDVI_{3km}$	-143.94	2	291.92	1.79	0.02
6	$BIGSAGE_{1km}$	-143.97	2	291.98	1.85	0.01
7	$BIGSAGE_{5km}$ + NDVI	-143.00	3	292.08	1.95	0.01
8	$BIGSAGE_{5km}$ + $NDVI_{5km}$	-143.01	3	292.09	1.96	0.01
9	$BIGSAGE_{5km}$ + $NDVI_{3km}$	-143.01	3	292.10	1.96	0.01

[a] Variable definitions provided in Table 4.2.

TABLE 7.26. Evaluation statistics from AIC_c-based univariate model selection for least chipmunk occurrence in the Wyoming Basins Ecoregional Assessment area in relation to multi-scale vegetation, abiotic, and disturbance predictor variables (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and Akaike weight [w_i]). We ran logistic models with big sagebrush (5-km radius) as a base model for all variables tested. We used AIC_c to identify the scale at which least chipmunks respond to individual variables.

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	$CFRST_{5km}$	-142.88	3	291.84	0.00	0.26
	$CFRST_{1km}$	-142.93	3	291.94	0.10	0.25
	$CFRST_{18km}$	-142.94	3	291.95	0.11	0.25
	$CFRST_{3km}$	-142.97	3	292.01	0.17	0.24
	$GRASS_{3km}$	-141.47	3	289.01	0.00	0.32
	$GRASS_{540}$	-141.77	3	289.61	0.60	0.24
	$GRASS_{5km}$	-142.00	3	290.08	1.07	0.19
	$GRASS_{1km}$	-142.03	3	290.13	1.13	0.18
	$GRASS_{18km}$	-143.01	3	292.10	3.10	0.07
	MIX_{18km}	-141.10	3	288.28	0.00	0.75
	MIX_{5km}	-142.79	3	291.66	3.38	0.14
	MIX_{3km}	-143.03	3	292.13	3.85	0.11
	RIP_{18km}	-142.67	3	291.42	0.00	0.25
	RIP_{1km}	-142.81	3	291.70	0.29	0.21
	RIP_{540}	-142.87	3	291.82	0.40	0.20
	RIP_{5km}	-143.02	3	292.13	0.71	0.17
	RIP_{3km}	-143.05	3	292.17	0.76	0.17
	$EDGE_{3km}$	-136.05	3	278.17	0.00	0.95
	$CONTAG_{3km}$	-139.18	3	284.43	6.26	0.04
	$EDGE_{1km}$	-142.74	3	291.55	13.38	0.00
	$CONTAG_{5km}$	-142.81	3	291.70	13.53	0.00
	$PATCH_{3km}$	-142.88	3	291.83	13.65	0.00
	$CONTAG_{1km}$	-142.98	3	292.03	13.86	0.00
	$PATCH_{1km}$	-143.00	3	292.07	13.90	0.00
	$PATCH_{5km}$	-143.02	3	292.12	13.95	0.00
	$EDGE_{5km}$	-143.04	3	292.15	13.97	0.00
	$SALT_{18km}$	-142.75	3	291.58	0.00	0.22
	$SALT_{3km}$	-142.83	3	291.74	0.16	0.21
	$SALT_{540}$	-142.86	3	291.79	0.21	0.20
	$SALT_{1km}$	-142.94	3	291.95	0.37	0.19
	$SALT_{5km}$	-142.95	3	291.97	0.39	0.18
Abiotic	CLAY	-142.28	3	290.64	0.00	1.00
	CTI	-142.65	3	291.37	0.00	1.00
	ELEV	-141.95	3	289.97	0.00	1.00
	$iH2Od_{1km}$[b]	-142.89	3	291.86	0.00	0.36
	$iH2Od_{250}$[b]	-143.00	3	292.09	0.23	0.32
	$iH2Od_{500}$[b]	-143.02	3	292.12	0.27	0.32

TABLE 7.26. Continued

Category	Variable[a]	LL	K	AIC_c	ΔAIC_c	w_i
	$pH2Od_{250}$[b]	-142.70	3	291.47	0.00	0.41
	$pH2Od_{500}$[b]	-142.98	3	292.04	0.56	0.31
	$pH2Od_{1km}$[b]	-143.05	3	292.17	0.70	0.29
	$SOIL_{cm}$	-142.54	3	291.16	0.00	1.00
	SAND	-142.84	3	291.75	0.00	1.00
	SOLAR	-142.24	3	290.55	0.00	1.00
	Tmin	-134.98	3	276.04	0.00	1.00
	TRI_{18km}	-141.26	3	288.60	0.00	0.39
	TRI_{3km}	-142.32	3	290.71	2.10	0.14
	TRI	-142.39	3	290.85	2.24	0.13
	TRI_{5km}	-142.68	3	291.43	2.83	0.10
	TRI_{270}	-142.75	3	291.58	2.98	0.09
	TRI_{540}	-142.84	3	291.75	3.15	0.08
	TRI_{1km}	-142.92	3	291.92	3.31	0.08
Disturbance	AG_{250}[b]	-142.68	3	291.44	0.00	0.40
	AG_{500}[b]	-142.95	3	291.99	0.54	0.31
	AG_{1km}[b]	-143.01	3	292.10	0.66	0.29
	$MjRD_{1km}$[b]	-142.31	3	290.70	0.00	0.49
	$MjRD_{250}$[b]	-142.87	3	291.82	1.12	0.28
	$MjRD_{500}$[b]	-143.04	3	292.16	1.46	0.23
	$PIPE_{250}$[b]	-141.69	3	289.46	0.00	0.60
	$PIPE_{500}$[b]	-142.60	3	291.27	1.80	0.24
	$PIPE_{1km}$[b]	-143.02	3	292.11	2.64	0.16
	$POWER_{1km}$[b]	-141.72	3	289.52	0.00	0.59
	$POWER_{500}$[b]	-142.62	3	291.32	1.80	0.24
	$POWER_{250}$[b]	-142.98	3	292.03	2.51	0.17
	$RDdens_{3km}$	-140.86	3	287.79	0.00	0.37
	$RDdens_{18km}$	-141.60	3	289.27	1.48	0.18
	$RDdens_{5km}$	-142.27	3	290.61	2.82	0.09
	$2RD_{250}$[b]	-142.28	3	290.63	2.84	0.09
	$2RD_{500}$[b]	-142.65	3	291.37	3.58	0.06
	$RDdens_{1km}$	-142.67	3	291.42	3.62	0.06
	$2RD_{1km}$[b]	-142.72	3	291.51	3.72	0.06
	$RDdens_{270}$	-143.03	3	292.13	4.34	0.04
	$RDdens_{540}$	-143.03	3	292.14	4.35	0.04
	$WELL_{500}$[b]	-141.56	3	289.20	0.00	0.45
	$WELL_{1km}$[b]	-141.97	3	290.01	0.81	0.30
	$WELL_{250}$[b]	-142.15	3	290.37	1.17	0.25

[a] Variable definitions provided in Table 4.2
[b] Distance decay function ($e^{(\text{Euclidean distance from feature/-distance parameter})}$)

TABLE 7.27. Results of AIC_c-based submodel selection for least chipmunk occurrence in the Wyoming Basins Ecoregional Assessment area; the table also shows log-likelihood (LL), number of parameters (K), Akaike's Information Criterion corrected for small sample sizes (AIC_c), change in AIC_c value from the top model (ΔAIC_c), and Akaike weight (w_i). Only models with $\Delta AIC_c \leq 2$ are shown.

Category	Rank	Model[a]	LL	K	AIC_c	ΔAIC_c	w_i
Vegetation	1	$BIGSAGE_{5km}$ + $EDGE_{3km}$ + $GRASS_{3km}$ + MIX_{18km}	-133.69	5	277.57	0.00	0.12
	2	$BIGSAGE_{5km}$ + $EDGE_{3km}$ + $GRASS_{3km}$	-134.80	4	277.72	0.15	0.11
	3	$BIGSAGE_{5km}$ + $EDGE_{3km}$ + MIX_{18km}	-134.85	4	277.83	0.27	0.10
	4	$BIGSAGE_{5km}$ + $EDGE_{3km}$	-136.05	3	278.17	0.61	0.09
Abiotic	1	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SOLAR + SAND	-131.17	6.00	274.61	0.00	0.03
	2	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SOLAR	-132.30	5.00	274.80	0.18	0.03
	3	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SOLAR + CTI	-131.31	6.00	274.89	0.28	0.03
	4	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SOLAR + $SOIL_{cm}$	-131.43	6.00	275.13	0.52	0.03
	5	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SAND	-132.56	5.00	275.31	0.70	0.02
	6	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SOLAR + CLAY	-131.57	6.00	275.41	0.80	0.02
	7	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + CTI	-132.63	5.00	275.44	0.83	0.02
	8	$BIGSAGE_{5km}$ + Tmin + TRI_{18km}	-133.67	4.00	275.47	0.86	0.02
	9	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + CTI + SAND	-131.62	6.00	275.51	0.90	0.02
	10	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + $SOIL_{cm}$	-132.78	5.00	275.74	1.13	0.02
	11	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + CLAY	-132.79	5.00	275.78	1.16	0.02
	12	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + CTI + CLAY	-131.77	6.00	275.81	1.19	0.02
	13	$BIGSAGE_{5km}$ + Tmin	-134.98	3.00	276.04	1.42	0.02
	14	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + CTI + $SOIL_{cm}$	-131.98	6.00	276.23	1.61	0.02
	15	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SAND + CLAY	-132.00	6.00	276.28	1.66	0.01
	16	$BIGSAGE_{5km}$ + Tmin + SAND	-134.10	4.00	276.32	1.71	0.01
	17	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SOLAR + $iH2Od_{1km}$	-132.06	6.00	276.39	1.78	0.01
	18	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SOLAR + $pH2Od_{250}$	-132.08	6.00	276.43	1.82	0.01
	19	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + CTI + $pH2Od_{250}$	-132.10	6.00	276.46	1.85	0.01
	20	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + SAND + $pH2Od_{250}$	-132.11	6.00	276.49	1.88	0.01
	21	$BIGSAGE_{5km}$ + Tmin + TRI_{18km} + $pH2Od_{250}$	-133.21	5.00	276.60	1.99	0.01
Disturbance	1	$BIGSAGE_{5km}$ + $PIPE_{250}$ + $POWER_{1km}$ + $WELL_{500}$ + $MjRD_{1km}$	-135.35	6.00	282.97	0.00	0.16
	2	$BIGSAGE_{5km}$ + $PIPE_{250}$ + $POWER_{1km}$ + $WELL_{500}$	-136.76	5.00	283.72	0.75	0.11

[a] Variable definitions provided in Table 4.2

TABLE 7.28. Results of AIC_c-based model selection for the combined least chipmunk occurrence models[a] in the Wyoming Basins Ecoregional Assessment area; the table also shows parameter estimates (beta [SE]) and evaluation statistics (log-likelihood [LL], number of parameters [K], Akaike's Information Criterion corrected for small sample sizes [AIC_c], change in AIC_c value from the top model [ΔAIC_c], and cumulative Akaike weight [$\sum w_i$]). Models shown with cumulative Akaike weight (w_i) of just ≥ 0.9.

