Sora Distribution Modeling

Scientific Name: *Porzana carolina*
Distribution Status: Migratory Summer Breeder
State Rank: S5B
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	1096
Location Data Selection Rule 1	Spatially unique records associated with breeding activity with <= 1600 meters of locational uncertainty
No. Locations Meeting Selection Rule 1	138
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	122
Season Modeled	Summer Breeding
No. Model Train Locations	88
No. Model Test Locations	31
No. Model Background Locations	60,088
Area of Species Range in State (Percent of Montana)	Statewide distribution

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:

Statewide

java –mx2048 –jar c:\MaxEnt\maxent.jar -a -z nowarnings noprefixes -P -J -o U:\IndSpecies\Porz_caro\2012_05_14\StateOut -s U:\IndSpecies\Porz_caro\2012_05_14\Porz_caro_train.csv -T U:\IndSpecies\Porz_caro\2012_05_14\Porz_caro_test.csv -e I:\modelingSecondRoundInputLayers nowriteclampgrid nowritemess maximumbackground=60000 writebackgroundpredictions noextrapolate nodoclamp -N CONTVRM -N cala_mela_mask -N limo_fedo_mask -N trin_semi_mask -t BIAS -t CATESYS -t CATSDEGEOL -t CATSOILTMP

Inductive Model Evaluation

Model Performance:

The model appears to adequately predict the distribution of Sora nesting habitat across Montana at large spatial scales where there is survey data and evaluation metrics suggest a good model fit (see table of evaluation metrics). However, the model also clearly over predicts the distribution of suitable habitat in at least a couple of regions; e.g., open water and floodplain habitats in the Flathead and Bitterroot Valleys. Finally, it should be noted that surveys adequate for the detection of Sora are lacking across large regions of the state.

Top contributing layers:

Variable	Percent Contribution	Permutation Importance
CONTSLOPE	26.5	70.2
CATSOILTMP	24.6	1.8
CONTTMIN	15.8	4.9
CATSDEGEOL	13.2	3.6
CATESYS	10.8	8.4
CONTSTRMED	3.3	0

Evaluation metrics:

Metric	Value
Low Logistic Threshold[a]	0.018
Area of predicted low suitability habitat within species' range	78,440 km^2
Medium Logistic Threshold[b]	0.08
Area of moderate suitability habitat within species' range	26,918 km^2
Optimal Logistic Threshold[c]	0.42
Area of predicted optimal habitat within species' range	3,776 km^2
Total area of predicted suitable habitat within species' range	109,134 km^2
Absolute validation index (AVI)[d]	0.871
Avg Deviance (X +/- SD)[e]	3.05 +/- 3.95
Training AUC[f]	0.964
Test AUC[g]	0.891

