Lark Bunting Distribution Modeling

Scientific Name: *Calamospiza melanocorys*
Distribution Status: Migratory Summer Breeder
State Rank: S4B
Global Rank: G5

Inductive Modeling

Model Created By: Joy Ritter
Model Creation Date: May 14, 2012
Model Evaluators: Bryce Maxell and Joy Ritter
Model Goal: Inductive models will predict the distribution and relative suitability of breeding habitats at large spatial scales across the species' known breeding range in Montana.

Inductive Modeling Methods

Model Data and Species Range Information:

Location Data Source	Montana Natural Heritage Program Point Observation Database
Total Number of Records	8237
Location Data Selection Rule 1	Spatially unique records associated with breeding activity with <=1600 meters of locational uncertainty
No. Locations Meeting Selection Rule 1	3500
Location Data Selection Rule 2	No overlap in locations when buffered by the associated locational uncertainty in order to avoid spatial autocorrelation.
No. Locations Meeting Selection Rule 2	2194
Season Modeled	Summer Breeding
No. Model Train Locations	1645
No. Model Test Locations	549
No. Model Background Locations	47,301
Area of Species Range in State (Percent of Montana)	300,262 km^2 (78.9)

Environmental layer information:

Layer	Identifier	Description
Aspect	CONTEWASP CONTNSASP	Continuous measure of east to west aspect Continuous measure of north to south aspect
Bias	BIAS	Categorical layer representing potential underlying biases inherent in the observation database as a result of proximity to roads and public lands
Elevation	CONTELEV	Continuous elevation in meters form the National Elevation Dataset
Geology	CATSDEGEOL	Categorical surficial geology - 931 categories
Land Cover	CATESYS	Categorical Level 2 Montana land cover framework with roads removed – 27 categories
Max Temp	CONTTMAX	Continuous estimated average maximum daily July temperature in degrees Fahrenheit for 1971-2000
Min Temp	CONTTMIN	Continuous estimated average minimum daily January temperature in degrees Fahrenheit for 1971 -2000
Precipitation	CONTPRECIP	Continuous annual precipitation in 1cm intervals
Slope	CONTSLOPE	Continuous degrees of slope
Soil Temp	CATSOILTMP	Categorical soil temperature and moisture regimes – 12 categories
Stream Dist	CONTSTRMED	Continuous Euclidean distance from major streams in 1-meter intervals

Maxent Model Input String:

Range wide

java –mx2048m –jar c:\MaxEnt\maxent.jar -a -z nowarnings noprefixes -P -J -o U:\IndSpecies\Cala_mela\2012_05_14\RangeOut -s U:\IndSpecies\Cala_mela\2012_05_14\Cala_mela_train.csv -T U:\IndSpecies\Cala_mela\2012_05_14\Cala_mela_test.csv -e I:\modelingSecondRoundInputLayers nowriteclampgrid nowritemess maximumbackground=47304 writebackgroundpredictions noextrapolate nodoclamp -N CONTVRM -t BIAS -t CATESYS -t CATSDEGEOL -t CATSOILTMP

Statewide

java –mx2048m –jar c:\MaxEnt\maxent.jar -a -z nowarnings noprefixes -P -J -o U:\IndSpecies\Cala_mela\2012_05_14\StateOut -s U:\IndSpecies\Cala_mela\2012_05_14\Cala_mela_train.csv -T U:\IndSpecies\Cala_mela\2012_05_14\Cala_mela_test.csv -e I:\modelingSecondRoundInputLayers nowriteclampgrid nowritemess maximumbackground=60000 writebackgroundpredictions noextrapolate nodoclamp -N CONTVRM -t BIAS -t CATESYS -t CATSDEGEOL -t CATSOILTMP

Inductive Model Evaluation

Model Performance:

Model appears to adequately reflect the distribution of Lark Bunting nesting habitat across Montana. Evaluation metrics suggest a good model fit (see table of evaluation metrics). The presence of Bias as a significant predictor variable suggests that survey efforts may be biased towards roads and public lands.