Model	Constant	$BIGSAGE_{5km}$	$EDGE_{3km}$	Tmin	$POWER_{1km}$	$PIPE_{250}$	TRI_{18km}	SOLAR
1	-1.61 (0.68)	-0.48 (0.55)	-0.02 (0.01)	-0.27 (0.10)	1.61 (0.71)	-2.03 (1.50)		
2	-0.60 (0.97)	-1.41 (0.80)	-0.02 (0.01)	-0.28 (0.10)	1.10 (0.67)		-0.02 (0.01)	
3	-2.60 (1.78)	-1.47 (0.79)	-0.02 (0.01)	-0.26 (0.09)			-0.03 (0.01)	0.02 (0.01)
4	0.37 (1.02)	-1.38 (0.79)	-0.02 (0.01)	-0.28 (0.09)			-0.03 (0.01)	
5	-1.69 (0.67)	-0.51 (0.54)	-0.02 (0.01)	-0.29 (0.10)	1.26 (0.65)			
6	-1.51 (0.67)	-0.71 (0.57)	-0.02 (0.01)	-0.26 (0.10)	1.33 (0.65)			
7	-0.25 (0.94)	-1.48 (0.79)	-0.02 (0.01)	-0.26 (0.09)			-0.02 (0.01)	
8	0.00 (0.95)	-1.72 (0.81)	-0.02 (0.01)	-0.23 (0.10)			-0.02 (0.01)	
9	-1.26 (0.74)	-0.35 (0.56)	-0.02 (0.01)	-0.31 (0.09)	1.21 (0.65)			
10	-0.44 (0.95)	-1.47 (0.79)	-0.02 (0.01)	-0.27 (0.10)			-0.02 (0.01)	
11	-3.49 (1.69)	-0.34 (0.56)	-0.02 (0.01)	-0.29 (0.10)	1.29 (0.65)			0.01 (0.01)
12	-1.37 (0.73)	-0.75 (0.58)	-0.02 (0.01)	-0.28 (0.10)	1.24 (0.65)			
13	-0.08 (0.96)	-1.48 (0.79)	-0.02 (0.01)	-0.24 (0.10)		-1.46 (1.40)	-0.02 (0.01)	
14	-1.78 (0.68)	-0.49 (0.54)	-0.02 (0.01)	-0.30 (0.10)	1.10 (0.68)			
15	-1.59 (0.67)	-0.34 (0.54)	-0.02 (0.01)	-0.26 (0.09)		-1.98 (1.47)		
16	-1.50 (0.65)	-0.42 (0.53)	-0.02 (0.01)	-0.27 (0.09)				
17	-1.05 (0.72)	-0.25 (0.55)	-0.02 (0.01)	-0.29 (0.09)				
18	-0.03 (0.99)	-1.43 (0.79)	-0.02 (0.01)	-0.23 (0.10)			-0.03 (0.01)	
19	-1.66 (0.67)	-0.41 (0.54)	-0.02 (0.01)	-0.28 (0.09)				
20	-0.22 (0.94)	-1.50 (0.78)	-0.02 (0.01)	-0.25 (0.10)			-0.02 (0.01)	
21	-1.62 (0.69)	-0.45 (0.56)	-0.02 (0.01)	-0.28 (0.10)	1.24 (0.65)			
22	-1.49 (0.67)	-0.61 (0.56)	-0.02 (0.01)	-0.25 (0.10)				
23	-1.33 (0.66)	-0.60 (0.55)	-0.02 (0.01)	-0.25 (0.09)				
24	-1.17 (0.71)	-0.68 (0.58)	-0.02 (0.01)	-0.26 (0.09)				
25	-1.22 (0.74)	-0.24 (0.55)	-0.02 (0.01)	-0.30 (0.09)				
26	-0.70 (0.77)	-0.51 (0.59)	-0.02 (0.01)	-0.28 (0.09)				
27	-1.32 (0.72)	-0.68 (0.58)	-0.02 (0.01)	-0.27 (0.10)				
28	-3.18 (1.66)	-0.26 (0.56)	-0.02 (0.01)	-0.27 (0.09)				0.01 (0.01)
29	-1.41 (0.66)	-0.38 (0.54)	-0.02 (0.01)	-0.26 (0.09)		-1.26 (1.36)		
30	-2.74 (1.68)	-0.08 (0.57)	-0.02 (0.01)	-0.29 (0.09)				0.01 (0.01)
31	-0.97 (0.72)	-0.19 (0.56)	-0.02 (0.01)	-0.28 (0.09)		-1.29 (1.36)		
32	-0.94 (0.73)	-0.42 (0.58)	-0.02 (0.01)	-0.27 (0.10)				
33	-1.01 (0.71)	-0.85 (0.59)	-0.02 (0.01)	-0.24 (0.10)				
34	-1.22 (0.67)	-0.56 (0.55)	-0.02 (0.01)	-0.23 (0.10)		-1.46 (1.43)		
35	-0.11 (0.41)	-1.26 (0.53)	-0.03 (0.01)		1.75 (0.71)	-3.02 (1.69)		
36	-2.91 (1.64)	-0.44 (0.58)	-0.02 (0.01)	-0.25 (0.09)				0.01 (0.01)

TABLE 7.28. Extended

SAND	$WELL_{500}$	$MjRD_{1km}$	$GRASS_{3km}$	MIX_{18km}	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
					-128.55	6	269.37	0.00	0.040
					-128.64	6	269.55	0.18	0.076
					-128.69	6	269.64	0.27	0.111
-0.02 (0.01)					-128.72	6	269.70	0.34	0.145
					-129.80	5	269.80	0.43	0.177
	1.69 (1.20)				-128.87	6	270.01	0.64	0.206
					-129.92	5	270.02	0.66	0.235
	1.68 (1.20)				-129.01	6	270.29	0.92	0.260
-0.01 (0.01)					-129.03	6	270.32	0.96	0.284
		0.80 (0.60)			-129.08	6	270.44	1.07	0.308
					-129.11	6	270.49	1.12	0.331
			-3.40 (3.21)		-129.17	6	270.60	1.23	0.352
					-129.22	6	270.70	1.34	0.372
		0.55 (0.63)			-129.44	6	271.15	1.78	0.389
		1.15 (0.64)			-129.47	6	271.21	1.84	0.405
					-131.56	4	271.25	1.89	0.420
-0.02 (0.01)					-130.65	5	271.48	2.12	0.434
				-21.57 (30.66)	-129.64	6	271.56	2.19	0.447
		0.81 (0.60)			-130.68	5	271.56	2.19	0.461
			-1.93 (3.14)		-129.71	6	271.69	2.32	0.473
				-10.90 (30.16)	-129.73	6	271.74	2.37	0.485
	1.69 (1.20)	0.90 (0.60)			-129.76	6	271.79	2.42	0.497
	1.50 (1.19)				-130.82	5	271.83	2.46	0.509
			-3.57 (3.20)		-130.85	5	271.89	2.53	0.520
-0.01 (0.01)		0.77 (0.59)			-129.84	6	271.95	2.58	0.531
-0.02 (0.01)			-3.72 (3.22)		-129.87	6	272.01	2.65	0.542
		0.85 (0.60)	-3.80 (3.25)		-129.90	6	272.06	2.70	0.552
					-130.94	5	272.08	2.71	0.562
					-131.02	5	272.24	2.87	0.572
-0.02 (0.01)					-130.01	6	272.29	2.92	0.581
-0.02 (0.01)					-130.08	6	272.42	3.06	0.590
-0.01 (0.01)	1.31 (1.22)				-130.10	6	272.47	3.10	0.598
	1.46 (1.19)		-3.48 (3.18)		-130.14	6	272.55	3.18	0.606
	1.64 (1.19)				-130.15	6	272.56	3.19	0.615
	2.72 (1.16)				-130.21	6	272.69	3.33	0.622
	1.45 (1.20)				-130.25	6	272.76	3.40	0.629