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

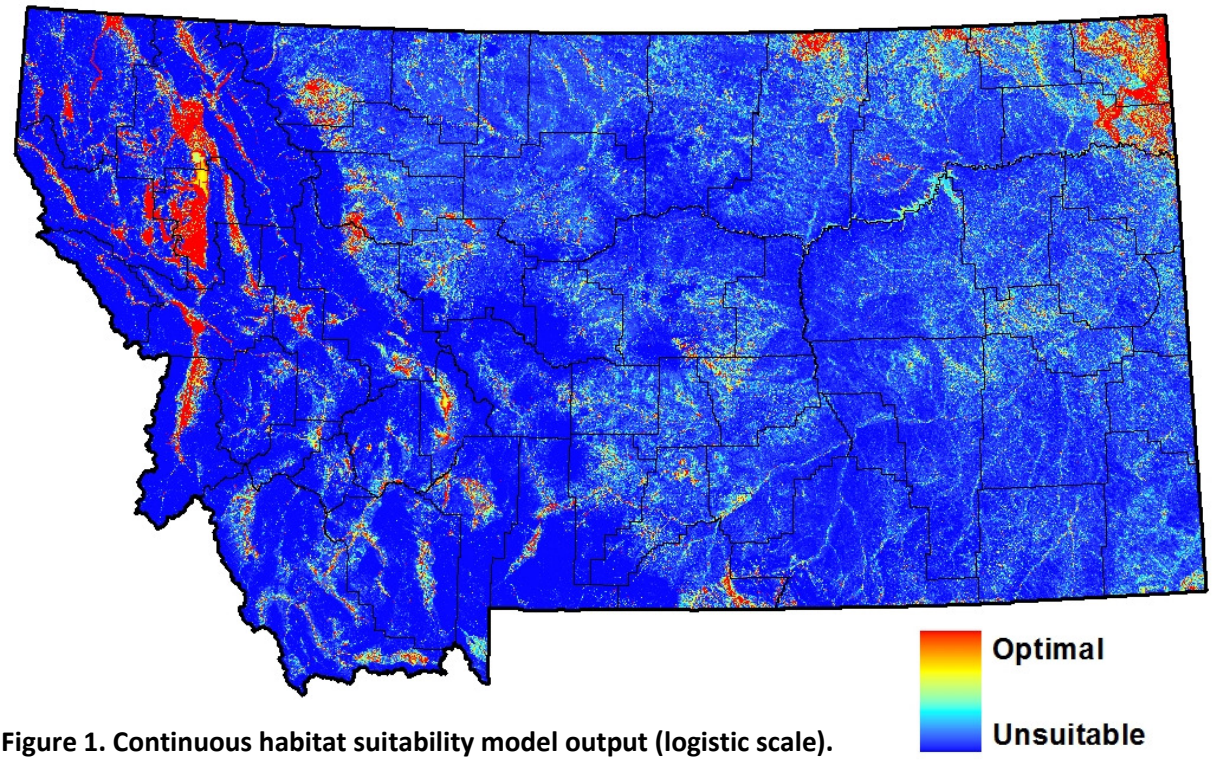

Figure 1. Continuous habitat suitability model output (logistic scale).

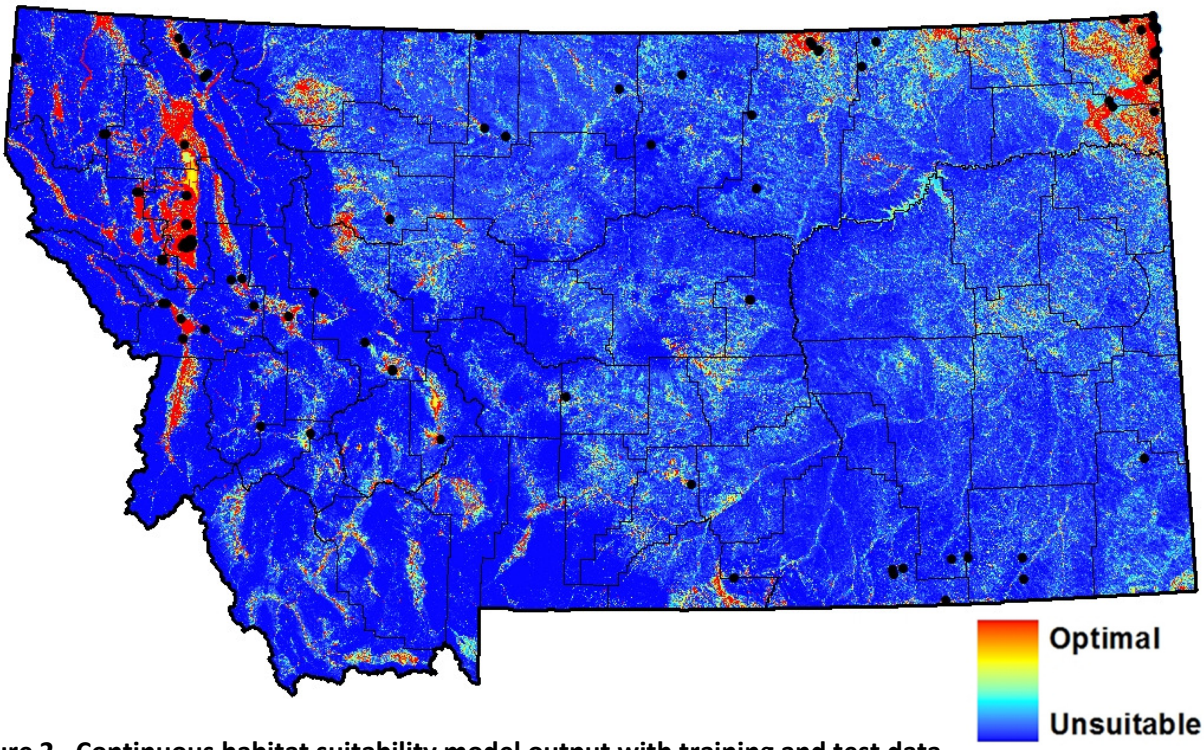

Figure 2. Continuous habitat suitability model output with training and test data.