Top contributing layers:

Variable	Percent Contribution	Permutation Importance
BIAS	23.8	16
CATSDEGEOL	22.5	9.2
CONTSLOPE	14.8	26
CATSOILTMP	11.3	8.9
CONTELEV	10.6	10.7
CATESYS	9	15.6

Evaluation metrics:

Metric	Value
Low Logistic Threshold[a]	0.08
Area of predicted low suitability habitat within species' range	119,077 km^2
Medium Logistic Threshold[b]	0.32
Area of moderate suitability habitat within species' range	46,785 km^2
Optimal Logistic Threshold[c]	0.72
Area of predicted optimal habitat within species' range	4,871 km^2
Total area of predicted suitable habitat within species' range	170,733 km^2
Absolute validation index (AVI)[d]	0.96
Avg Deviance (X +/- SD)[e]	1.75 +/- 1.51
Training AUC[f]	0.869
Test AUC[g]	0.852

a. The logistic threshold between unsuitable and low suitable as determined by Maxent which balances training data omission error rates with predicted area.
b. The logistic threshold value where the percentage of observations above the threshold is what would be expected if the observations were randomly distributed across logistic value classes. This is equivalent to a null model.
c. The logistic threshold where the percentage of observations above the threshold is 10 times higher than would be expected if the observations were randomly distributed across logistic value classes.
d. The proportion of test locations that fall above the low logistic threshold.
e. A measure of how well model output matched the location of test observations. In theory, everywhere a test location was located, the logistic value should have been 1.0. The deviance value for each test location is calculated as 2 times the natural log of the associated logistic output value. Deviance values vary from 0, when test observations are associated with a logistic value of 1, to around 13.8, when logistic values approach 0.001. Deviances for individual test locations are plotted in Figure 3.
f. The area under a curve obtained by plotting the true positive rate against 1 minus the false positive rate for model training observations. Values range from 0 to 1 with a random or null model performing at a value of 0.5.
g. The same metric described in f, but calculated for test observations.

Inductive Modeling Map Outputs

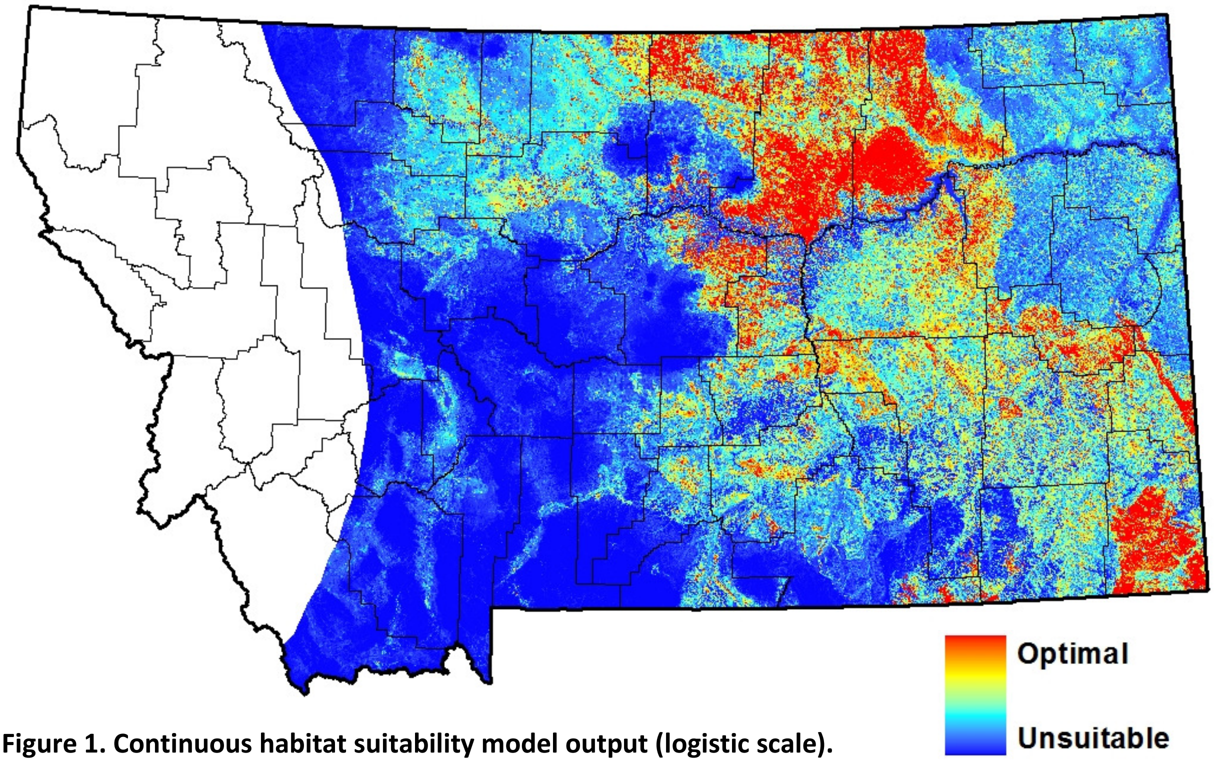

Figure 1. Continuous habitat suitability model output (logistic scale).