TABLE 7.28. Continued

Model	Constant	$BIGSAGE_{5km}$	$EDGE_{3km}$	Tmin	$POWER_{1km}$	$PIPE_{250}$	TRI_{18km}	SOLAR
37	-3.07 (1.67)	-0.27 (0.56)	-0.02 (0.01)	-0.28 (0.09)				0.01 (0.01)
38	1.55 (0.76)	-2.37 (0.75)	-0.03 (0.01)			-2.37 (1.57)	-0.03 (0.01)	
39	-2.82 (1.69)	-0.53 (0.60)	-0.02 (0.01)	-0.26 (0.09)				0.01 (0.01)
40	-1.40 (0.67)	-0.35 (0.55)	-0.02 (0.01)	-0.26 (0.10)				
41	-3.09 (1.67)	-0.22 (0.56)	-0.02 (0.01)	-0.26 (0.09)		-1.23 (1.34)		0.01 (0.01)
42	-1.13 (0.71)	-0.62 (0.58)	-0.02 (0.01)	-0.25 (0.09)		-1.10 (1.34)		
43	1.50 (0.75)	-2.11 (0.77)	-0.03 (0.01)				-0.03 (0.01)	
44	-2.71 (0.53)	-0.32 (0.54)		-0.34 (0.09)	1.69 (0.70)	-2.16 (1.48)		
45	-1.57 (0.69)	-0.33 (0.55)	-0.02 (0.01)	-0.26 (0.10)				
46	-0.99 (0.74)	-0.19 (0.57)	-0.02 (0.01)	-0.28 (0.10)				
47	-0.99 (1.66)	-2.36 (0.76)	-0.03 (0.01)				-0.03 (0.01)	0.02 (0.01)
48	-2.83 (0.54)	-0.28 (0.55)		-0.34 (0.09)	1.52 (0.72)	-2.61 (1.56)		
49	-1.23 (0.68)	-0.52 (0.57)	-0.02 (0.01)	-0.23 (0.10)				
50	1.15 (0.76)	-2.10 (0.74)	-0.03 (0.01)		1.35 (0.72)	-2.69 (1.57)	-0.03 (0.01)	
51	-1.80 (0.86)	-1.10 (0.80)		-0.33 (0.09)	1.55 (0.71)	-2.17 (1.48)	-0.02 (0.01)	
52	-1.17 (1.69)	-1.85 (0.76)	-0.03 (0.01)				-0.04 (0.01)	0.02 (0.01)
53	-1.07 (0.73)	-0.61 (0.59)	-0.02 (0.01)	-0.24 (0.10)				
54	-4.66 (1.61)	-0.13 (0.57)		-0.34 (0.09)	1.73 (0.70)	-2.20 (1.46)		0.01 (0.01)
55	-2.28 (0.62)	-0.15 (0.56)		-0.36 (0.09)	1.64 (0.70)	-2.24 (1.47)		
56	-2.60 (0.53)	-0.50 (0.57)		-0.32 (0.09)	1.81 (0.71)	-2.46 (1.57)		
57	1.19 (0.76)	-2.38 (0.76)	-0.03 (0.01)		1.03 (0.66)		-0.03 (0.01)	
58	1.30 (0.76)	-2.15 (0.74)	-0.03 (0.01)			-2.80 (1.56)	-0.03 (0.01)	
59	-3.08 (1.67)	-0.19 (0.57)	-0.02 (0.01)	-0.25 (0.10)				0.01 (0.01)
60	-4.22 (1.68)	-1.18 (0.80)		-0.35 (0.09)	1.12 (0.64)		-0.02 (0.01)	0.02 (0.01)
61	1.40 (0.75)	-2.39 (0.76)	-0.03 (0.01)				-0.03 (0.01)	
62	-1.33 (0.68)	-0.31 (0.55)	-0.02 (0.01)	-0.24 (0.10)		-1.24 (1.36)		
63	1.51 (0.75)	-1.87 (0.75)	-0.03 (0.01)			-1.90 (1.44)	-0.03 (0.01)	
64	-1.08 (1.71)	-2.09 (0.74)	-0.03 (0.01)			-1.95 (1.41)	-0.03 (0.01)	0.02 (0.01)
65	-0.14 (0.41)	-1.09 (0.52)	-0.03 (0.01)			-2.90 (1.63)		
66	-2.81 (0.53)	-0.37 (0.54)		-0.37 (0.09)	1.26 (0.63)			
67	1.28 (0.76)	-2.42 (0.76)	-0.03 (0.01)				-0.03 (0.01)	
68	1.42 (0.75)	-1.89 (0.76)	-0.03 (0.01)				-0.03 (0.01)	
69	-2.47 (0.59)	-0.52 (0.58)		-0.33 (0.09)	1.64 (0.70)	-2.05 (1.47)		
70	-3.34 (1.69)	-1.14 (0.79)		-0.36 (0.09)			-0.03 (0.01)	0.02 (0.01)
71	-1.90 (0.85)	-1.16 (0.79)		-0.36 (0.09)	1.13 (0.64)		-0.02 (0.01)	
72	-1.57 (0.84)	-1.19 (0.79)		-0.32 (0.09)		-2.08 (1.44)	-0.02 (0.01)	
73	-3.92 (1.66)	-1.25 (0.78)		-0.34 (0.09)			-0.03 (0.01)	0.02 (0.01)
74	-4.64 (1.60)	-0.20 (0.56)		-0.37 (0.09)	1.28 (0.63)			0.01 (0.01)

TABLE 7.28. Extended

SAND	$WELL_{500}$	$MjRD_{1km}$	$GRASS_{3km}$	MIX_{18km}	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
		0.73 (0.60)			-130.25	6	272.77	3.41	0.637
	2.53 (1.14)				-130.25	6	272.77	3.41	0.644
			-3.57 (3.25)		-130.26	6	272.78	3.42	0.651
				-14.25 (29.51)	-131.44	5	273.07	3.70	0.657
					-130.41	6	273.10	3.73	0.664
			-3.25 (3.21)		-130.44	6	273.15	3.79	0.670
	2.26 (1.15)			-46.87 (30.56)	-130.48	6	273.22	3.86	0.675
					-131.58	5	273.35	3.99	0.681
		0.82 (0.60)		-15.10 (29.90)	-130.55	6	273.36	4.00	0.686
-0.01 (0.01)				-11.50 (30.22)	-130.57	6	273.41	4.04	0.692
	2.31 (1.15)				-130.59	6	273.45	4.09	0.697
		0.94 (0.65)			-130.61	6	273.48	4.12	0.702
	1.52 (1.19)			-14.83 (28.89)	-130.68	6	273.63	4.26	0.707
					-130.69	6	273.64	4.28	0.711
					-130.70	6	273.66	4.29	0.716
				-51.62 (31.95)	-130.71	6	273.69	4.33	0.720
			-3.58 (3.20)	-14.41 (29.27)	-130.72	6	273.71	4.34	0.725
					-130.72	6	273.71	4.34	0.730
-0.01 (0.01)					-130.75	6	273.77	4.40	0.734
	1.57 (1.20)				-130.78	6	273.82	4.45	0.738
	2.53 (1.15)				-130.79	6	273.85	4.48	0.743
		1.15 (0.63)			-130.82	6	273.91	4.54	0.747
				-14.06 (29.43)	-130.82	6	273.91	4.54	0.751
					-130.89	6	274.04	4.68	0.755
	2.35 (1.14)				-131.94	5	274.06	4.70	0.758
				-13.27 (30.04)	-130.92	6	274.11	4.74	0.762
				-48.69 (31.96)	-130.99	6	274.25	4.88	0.766
					-131.02	6	274.31	4.94	0.769
	2.71 (1.15)	1.32 (0.63)			-131.03	6	274.32	4.95	0.772
					-133.11	4	274.34	4.97	0.776
	2.56 (1.15)	0.82 (0.60)			-131.06	6	274.39	5.02	0.779
				-51.24 (32.01)	-132.19	5	274.58	5.21	0.782
			-2.83 (3.25)		-131.16	6	274.59	5.22	0.785
-0.02 (0.01)					-131.17	6	274.61	5.25	0.788
					-132.22	5	274.62	5.26	0.791
		1.22 (0.64)			-131.26	6	274.79	5.42	0.793
					-132.30	5	274.80	5.43	0.796
					-132.34	5	274.86	5.50	0.798