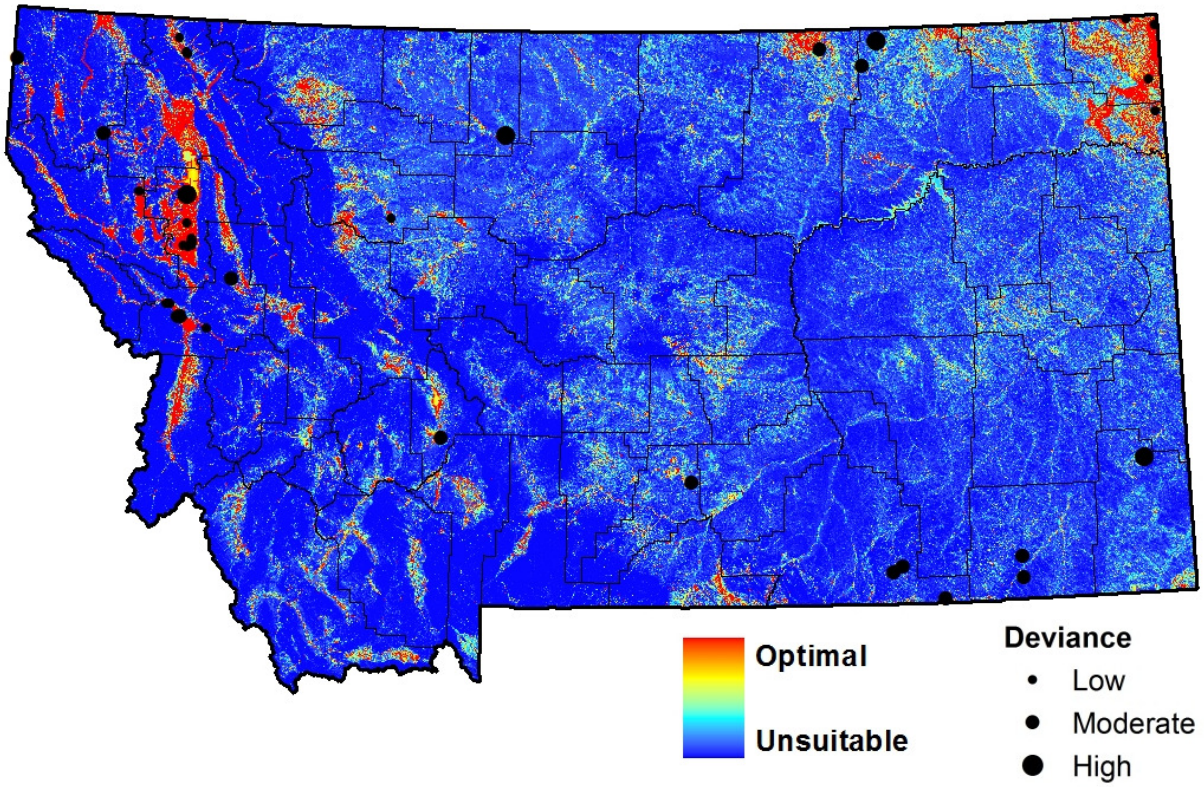

Figure 3. Continuous habitat suitability model output with relative deviance for each test observation