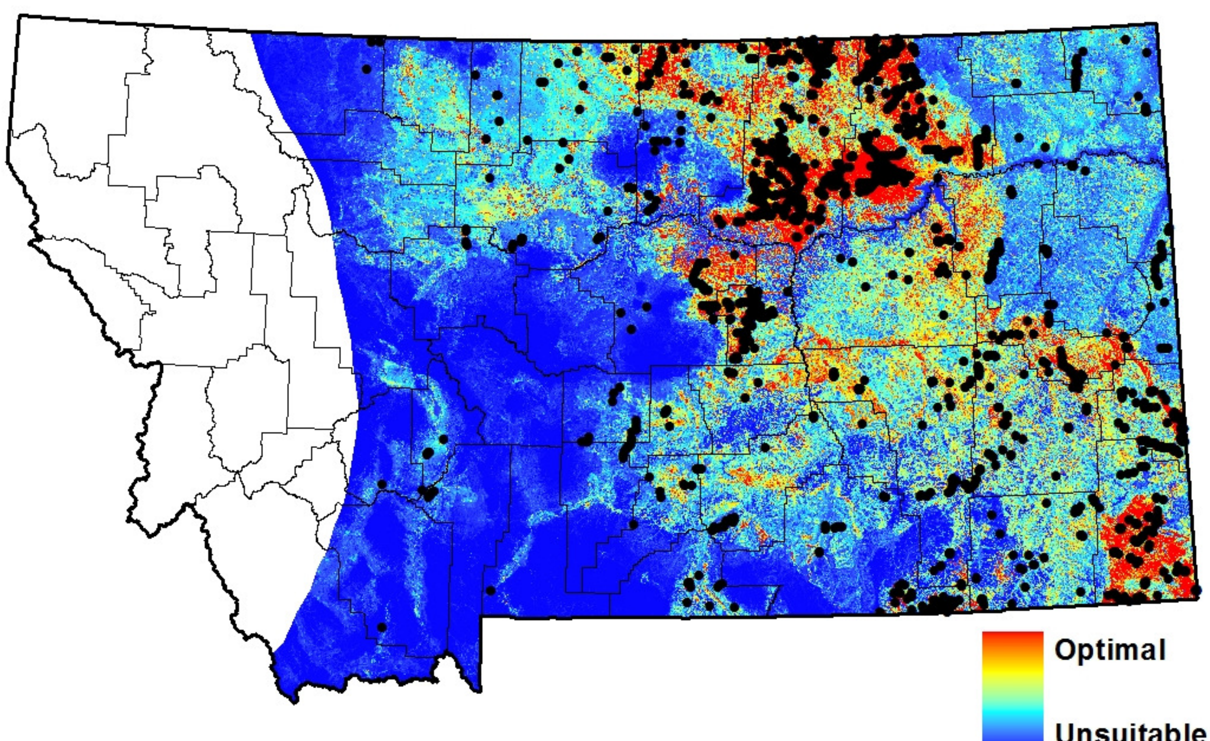

Figure 2. Continuous habitat suitability model output with training and test data.