TABLE 7.28. Continued

Model	Constant	$BIGSAGE_{5km}$	$EDGE_{3km}$	Tmin	$POWER_{1km}$	$PIPE_{250}$	TRI_{18km}	SOLAR
75	-1.24 (1.70)	-2.13 (0.75)	-0.03 (0.01)				-0.03 (0.01)	0.02 (0.01)
76	-1.35 (0.94)	-1.08 (0.80)		-0.37 (0.09)	1.05 (0.65)		-0.02 (0.01)	
77	1.44 (0.75)	-2.15 (0.74)	-0.03 (0.01)			-2.04 (1.44)	-0.03 (0.01)	
78	-2.41 (0.62)	-0.23 (0.55)		-0.38 (0.09)	1.20 (0.63)			
79	1.22 (0.76)	-1.86 (0.76)	-0.03 (0.01)		0.84 (0.66)		-0.03 (0.01)	
80	-1.45 (1.71)	-2.10 (0.75)	-0.03 (0.01)		0.91 (0.65)		-0.03 (0.01)	0.02 (0.01)
81	-2.52 (0.59)	-0.60 (0.58)		-0.35 (0.09)	1.24 (0.63)			
82	1.85 (0.89)	-2.34 (0.76)	-0.03 (0.01)				-0.03 (0.01)	
83	-0.99 (0.89)	-1.13 (0.79)		-0.36 (0.09)			-0.02 (0.01)	
84	1.30 (0.76)	-1.89 (0.76)	-0.03 (0.01)				-0.03 (0.01)	
85	-3.86 (1.67)	-1.20 (0.78)		-0.32 (0.09)		-1.42 (1.32)	-0.03 (0.01)	0.02 (0.01)
86	-2.67 (0.57)	-0.29 (0.56)		-0.33 (0.10)	1.68 (0.70)	-2.17 (1.48)		
87	1.41 (0.75)	-2.38 (0.75)	-0.03 (0.01)				-0.03 (0.01)	
88	-0.11 (0.40)	-1.07 (0.52)	-0.03 (0.01)		1.55 (0.70)	-2.60 (1.56)		
89	-2.73 (0.53)	-0.51 (0.56)		-0.35 (0.09)	1.30 (0.63)			
90	1.93 (0.89)	-1.83 (0.76)	-0.03 (0.01)				-0.03 (0.01)	
91	-1.57 (0.82)	-1.23 (0.78)		-0.34 (0.09)			-0.02 (0.01)	
92	-3.81 (1.68)	-1.25 (0.79)		-0.34 (0.09)			-0.03 (0.01)	0.02 (0.01)
93	0.22 (0.46)	-1.58 (0.56)	-0.03 (0.01)		1.19 (0.64)			
94	-4.21 (1.62)	-0.05 (0.58)		-0.38 (0.09)	1.22 (0.63)			0.01 (0.01)
95	-0.15 (0.41)	-0.74 (0.57)	-0.03 (0.01)		1.54 (0.71)	-2.53 (1.57)		
96	-1.78 (0.86)	-1.34 (0.81)		-0.34 (0.09)	1.18 (0.64)		-0.02 (0.01)	
97	-0.23 (0.41)	-1.04 (0.52)	-0.03 (0.01)		1.38 (0.72)	-3.12 (1.66)		
98	-2.90 (0.54)	-0.35 (0.54)		-0.37 (0.09)	1.10 (0.65)			
99	-0.08 (0.40)	-1.32 (0.53)	-0.03 (0.01)		1.20 (0.64)			
100	-1.71 (0.83)	-1.23 (0.79)		-0.35 (0.09)			-0.02 (0.01)	
101	-0.75 (1.75)	-2.07 (0.76)	-0.03 (0.01)				-0.03 (0.01)	0.02 (0.01)
102	-1.15 (0.91)	-1.15 (0.79)		-0.37 (0.09)			-0.02 (0.01)	
103	-2.72 (0.53)	-0.18 (0.54)		-0.33 (0.09)		-1.92 (1.41)		
104	1.33 (0.74)	-2.18 (0.74)	-0.03 (0.01)				-0.03 (0.01)	
105	-0.83 (0.90)	-1.08 (0.79)		-0.34 (0.09)		-1.52 (1.37)	-0.02 (0.01)	
106	-2.08 (0.68)	-0.46 (0.59)		-0.37 (0.09)	1.17 (0.63)			
107	1.97 (0.89)	-2.10 (0.75)	-0.03 (0.01)			-2.08 (1.46)	-0.03 (0.01)	
108	-1.96 (0.86)	-1.17 (0.80)		-0.36 (0.09)	0.95 (0.67)		-0.02 (0.01)	
109	-4.34 (1.62)	-0.43 (0.60)		-0.35 (0.09)	1.26 (0.63)			0.01 (0.01)
110	-0.11 (0.40)	-0.99 (0.58)	-0.03 (0.01)		1.16 (0.64)			
111	0.13 (0.45)	-1.30 (0.55)	-0.03 (0.01)		1.49 (0.70)	-2.29 (1.52)		
112	1.42 (0.75)	-1.90 (0.75)	-0.03 (0.01)				-0.03 (0.01)	

TABLE 7.28. Extended

SAND	$WELL_{500}$	$MjRD_{1km}$	$GRASS_{3km}$	MIX_{18km}	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
					-132.36	5	274.91	5.54	0.801
-0.02 (0.01)					-131.32	6	274.92	5.55	0.803
					-132.39	5	274.98	5.61	0.806
-0.01 (0.01)					-132.40	5	274.99	5.62	0.808
				-49.94 (32.42)	-131.42	6	275.11	5.75	0.810
					-131.44	6	275.15	5.78	0.813
			-3.31 (3.25)		-132.52	5	275.23	5.86	0.815
-0.01 (0.01)	2.26 (1.15)				-131.48	6	275.23	5.87	0.817
-0.02 (0.01)					-132.56	5	275.31	5.94	0.819
		0.71 (0.60)		-52.92 (32.35)	-131.53	6	275.32	5.95	0.821
					-131.55	6	275.36	5.99	0.823
				-7.30 (32.22)	-131.56	6	275.38	6.01	0.825
	2.28 (1.14)		-2.48 (3.04)		-131.56	6	275.39	6.02	0.827
					-132.60	5	275.39	6.03	0.829
	1.22 (1.19)				-132.61	5	275.41	6.04	0.831
-0.01 (0.01)				-53.07 (33.11)	-131.58	6	275.43	6.06	0.833
					-133.67	4	275.47	6.11	0.835
		0.72 (0.60)			-131.62	6	275.52	6.15	0.836
	2.33 (1.15)		-4.26 (3.18)		-131.63	6	275.54	6.17	0.838
-0.01 (0.01)					-131.64	6	275.55	6.18	0.840
				-41.44 (32.35)	-131.64	6	275.55	6.19	0.842
	1.31 (1.20)				-131.65	6	275.56	6.19	0.844
		0.91 (0.65)			-131.66	6	275.59	6.22	0.845
		0.57 (0.62)			-132.70	5	275.59	6.23	0.847
	2.43 (1.14)				-132.71	5	275.60	6.23	0.849
		0.85 (0.59)			-132.71	5	275.61	6.24	0.851
-0.01 (0.01)					-131.69	6	275.65	6.28	0.852
-0.02 (0.01)		0.81 (0.60)			-131.70	6	275.66	6.29	0.854
		1.17 (0.63)			-132.75	5	275.70	6.33	0.856
					-133.80	4	275.72	6.35	0.858
-0.02 (0.01)					-131.73	6	275.73	6.36	0.859
-0.01 (0.01)			-3.54 (3.30)		-131.74	6	275.74	6.37	0.861
-0.01 (0.01)					-131.74	6	275.75	6.39	0.862
		0.62 (0.63)			-131.75	6	275.77	6.40	0.864
			-3.37 (3.31)		-131.75	6	275.77	6.41	0.866
	2.31 (1.15)			-37.92 (30.52)	-131.79	6	275.84	6.47	0.867
			-3.68 (3.18)		-131.82	6	275.90	6.54	0.869
			-2.46 (3.05)	-48.86 (31.55)	-131.83	6	275.92	6.55	0.870

TABLE 7.28. Continued

Model	Constant	$BIGSAGE_{5km}$	$EDGE_{3km}$	Tmin	$POWER_{1km}$	$PIPE_{250}$	TRI_{18km}	SOLAR
113	1.12 (0.76)	-2.15 (0.75)	-0.03 (0.01)		0.91 (0.65)		-0.02 (0.01)	
114	-3.74 (1.65)	-1.41 (0.80)		-0.32 (0.09)			-0.03 (0.01)	0.02 (0.01)
115	-4.48 (1.58)	-0.35 (0.58)		-0.35 (0.09)	1.32 (0.63)			0.01 (0.01)
116	-2.62 (0.51)	-0.29 (0.53)		-0.35 (0.09)				
117	-1.90 (1.59)	-0.88 (0.55)	-0.03 (0.01)		1.58 (0.70)	-2.54 (1.55)		0.01 (0.01)
118	-2.29 (0.61)	-0.01 (0.56)		-0.35 (0.09)		-1.93 (1.40)		
119	-1.44 (0.82)	-1.19 (0.78)		-0.32 (0.09)		-1.39 (1.34)	-0.02 (0.01)	
120	-2.78 (0.53)	-0.27 (0.53)		-0.36 (0.09)				
121	-1.15 (1.71)	-2.13 (0.75)	-0.03 (0.01)				-0.03 (0.01)	0.02 (0.01)
122	-1.87 (0.86)	-1.16 (0.79)		-0.35 (0.09)	1.14 (0.64)		-0.01 (0.01)	
123	-2.61 (0.53)	-0.34 (0.55)		-0.31 (0.09)		-2.16 (1.48)		
124	-2.50 (0.63)	-0.21 (0.55)		-0.38 (0.09)	1.05 (0.65)			
125	-2.19 (0.59)	-0.13 (0.55)		-0.36 (0.09)				
126	0.03 (0.40)	-1.09 (0.52)	-0.03 (0.01)			-2.01 (1.49)		
127	-2.76 (0.56)	-0.34 (0.56)		-0.36 (0.10)	1.25 (0.63)			
128	-2.45 (0.59)	-0.73 (0.60)		-0.34 (0.09)	1.28 (0.63)			
129	-2.38 (0.62)	-0.36 (0.58)		-0.36 (0.09)	1.24 (0.63)			
130	-1.06 (1.70)	-2.14 (0.74)	-0.03 (0.01)				-0.03 (0.01)	0.02 (0.01)
131	-1.74 (1.54)	-1.16 (0.56)	-0.03 (0.01)		1.22 (0.64)			0.01 (0.01)
132	-3.74 (1.68)	-1.22 (0.79)		-0.31 (0.10)			-0.03 (0.01)	0.02 (0.01)
133	-2.60 (0.60)	-0.58 (0.58)		-0.36 (0.09)	1.06 (0.66)			
134	-4.54 (1.61)	-0.19 (0.56)		-0.37 (0.09)	1.15 (0.65)			0.01 (0.01)
135	-1.58 (0.84)	-1.42 (0.81)		-0.33 (0.09)			-0.02 (0.01)	
136	-1.77 (0.91)	-1.13 (0.80)		-0.34 (0.10)	1.10 (0.65)		-0.02 (0.01)	

[a] Variable definitions provided in Table 4.2

hood of cottontail use of these areas near power lines and potentially indicate that areas near power lines act as an ecological trap (Dwernychuk and Boag 1972, Battin 2004). However, caution should be used in broadly interpreting this as an effect of power lines because our data only contained major transmission corridors and did not include smaller and more common power lines.