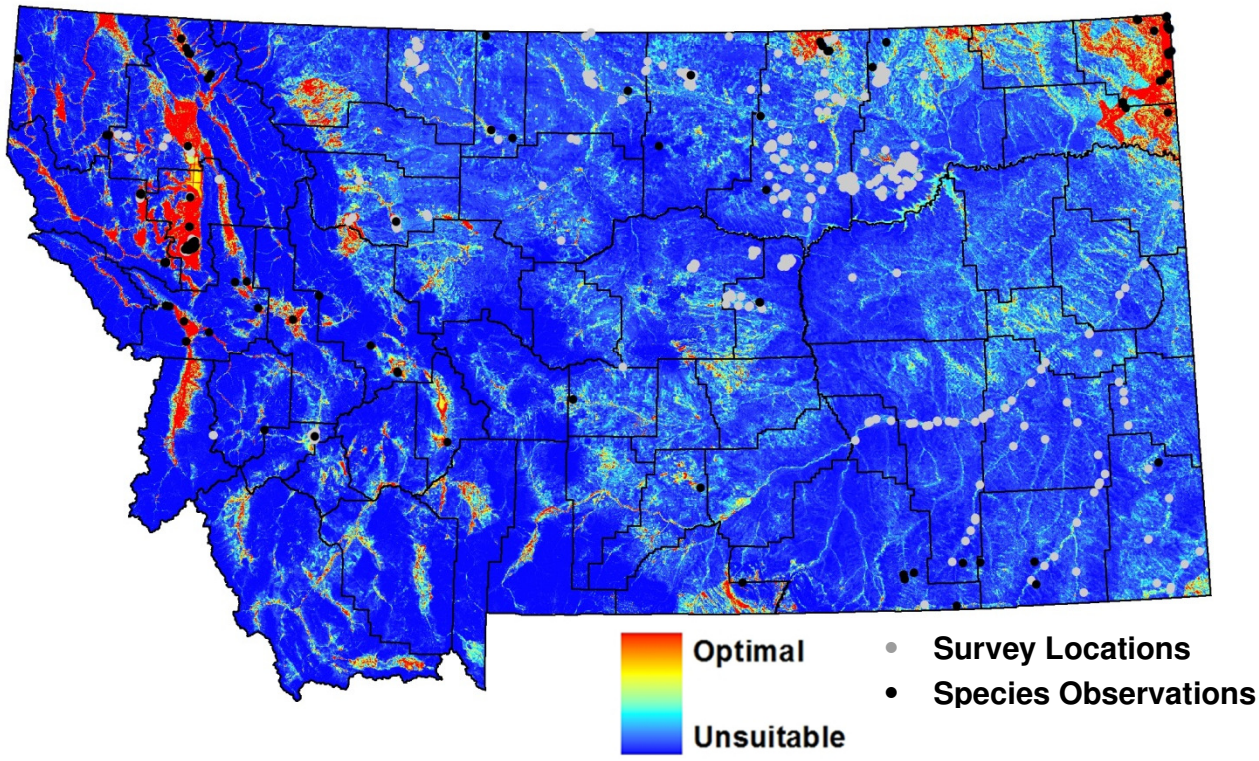

Figure 4. Continuous habitat suitability model output with survey locations that could have detected the species (gray) and detections of species (black)

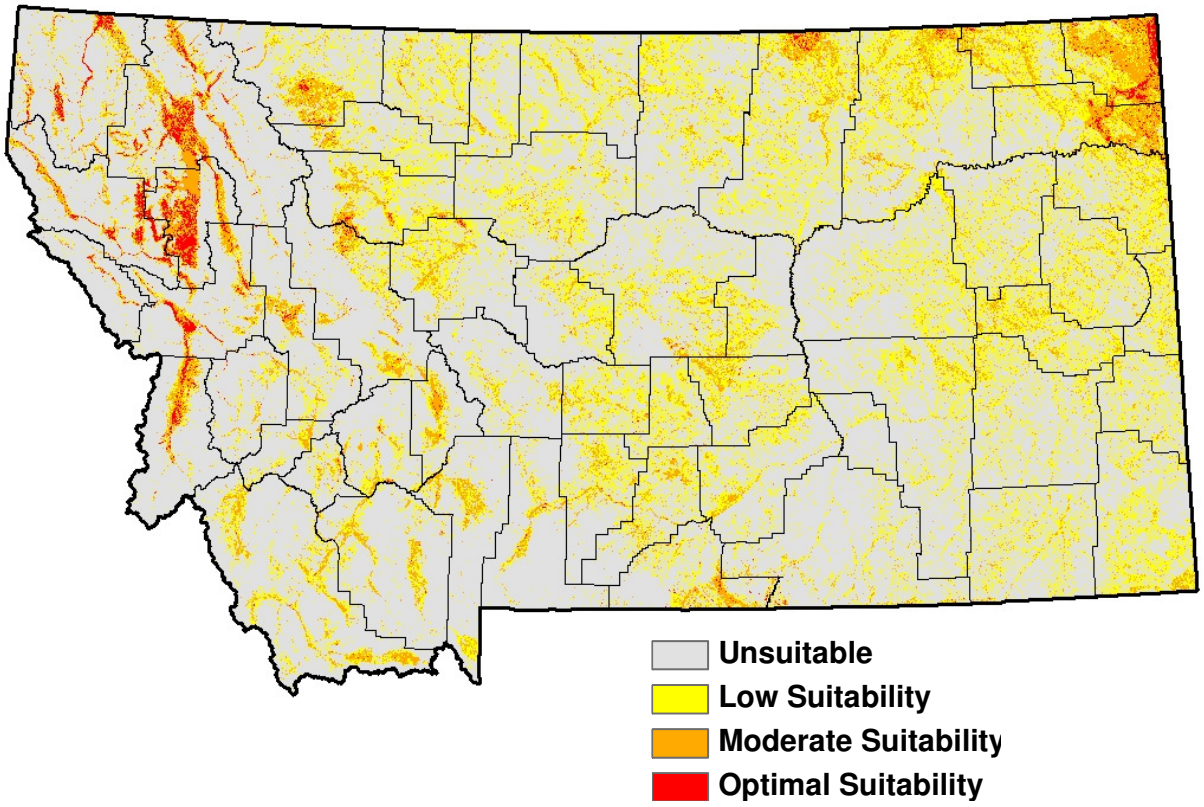

Figure 5. Model output classified into unsuitable (gray), low suitability (yellow), medium suitability (orange), and optimal suitability (red) habitat classes.