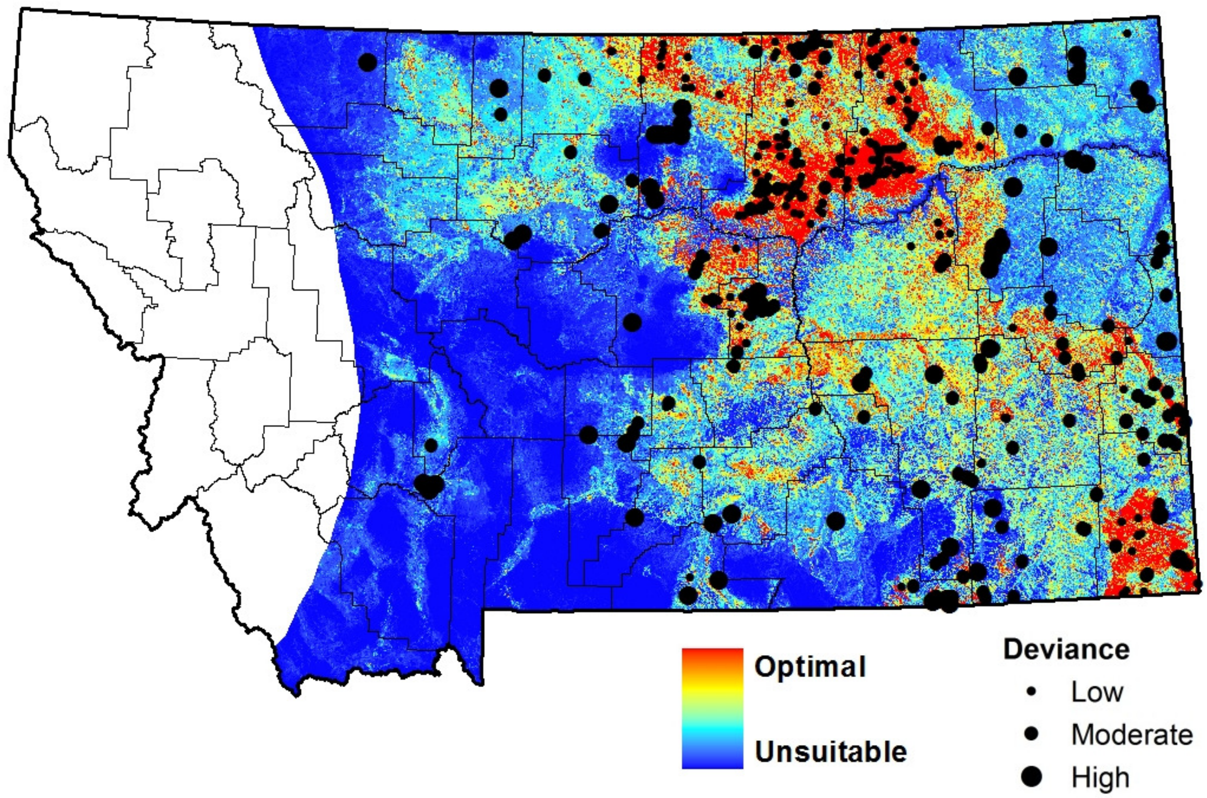

Figure 3. Continuous habitat suitability model output with relative deviance for each test observation