Least Chipmunk

Least chipmunk occupancy in the WBEA area was negatively associated with proportion of sagebrush habitat and mixed shrublands, and increased sagebrush edge density. Least chipmunks occur across many habitat types, including areas above treeline, montane forest, and shrublands (Bergstrom and Hoffmann 1991, Verts and Carraway 2001). We sampled gradients of disturbance and productivity within the sagebrush ecosystem along a large elevation gradient. The ability of least chipmunks to occupy forest and woodland habitats, as well as high elevation habitat, may lead to a negative association with large-scale sagebrush metrics. Previous research conducted

TABLE 7.28. Extended

SAND	$WELL_{500}$	$MjRD_{1km}$	$GRASS_{3km}$	MIX_{18km}	LL	K	AIC_c	ΔAIC_c	$\sum w_i$
					-132.89	5	275.97	6.60	0.872
	1.14 (1.20)				-131.87	6	276.01	6.64	0.873
	1.18 (1.20)				-131.87	6	276.02	6.65	0.875
					-134.98	3	276.04	6.67	0.876
					-131.91	6	276.08	6.71	0.877
-0.01 (0.01)		1.10 (0.63)			-131.93	6	276.13	6.76	0.879
					-132.98	5	276.15	6.78	0.880
		0.84 (0.59)			-134.03	4	276.19	6.82	0.881
		0.53 (0.60)			-131.98	6	276.24	6.87	0.883
			-2.13 (3.28)		-131.98	6	276.24	6.87	0.884
	1.50 (1.21)	1.27 (0.63)			-132.01	6	276.29	6.93	0.885
-0.01 (0.01)		0.55 (0.62)			-132.02	6	276.30	6.94	0.887
-0.01 (0.01)					-134.10	4	276.32	6.96	0.888
	2.35 (1.13)				-133.07	5	276.33	6.97	0.889
				-7.66 (31.01)	-133.07	5	276.34	6.97	0.890
	1.18 (1.19)		-3.22 (3.24)		-132.05	6	276.37	7.00	0.891
-0.01 (0.01)	1.03 (1.22)				-132.05	6	276.38	7.01	0.893
			-2.29 (3.13)		-132.06	6	276.38	7.01	0.894
	2.38 (1.15)				-132.06	6	276.39	7.03	0.895
				-20.43 (31.86)	-132.08	6	276.42	7.05	0.896
		0.60 (0.63)	-3.43 (3.28)		-132.08	6	276.43	7.06	0.897
		0.46 (0.64)			-132.09	6	276.44	7.07	0.899
	1.36 (1.21)	0.92 (0.60)			-132.11	6	276.48	7.12	0.900
				-13.41 (31.96)	-132.12	6	276.51	7.15	0.901

within shrubland regions with small elevation gradients found that least chipmunks were sensitive to fragmentation and loss of sagebrush habitat and may be eliminated from landscapes without sagebrush cover (Reynolds 1980, Parmenter and MacMahon 1983) or were absent in sagebrush patches isolated by >450 m in Idaho (Hanser and Huntly 2006). Least chipmunks were absent from grasslands in Oregon and Utah (Feldhamer 1979; Smith and Urness 1984), which corroborates our results. Conversely, in southeast Oregon they were only found in sagebrush and greasewood (*Sarcobatus vermiculatus*) communities (Feldhamer 1979). In addition, least chipmunk predation on passerine nests in Washington was more than twice as common in a continuous shrub steppe community as in a landscape fragmented by agriculture (Vander Haegen et al. 2002), suggesting greater abundance of this species in contiguous habitats. In Utah, least chipmunk abundance was lower in edge habitat between grassland and sagebrush when compared to contiguous sagebrush (Smith and Urness 1984). Mixed shrublands generally represented areas of low productivity and therefore may not

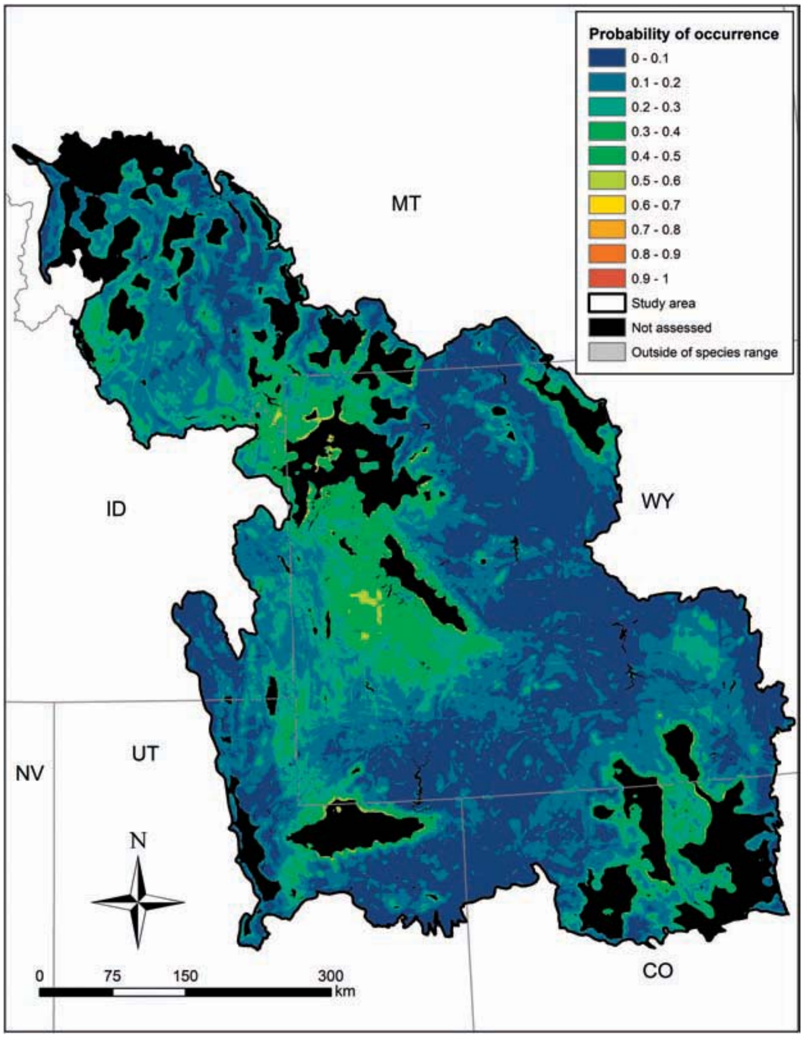

FIG. 7.19. Least chipmunk probability of occurrence in the Wyoming Basins Ecoregional Assessment area. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water). Least chipmunks are likely to occur in areas with probability > 0.18.

have the resources necessary to maintain populations of least chipmunks.

Abiotic factors, including temperature, topographic ruggedness, solar radiation, and soil sand content, also influenced the occurrence of least chipmunks. Least chipmunks are commonly associated with rocky habitats at higher elevations and have been recorded above tree line in Colorado and up to 2,745 m in Oregon (Verts and Carraway 2001). High-elevation habitats have lower minimum temperatures than habitats at low elevation; this relationship is potentially leading to the association of least chipmunks with cooler temperatures in the WBEA area. Minimum temperature (rather than elevation, even though both were evaluated) was an important factor explaining least chipmunk occurrence. Temperature models used in our study were based on additional factors, such as aspect and top-

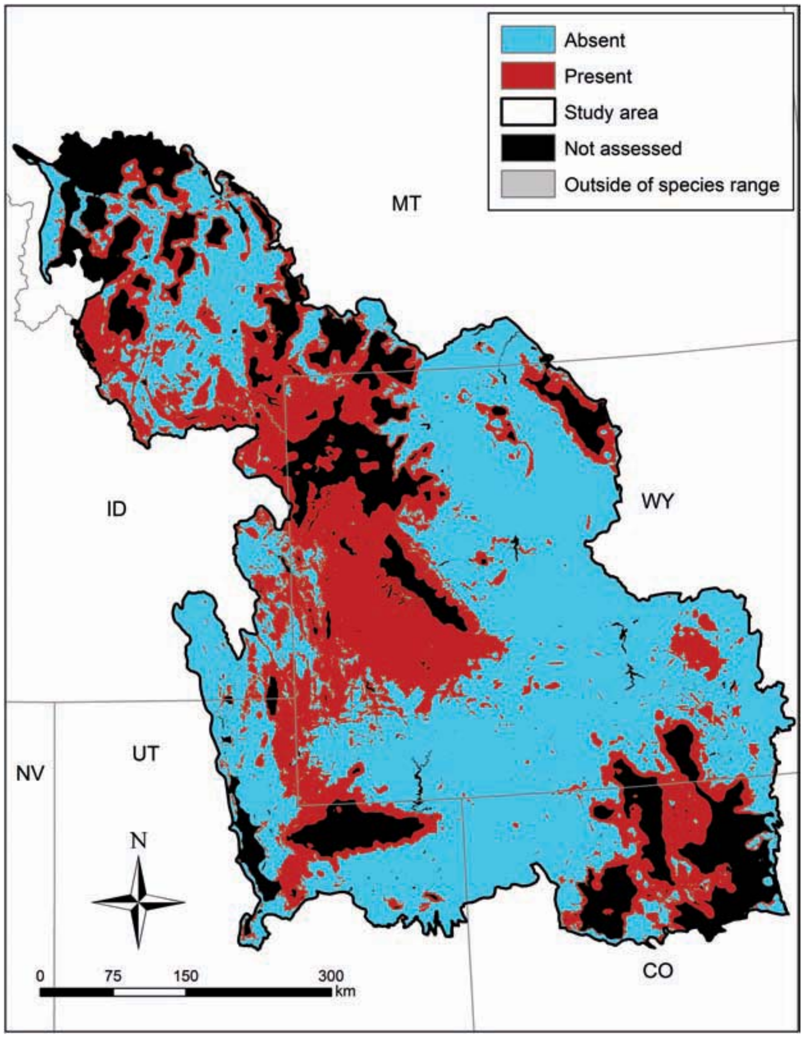

FIG. 7.20. Distribution of least chipmunks in the Wyoming Basins Ecoregional Assessment area based on an optimum probability cutoff threshold of 0.18. Black areas are outside the inference of our models (<3% sagebrush within 5 km or within a body of water).

ographic position. Within a large-scale context, least chipmunks in the WBEA were negatively associated with increased topographic ruggedness. In Colorado, least chipmunks are the only *Tamias* species to occupy level, non-rocky shrubland habitats (Bergstrom and Hoffmann 1991). However, on a local scale, least chipmunks can be numerous on cliffs (Ward and Anderson 1988). Least chipmunk density in Oregon was positively correlated with soil depth and proportion of clay (Feldhamer 1979). Although we did not find a similar relationship with clay soils, clay content is negatively correlated with sand content, for which occurrence of least chipmunks was negatively correlated.