Deductive Model

Model Created By: Bryce Maxell
Model Creation Date: August 14, 2009
Model Evaluators: Joy Ritter and Bryce Maxell
Model Evaluation Date: May 14, 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
Great Plains Prairie Pothole	9203	Common
Great Plains Riparian	9326	Common
Rocky Mountain Subalpine-Montane Mesic Meadow	7118	Common
Alpine-Montane Wet Meadow	9217	Common
Emergent Marsh	9222	Common
Great Plains Closed Depressional Wetland	9252	Common
Great Plains Open Freshwater Depression Wetland	9218	Common
Great Plains Saline Depression Wetland	9256	Common
Rocky Mountain Subalpine-Montane Fen	9234	Common
Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland	9155	Common
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland	9156	Common
Rocky Mountain Subalpine-Montane Riparian Shrubland	9187	Common
Rocky Mountain Subalpine-Montane Riparian Woodland	9171	Common

Deductive Model Evaluation

Discussion of Model Performance:
The model only accounts for 19% of the test observations. So, even though it appears to do a reasonable job of representing breeding habitat at large spatial scales across the state, it has poor predictive power. When completed, statewide wetland and riparian mapping efforts should be able to do a much better job of predicted suitable habitat for the species.

Evaluation metrics:

Metric	Value
Area of commonly associated habitats (Km^2)	15,455
Absolute validation index (AVI) for common habitat associations	0.194

Deductive Model Output (Maps)

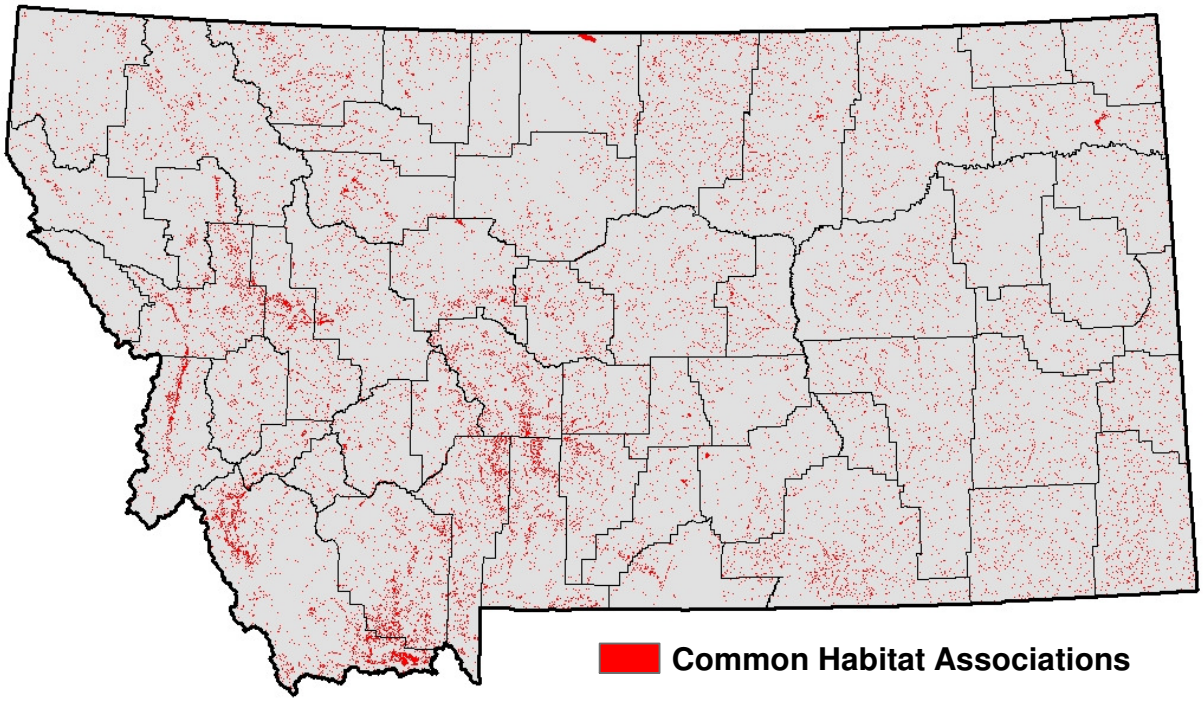

Figure 6. Habitat association classes as determined by expert opinion (see Montana Field Guide species account).