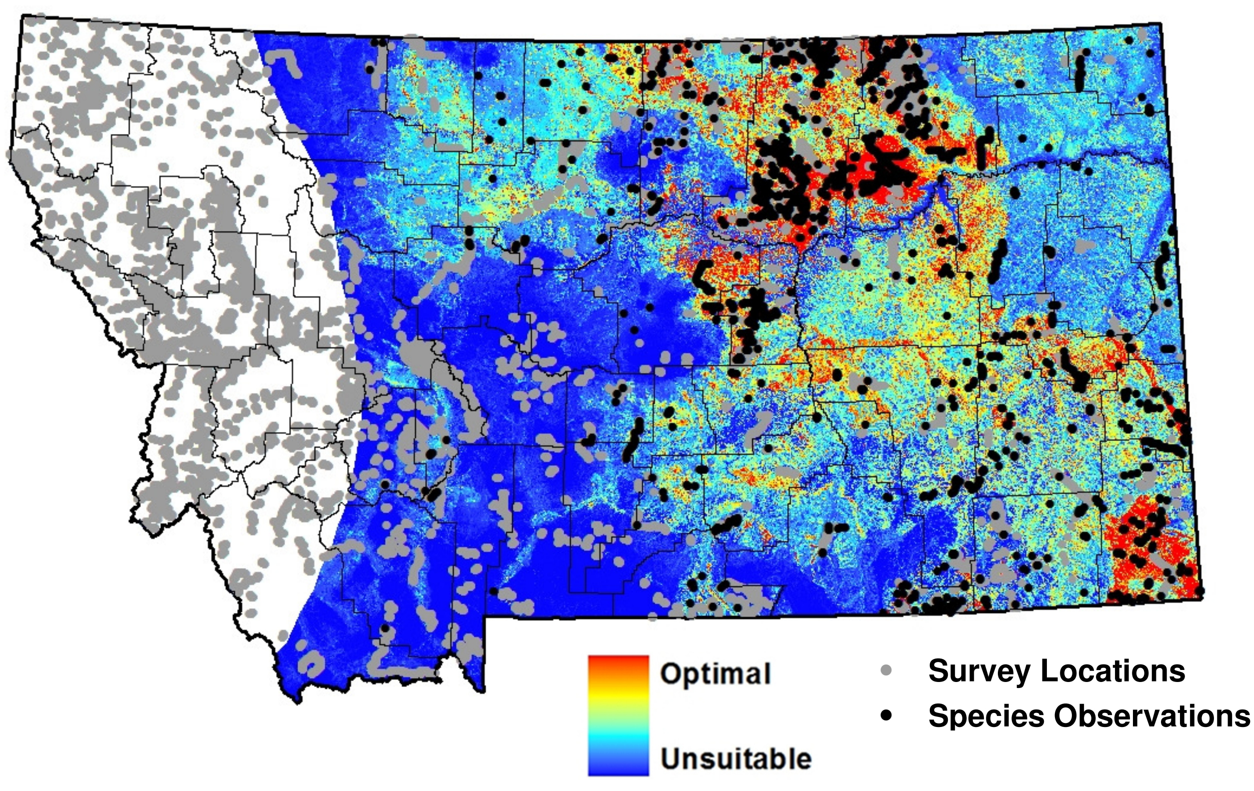

Figure 4. Continuous habitat suitability model output with survey locations that could have detected the species (gray) and detections of species (black)

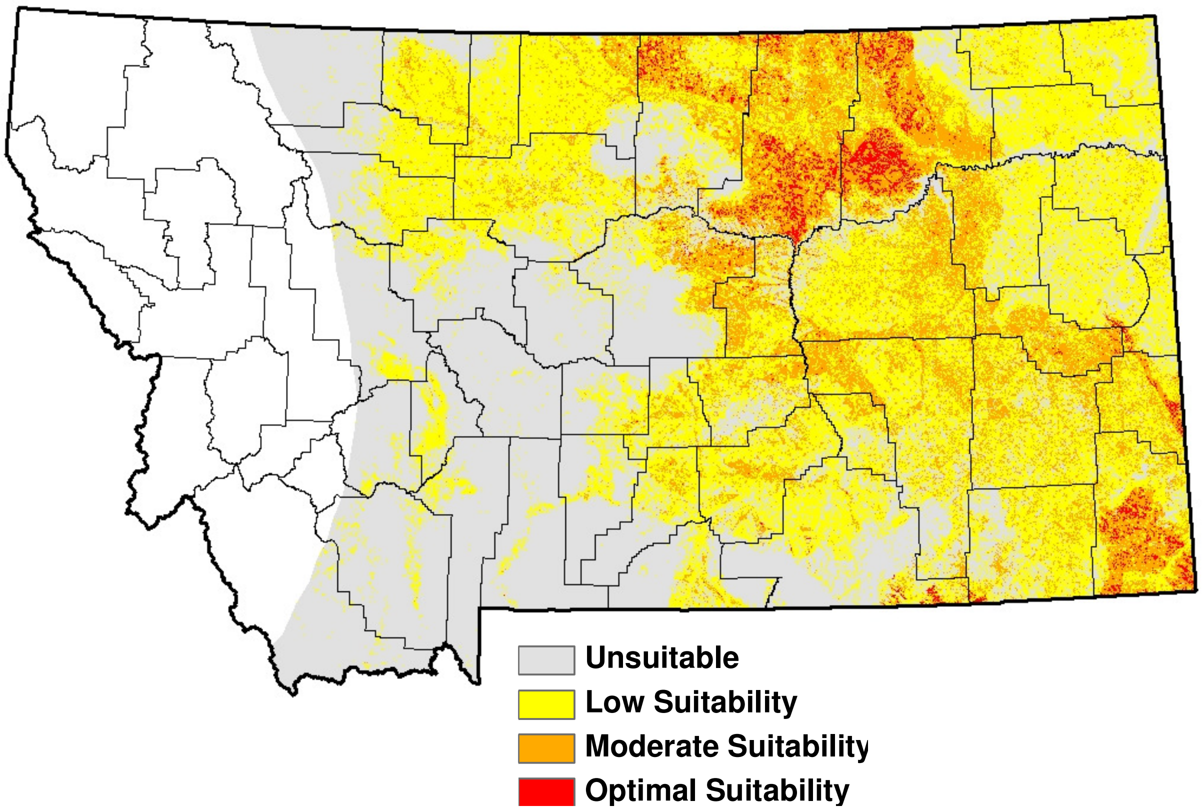

Figure 5. Model output classified into unsuitable (gray), low suitability (yellow), medium suitability (orange), and optimal suitability (red) habitat classes.