Our results linking anthropogenic factors to least chipmunk occurrence were perplexing. Least chipmunk occurrence was negatively associated with proximity to pipelines. But we also found posi-

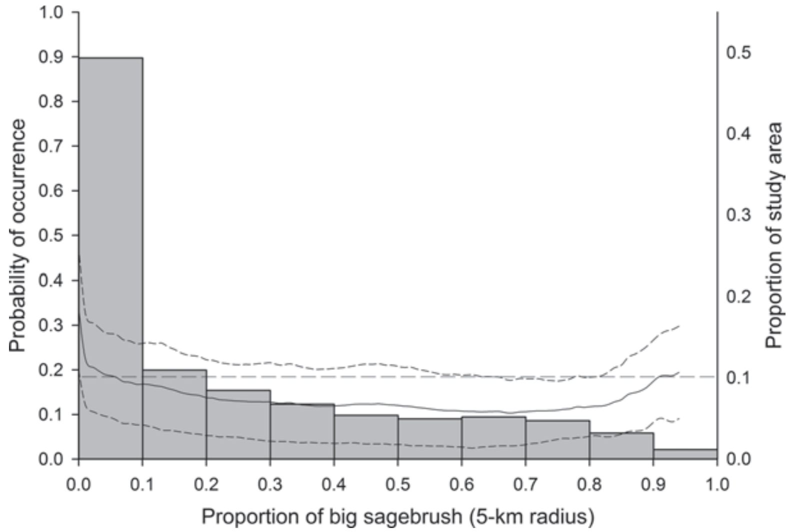

FIG. 7.21. Distribution of least chipmunk probability of occurrence in the Wyoming Basins Ecoregional Assessment area in relation to proportion of big sagebrush (*Artemisia tridentata* spp. *tridentata*, *A. t.* spp. *wyomingensis*) within a 5-km radius. Mean probability of occurrence (black line, ± 1 SD [dashed lines]) values were calculated in each one percent increment of big sagebrush within a 5-km radius moving window. Range of predictions relate to the observed range of sagebrush at study site locations. The dashed horizontal line represents the optimal cutoff threshold (0.18), above which occurrence is predicted. Histogram values represent proportion of the total study area in each 10% segment of big sagebrush within 5 km.

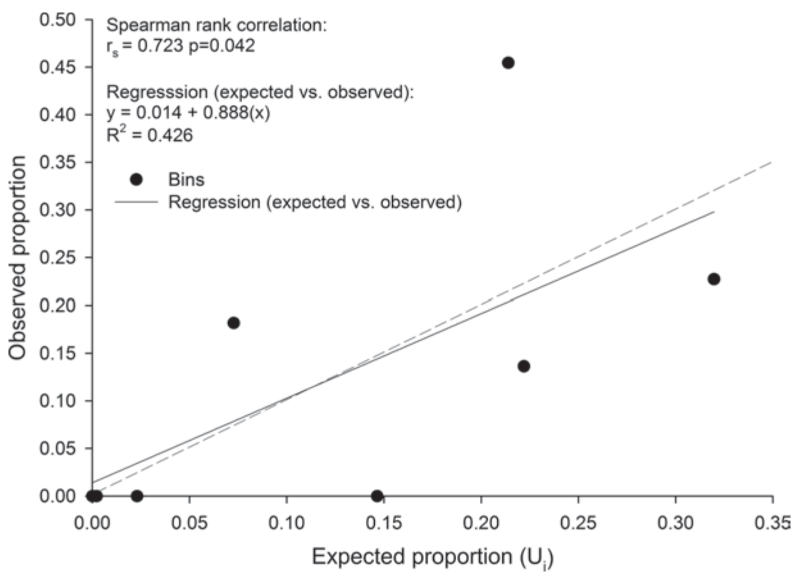

FIG. 7.22. Validation results for short-horned lizard occurrence model in the Wyoming Basins Ecoregional Assessment area. Based on the distribution of values in the probability of occurrence map, we compared expected versus the observed proportion of 22 independent short-horned lizard occurrence locations in 10% probability bins. The fitted regression is shown as a solid line; points represent the location of individual probability of occurrence bins; the dashed line is the 1:1 perfect fit line. Spearman rank correlation and regression metrics are provided.

tive associations between least chipmunk occurrence and proximity to interstates and highways, power lines, and oil and gas wells although error estimates for these coefficients were quite large and indicated weak relationships. We expected negative associations with these factors due to the disturbance associated with these types of development, the clearing of rights-of-way, the resulting lack of shrub cover, and the increased predation risk in the vicinity of these features and their associated infrastructure (Knight and Kawashima 1993, Steenhof et al. 1993, Booth and Cox 2009). Alternatively, interstates and highways, power lines, and oil and gas wells may be a surrogate for low topographic ruggedness; a factor that was positively related to least chipmunk occurrence.

CONCLUSIONS

The majority of species examined in the WBEA area had positive relationships between probability of occurrence and the quantity or configuration of sagebrush habitats across scales ranging from local to large spatial extents (0.27 km–18 km). This highlights the importance of sagebrush and sagebrush habitats to the integrity of insect, reptile, and mammal populations and the wildlife community. Human disturbance also affected the occurrence of sagebrush-dependent species. Although land use or construction of human infrastructure leads to direct loss of sagebrush habitat, the influence of human disturbance, or ecological footprint (Leu et al. 2008), extends beyond the physical extent of the feature. Our results in the WBEA area help to increase our understanding of how individual species respond to different habitats and individual human disturbances. This information will therefore help inform regional management plans and decisions regarding rights-of-way, such as buffer distances around infrastructure projects. We caution that our models of species occurrence represent an initial exploratory effort and that further examination of population processes is necessary in order to determine the mechanisms influencing occupancy and abundance patterns.

LITERATURE CITED

BATTIN, J. 2004. When good animals love bad habitats: ecological traps and the conservation of animal populations. Conservation Biology 18:1482–1491.

BEATTIE, A. J., AND D. C. CULVER. 1977. Effects of the mound nests of the ant, *Formica obscuripes*, on the surrounding vegetation. American Midland Naturalist 97:390–399.

BEEVER, E. A., AND J. E. HERRICK. 2006. Effects of feral horses in Great Basin landscapes on soils and ants: direct and indirect mechanisms. Journal of Arid Environments 66:96–112.

BENTON, T. G., D. M. BRYANT, L. COLE, AND H. Q. P. CRICK. 2002. Linking agricultural practice to insect and bird populations: a historical study over three decades. Journal of Applied Ecology 39:673–687.

BERGSTROM, B. J., AND R. S. HOFFMANN. 1991. Distribution and diagnosis of three species of chipmunks (*Tamias*) in the front range of Colorado. Southwestern Naturalist 36:14–28.

BLOM, P. E., W. H. CLAR, AND J. B. JOHNSON. 1991. Colony densities of the seed harvesting ant *Pogonomyrmex salinus* (Hymenoptera: Formicidae) in seven plant communities on the Idaho National Engineering Laboratory. Journal of the Idaho Academy of Science 27:28–36.

BOOTH, D., AND S. COX. 2009. Dual-camera, high-resolution aerial assessment of pipeline revegetation. Environmental Monitoring and Assessment 158:23–33.

BURNHAM, K. P., AND D. R. ANDERSON. 2002. Model selection and multimodel inference: a practical information-theoretic approach. Second edition. Springer-Verlag, New York, NY.

CARLSON, S. R., AND W. G. WHITFORD. 1991. Ant mound influence on vegetation and soils in a semiarid mountain ecosystem. American Midland Naturalist 126:125–139.

COFFIN, D. P., AND W. K. LAUENROTH. 1990. Vegetation associated with nest sites of western harvester ants (*Pogonomyrex occidentalis* Cresson) in a semiarid grassland. American Midland Naturalist 123:226–235.

COLE, A. C., JR. 1932a. The relation of the ant, *Pogonomyrmex Occidentalis* Cr., to its habitat. Ohio Journal of Science 32:133–146.

COLE, A. C., JR. 1932b. The thatching ant, *Formica obscuripes* Forel. Psyche 39:30–33.

CRIST, T. O., AND J. A. MACMAHON. 1992. Harvester ant foraging and shrub-steppe seeds: interactions of seed resources and seed use. Ecology 73:1768–1779.

DALQUEST, W.W. 1948. Mammals of Washington. University of Kansas Publishing, Museum of Natural History 2:l–444.

DECALESTA, D. S. 1979. Spring and summer foods of Audubon's cottontail rabbit (*Sylvilagus audubonii*) in north-central Colorado. Southwestern Naturalist 24:549–553.

DEMERS, M. N. 1993. Roadside ditches as corridors for range expansion of the western harvester ant (*Pogonomyrmex occidentalis* Cresson). Landscape Ecology 8:93–102.

DILLER, L. V., AND D. R. JOHNSON. 1982. Ecology of reptiles in the Snake River Birds of Prey Area. U.S. Bureau of Land Management, Boise, ID.

DOBKIN, D. S., AND J. S. SAUDER. 2004. Shrubsteppe landscapes in jeopardy. Distributions, abundances, and the uncertain future of birds and small mammals in the Intermountain West. High Desert Ecological Research Institute, Bend, OR.

DOBLER, F. C., AND K. R. DIXON. 1990. The pygmy rabbit *Brachylagus idahoensis.* Pages 111–115 *in* J. A. Chapman and J. E. C. Flux (editors). Rabbits, hares, and pikas. Status survey and conservation action. International Union for Conservation of Nature and Natural Resources, Gland, CH.

DWERNYCHUK, L. W., AND D. A. BOAG. 1972. Ducks nesting in association with gulls: an ecological trap? Canadian Journal of Zoology 50:559–563.

ENGEL, K. A., L. S. YOUNG, K. STEENHOF, J. A. ROPPE, AND M. N. KOCHERT. 1992. Communal roosting of common ravens in southwestern Idaho. Wilson Bulletin 104:105–121.

ESRI. 2006. ArcMap version 9.2. Environmental Systems Research Institute, Inc., Redlands, CA.

FELDHAMER, G. A. 1979. Vegetative and edaphic factors affecting abundance and distribution of small mammals in southeast Oregon. Great Basin Naturalist 39:207–218.

FITZNER, R. E., K. A. GANO, W. H. RICKARD, AND L. E. ROGERS. 1979. Characterization of the Hanford 300 area burial grounds. Task IV. Biological transport, p. 86. Battelle Pacific Northwest Laboratory, Richland, WA.

FLINDERS, J. T., AND R. M. HANSEN. 1973. Abundance and dispersion of leporids within a shortgrass ecosystem. Journal of Mammalogy 54:287–291.

GABLER, K. I., J. W. LAUNDRÉ, AND L. T. HEADY. 2000. Predicting the suitability of habitat in southeast Idaho for pygmy rabbits. Journal of Wildlife Management 64:759–764.

GERMAINE, S. S., AND B. F. WAKELING. 2001. Lizard species distributions in habitat occupation along an urban gradient in Tucson, Arizona, USA. Biological Conservation 97:229–237.

GRANT, C. V. 1986. Wildlife distribution and abundance on the Utah oil shale tracts 1975–1984. Great Basin Naturalist 46:469–507.

GRABOWSKI, J. H. 2004. Habitat complexity disrupts predator–prey interactions but not the trophic cascade on oyster reefs. Ecology 85:995–1004.

GREEN, J. S., AND J. T. FLINDERS. 1980a. *Brachylagus idahoensis*. Mammal Species 125:1–4.

GUYER, C., AND A. D. LINDER. 1985. Thermal ecology and activity patterns of the short–horned lizard (*Phrynosoma douglassi*) and the sagebrush lizard (*Sceloporus graciosus*) in southeastern Idaho. Great Basin Naturalist 45:607–614.

HANSEN, R. M., AND I. K. GOLD. 1977. Blacktail prairie dogs, desert cottontails and cattle trophic relations on shortgrass range. Journal of Range Management 30:210–214.

HANSER, S. E., C. L. ALDRIDGE, M. LEU, AND S.E. NIELSEN. 2011. Dose Response Calculator for ArcGIS. United States Geological Survey Data Series 631. <http://pubs.usgs.gov/ds/631/> (20 September 2011).

HANSER, S. E., AND N. J. HUNTLY. 2006. The biogeography of small mammals of fragmented sagebrush-steppe landscapes. Journal of Mammalogy 87:1165–1174.

HIMES, J. G. AND P. J. DROHAN. 2007. Distribution and habitat selection of the pygmy rabbit, *Brachylagus idahoensis*, in Nevada (USA). Journal of Arid Environments 68:371–382.

HOSMER, D. W., AND S. LEMESHOW. 2000. Applied logistic regression, Second edition. John Wiley and Sons Inc., New York, NY.

JACKSON, H. H. T. 1961. Mammals of Wisconsin. University of Wisconsin Press, Madison, WI.

JAMES, J. D. 2004. Status of the short-horned lizard (*Phrynosoma hernandesi)* in Alberta: update 2004. Alberta Sustainable Resource Development, Fish and Wildlife Division, and Alberta Conservation Association, Wildlife Status Report No. 5 (Update 2004), Edmonton, AB.

JOHNSON, C. J., S. E. NIELSEN, E. H. MERRILL, T. L. MCDONALD, AND M. S. BOYCE. 2006. Resource selection functions based on use-availability data: theoretical motivation and evaluation methods. Journal of Wildlife Management 70:347–357.

JOHNSTON, R. F. 2001. Synanthropic birds of North America. Pp. 49–67 *in* J. M. Marzluff, R. Bowman, and R. Donnelly (editors). Avian ecology and conservation in an urbanizing world. Kluwer Academic, Boston, MA.

JONES, C. G., J. H. LAWTON, AND M. SHACHAK. 1994. Organisms as ecosystem engineers. Oikos 69:373–386.

KIM, B. 1987. *Lepus townsendii*. Mammalian Species 288:1–6.

KNICK, S. T., D. S. DOBKIN, J. T. ROTENBERRY, M. A. SCHROEDER, W. M. VANDER HAEGEN, AND C. VAN RIPER. 2003. Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. Condor 105:611–634.

KNIGHT, R. L., AND J. Y. KAWASHIMA. 1993. Responses of raven and red-tailed hawk populations to linear right-of-ways. Journal of Wildlife Management 57:266–271.

LAVIGNE, R. J. 1969. Bionomics and nest structure of *Pogonomyrmex occidentalis* (Hymenoptera: Formicidae). Annals of the Entomological Society of America 62:1166–1175.

LEU, M., S. E. HANSER, AND S. T. KNICK. 2008. The human footprint in the west: a large-scale analysis of anthropogenic impacts. Ecological Applications 18:1119–1139.

LIU, C., P. M. BERRY, T. P. DAWSON, R. G. PEARSON. 2005. Selecting thresholds of occurrence in the prediction of species distributions. Ecography 28:385–393.

MACCRACKEN, J. G., AND R. M. HANSEN. 1984. Seasonal foods of blacktail jackrabbits and Nuttall cottontails in southeastern Idaho. Journal of Range Management 37:256–259.

MANDEL, R. D., AND C. J. SORENSON. 1982. The role of the western harvester ant (*Pogonomyrmex occidentalis*) in soil formation. Soil Science Society of America Journal 46:785–788.

MARZLUFF, J. M., S. T. KNICK, M. S. VEKASY, L. S. SCHUECK, AND T. J. ZARRIELLO. 1997. Spatial use and habitat selection of golden eagles in southwestern Idaho. Auk 114:673–687.

MCADOO, J. K., G. N. BACK, M. R. BARRINGTON, D. A. KLEBENOW. 1986. Wildlife use of lowland meadows in the Great Basin. Transactions North American Wildlife and Natural Resources Conference 51:310–319.

MCGAHAN, J. 1967. Quantified estimates of predation by a golden eagle population. Journal of Wildlife Management 31:496–501.

MCIVER, J. D., T. R. TORGERSEN, AND N. J. CIMON. 1997. A supercolony of the thatch ant *Formica obscuripes* Forel (Hymenoptera Formicidae) from the Blue Mountains of Oregon. Northwest Science 71:18–29.

MCIVER, J. D., AND K. YANDELL. 1998. Honeydew harvest in the western thatching ant (Hymenoptera: Formicidae). American Entomologist 44:30–35.

METZ, C. E. 1978. Basic principles of ROC analysis. Seminars in Nuclear Medicine 8:283–298.

MONTANUCCI, R. R. 1981. Habitat separation between *Phrynosoma douglassi* and *P. or-*

biculare (Lacertilia: Iguanidae) in Mexico. Copeia 1:147–153.

MontBlanc, E. M., J. C. Chambers, and P. F. Brussard. 2007. Variation in ant populations with elevation, tree cover, and fire in a pinyon-juniper-dominated watershed. Western North American Naturalist 67:469–491.

Mull, J. F., and J. A. MacMahon. 1996. Factors determining the spatial variability of seed densities in a shrub-steppe ecosystem: the role of harvester ants. Journal of Arid Environments 32:181–192.

Nielsen, S. E., R. H. M. Munro, E. L. Bainbridge, G. B. Stenhouse, and M. S. Boyce. 2004. Grizzly bears and forestry II. Distribution of grizzly bear foods in clearcuts of west-central Alberta, Canada. Forest Ecology and Management 199:67–82.

Paige, C., and S. A. Ritter. 1999. Birds in a sagebrush sea: managing sagebrush habitats for bird communities. Partners in Flight Western Working Group, Boise, ID.

Parmenter, R. R., and J. A. MacMahon. 1983. Factors determining the abundance and distribution of rodents in a shrub-steppe ecosystem: the role of shrubs. Oecologia 59:145–156.

Patterson, B. D., G. Ceballos, W. Sechrest, M. F. Tognelli, T. Brooks, L. Luna, P. Ortega, I. Salazar, and B. E. Young. 2003. Digital distribution maps of the mammals of the western hemisphere, version 1.0. NatureServe, Arlington, VA.

Pianka, E. R., and W. S. Parker. 1975. Ecology of horned lizards: a review with special reference to *Phrynosoma platyrhinos*. Copiea 1:141–162.

Powell, G. L., and A. P. Russell. 1985. Field thermal ecology of the eastern short-horned lizard (*Phrynosoma douglassii brevirostre*) in southeastern Alberta. Canadian Journal of Zoology 63:228–238.

Powell, G. L., and A. P. Russell. 1998a. The diet of the eastern short-horned lizard (*Phrynosoma douglassi brevirostre*) in Alberta and its relationship to sexual size dimorphism. Canadian Journal of Zoology 62:428–440.

Powell, G. L., and A. P. Russell. 1998b. The status of short-horned lizards, *Phrynosoma douglasi* and *P. hernandezi*, in Canada. Canadian Field Naturalist 112:1–16.