Deductive Model

Model Created By: Bryce Maxell
Model Creation Date: 9/29/2009
Model Evaluators: Joy Ritter and Bryce Maxell
Model Approval Date: 9/3/2012
Model Goal: Deductive model is meant to represent species-habitat associations during summer breeding season. Species were classified as commonly or occasionally associated with ecological systems. See details on how ecological systems were associated with species and the suggested uses and limitations of these associations under individual species accounts in the Montana Field Guide at: http://fieldguide.mt.gov

Deductive Modeling Methods

Ecological System	Code	Habitat Association
Greasewood Flat	9103	Common
Great Plains Riparian	9326	Common
Great Plains Mixedgrass Prairie	7114	Common
Great Plains Sand Prairie	7121	Common
Big Sagebrush Shrubland	5257	Common
Great Plains Shrubland	5262	Common
Mat Saltbush Shrubland	5203	Common
Big Sagebrush Steppe	5454	Common
Montane Sagebrush Steppe	5455	Common

Deductive Model Evaluation

Discussion of Model Performance:

Species is irruptive in its breeding across large portions of Montana. Even still, the model may over predict the area of suitable breeding habitat during an irruptive breeding year in the southwestern portion of the species' breeding range in the state.

Evaluation metrics:

Metric	Value
Area of commonly associated habitats (km^2)	102,852
Absolute validation index (AVI) for common habitat associations	0.52

Deductive Model Output (Maps)

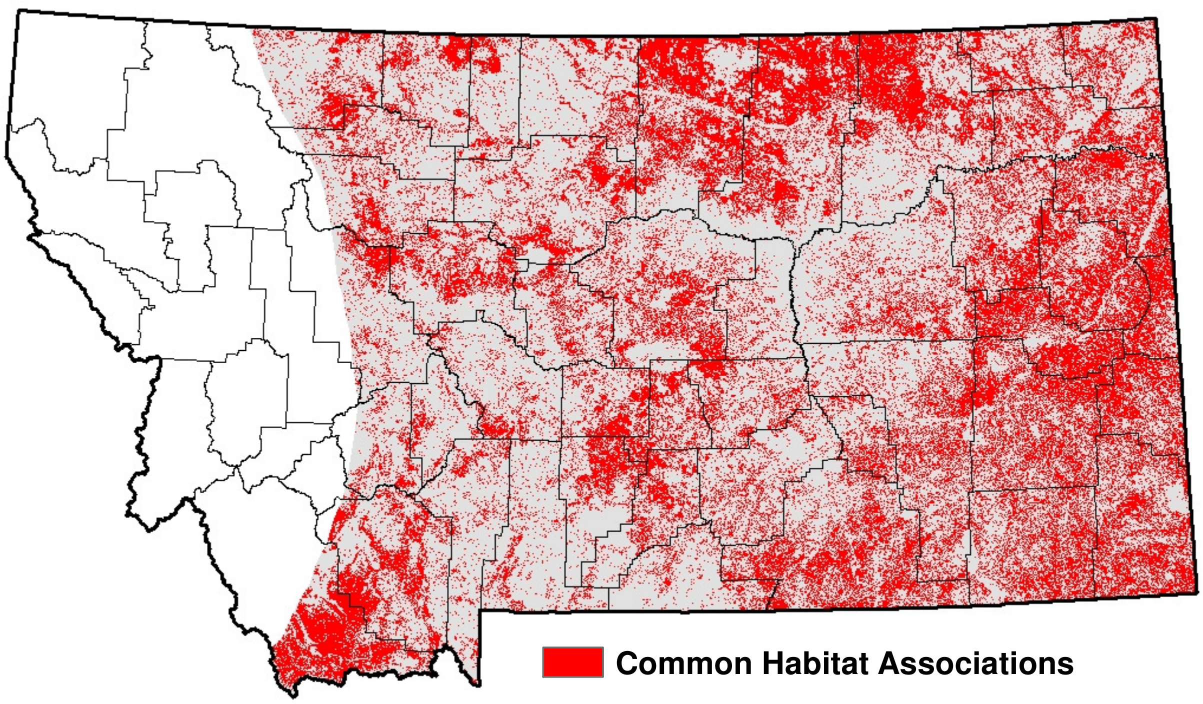

Figure 5. Common habitat association classes as determined by expert opinion (see Montana Field Guide species account).