Powell, G. L., A. P. Russell, and P. J. Fargey. 1998. The distribution of the short-horned lizard *Phrynosoma hernandezi* in Saskatchewan. Northwestern Naturalist 79:19–26.

Purcell, M. J. 2006. Pygmy rabbit (*Brachylagus idahoensis*) distribution and habitat selection in Wyoming. M.S. Thesis, University of Wyoming, Laramie, WY.

Rachlow, J. L., and L. K. Svancara. 2003. Pygmy rabbit in Idaho. Project Completion Report. University of Idaho, Moscow, ID.

Rachlow, J. L., and L. K. Svancara. 2006. Prioritizing habitat for surveys of an uncommon mammal: a modeling approach applied to pygmy rabbits. Journal of Mammalogy 87:827–833.

Reynolds, T. D. 1979. Response of reptile populations to different land management practices on the Idaho National Engineering Laboratory site. Great Basin Naturalist 39:255–262.

Reynolds, T. D. 1980. Effects of some different land management practices on small mammal populations. Journal of Mammalogy 61:558–561.

Risch, A. C., M. F. Jurgensen, A. J. Storer, M. D. Hyslop, and M. Schütz. 2008. Abundance and distribution of organic mound-building ants of the *Formica rufa* group in Yellowstone National Park. Journal of Applied Entomology 132:326–336.

Rogers, L. E. 1974. Foraging activity of the western harvester ant in the shortgrass plains ecosystem. Environmental Entomology 3:420–424.

Rogowitz, G. L. 1997. Locomotor and foraging activity of the white-tailed jackrabbit (*Lepus townsendii*). Journal of Mammalogy 78:1172–1181.

Schroeder, M. A., C. L. Aldridge, A. D. Apa, J. R. Bohne, C. E. Braun, S. D. Bunnell, J. W. Connelly, P. A. Deibert, S. C. Gardner, M. A. Hilliard, G. D. Kobriger, S. M. McAdam, C. W. McCarthy, J. J. McCarthy, D. L. Mitchell, E. V. Rickerson, and S. J. Stiver. 2004. Distribution of sage-grouse in North America. Condor 106:363–376.

Sherbrooke, W. C. 2003. Introduction to horned lizards of North America. California Natural History Guides No. 64. University of California Press, Berkeley, CA.

Sharp, L. A., and W. F. Barr. 1960. Preliminary investigations of harvester ants on southern Idaho rangelands. Journal of Range Management 13:131–134.

Smith, C. B., and P. J. Urness. 1984. Small mammal abundance on native and improved foothill ranges, Utah. Journal of Range Management 37:353–357.

Sneva, F. A. 1979. The western harvester ants: their density and hill size in relation to herbaceous productivity and big sagebrush cover. Journal of Range Management 32:46–47.

Soule, P. T., and P. A. Knapp. 1996. The influence of vegetation removal by western harvester ants (*Pogonomyrmex owyheei*) in a relict area of sagebrush-steppe in central Oregon. American Midland Naturalist 136:336–345.

Svihla, R. D. 1931. Mammals of the Uinta Mountain region. Journal of Mammalogy 12:256–266.

Steenhof, K., M. N. Kochert, and J. A. Roppe. 1993. Nesting by raptors and common ravens on electrical transmission line towers. Journal of Wildlife Management 57:271–281.

Suarez, A. V., and T. J. Case. 2002. Bottom-up effects on persistence of a specialist predator: ant invasions and horned lizards. Ecological Applications 12:291–298.

Thomas, L., J. L. Laake , S. Strindberg, F. F. C. Marques, S. T. Buckland, D. L. Borchers, D. R. Anderson, K. P. Burnham, S. L. Hedley, J. H. Pollard, J. R. B. Bishop, and T. A. Marques. 2006. Distance 5.0, Release 2. Research Unit for Wildlife Population Assessment, University of St. Andrews, UK. <http://www.ruwpa.st-and.ac.uk/distance/> (20 September 2011).

Turkowski, F. J. 1975. Dietary adaptability of the desert cottontail. Journal of Wildlife Management 39:748–756.

Ulmschneider, H., D. Hays, H. Roberts, J. Rachlow, T. Forbes, J. Himes, E. Sequin, M. Haworth, T. Katzner, A. Kozlowski, R. Rauscher, and P. Laruidson. 2004. Surveying for pygmy rabbits (*Brachylagus idahoensis*). BLM Technical Report, Fourth Draft – June 3, 2004. 21 pp.

U.S. Department of the Interior. 2002. BLM Wyoming sensitive species policy and list, September 20, 2002. U.S. Bureau of Land Management. <http://www.blm.gov/pgdata/etc/medialib/blm/wy/wildlife.Par.9226.File.dat/02species.pdf> (20 September 2011).

U.S. Department of the Interior. 2003. Endangered and threatened wildlife and plants; final rule to list the Columbia Basin distinct population segment of the pygmy rabbit (*Brachylagus idahoensis*) as endangered. Federal Register 68:59733–59749.

U.S. Department of the Interior. 2005a. Endangered and threatened wildlife and plants; 90-day finding on a petition to list the pygmy rabbit as threatened or endangered. Federal Register 70:29253–29265.

U.S. Department of the Interior. 2005b. Endangered and threatened wildlife and plants; 12-month finding for petitions to list the greater sage-grouse as threatened or endangered; Proposed rule. Federal Register 70:2243–2282.

U.S. Department of the Interior. 2008. Endangered and threatened wildlife and plants; 90-day finding on a petition to list the pygmy rabbit as threatened or endangered. Federal Register 73:1312–1313.

U.S. Department of the Interior. 2010. Endangered and threatened wildlife and plants; 12-month findings for petitions to list the greater sage- grouse (*Centrocercus urophasianus*) as threatened or endangered. Federal Register 74:13910–14014.

Vander Haegen, W. M., M. A. Schroeder, and R. M. DeGraaf. 2002. Predation on real and artificial nests in shrubsteppe landscapes fragmented by agriculture. Condor 104:496–506.

Verts, B. J., and L. N. Carraway. 2001. *Tamias minimus*. Mammalian Species 653:1–10.

Ward, J. P., and S. H. Anderson. 1988. Influences of cliffs on wildlife communities in southcentral Wyoming. Journal of Wildlife Management 52:673–678.

Weber, N. A. 1935. The biology of the thatching ant, *Formica rufa obscuripes* Forel, in North Dakota. Ecological Monographs 5:165–206.

WERSCHKUL, D. F. 1982. Species-habitat relationships in an Oregon cold desert lizard community. Great Basin Naturalist 42:380–384.

WHEELER, G. C., AND J. WHEELER. 1988. A checklist of ants of Wyoming (Hymenoptera: Formicidae). Insecta Mundi 2:231–239.

WHITFORD, W. G. 1978. Foraging in seed-harvester ants *Pogonomyrmex* spp. Ecology 59:185–189.

WILLARD, J. R., AND H. H. CROWELL. 1965. Biological activities of the harvester ant, *Pogonomyrmex owyheei*, in central Oregon. Journal of Economic Entomology 58:484–489.

WILLIAMS, R. 2006. Generalized ordered logit/partial proportional odds models for ordinal dependent variables. The Stata Journal 6:58–82.

WISDOM, M. J., M. M. ROWLAND, AND L. H. SURING (EDITORS). 2005. Habitat threats in the sagebrush ecosystem: methods of regional assessment and applications in the Great Basin. Alliance Communications Group, Lawrence, KS.

APPENDIX 7.1

Descriptive statistics for explanatory variables used to model harvester ant occurrence. Variables are summarized by occurrence class, and statistics include mean ($\bar{x}$), standard error (SE), lower (L95) and upper (U95) 95% confidence interval, and minimum and maximum value. This appendix is archived electronically and can be downloaded at the following URL: http://sagemap.wr.usgs.gov/wbea.aspx.

APPENDIX 7.2

Descriptive statistics for explanatory variables used to model thatch ant occurrence. Variables are summarized by occurrence class, and statistics include mean ($\bar{x}$), standard error (SE), lower (L95) and upper (U95) 95% confidence interval, and minimum and maximum value. This appendix is archived electronically and can be downloaded at the following URL: http://sagemap.wr.usgs.gov/wbea.aspx.

APPENDIX 7.3

Descriptive statistics for explanatory variables used to model short-horned lizard occurrence. Variables are summarized by occurrence class, and statistics include mean ($\bar{x}$), standard error (SE), lower (L95) and upper (U95) 95% confidence interval, and minimum and maximum value. This appendix is archived electronically and can be downloaded at the following URL: http://sagemap.wr.usgs.gov/wbea.aspx.

APPENDIX 7.4

Descriptive statistics for explanatory variables used to model white-tailed jackrabbit occurrence. Variables are summarized by occurrence class, and statistics include mean ($\bar{x}$), standard error (SE), lower (L95) and upper (U95) 95% confidence interval, and minimum and maximum value. This appendix is archived electronically and can be downloaded at the following URL: http://sagemap.wr.usgs.gov/wbea.aspx.

APPENDIX 7.5

Descriptive statistics for explanatory variables used to model cottontail occurrence. Variables are summarized by occurrence class, and statistics include mean ($\bar{x}$), standard error (SE), lower (L95) and upper (U95) 95% confidence interval, and minimum and maximum value. This appendix is archived electronically and can be downloaded at the following URL: http://sagemap.wr.usgs.gov/wbea.aspx.

APPENDIX 7.6

Descriptive statistics for explanatory variables used to model least chipmunk occurrence. Variables are summarized by occurrence class, and statistics include mean ($\bar{x}$), standard error (SE), lower (L95) and upper (U95) 95% confidence interval, and minimum and maximum value. This appendix is archived electronically and can be downloaded at the following URL: http://sagemap.wr.usgs.gov/wbea.aspx.