

# Baird's Sparrow (*Ammodramus bairdii*)

## Predicted Suitable Habitat Modeling

**Distribution Status:** Migratory Summer Breeder

**State Rank:** S3B (Species of Concern)

**Global Rank:** G4

### Modeling Overview

**Created by:** Braden Burkholder

**Creation Date:** July 14, 2016

**Evaluator:** Braden Burkholder

**Evaluation Date:** August 12, 2016



**Inductive Model Goal:** To predict the distribution and relative suitability of breeding habitat at large spatial scales across the species' known breeding range in Montana.

**Inductive Model Performance:** The model appears to adequately reflect the distribution of Baird's Sparrow breeding season habitat suitability at larger spatial scales across the species' known breeding range in Montana. Evaluation metrics suggest a good model fit. The delineation of habitat suitability classes is well-supported by the data.

**Deductive Model Goal:** To represent the ecological systems commonly and occasionally associated with this species during the breeding season, across the species' known breeding range in Montana.

**Deductive Model Performance:** Ecological systems that this species is commonly and occasionally associated with appear to overpredict the amount of suitable habitat for Baird's Sparrow across its known breeding range in Montana, especially across south central and southeastern Montana.

**Suggested Citation:** Montana Natural Heritage Program. 2016. Baird's Sparrow (*Ammodramus bairdii*) predicted suitable habitat models created on July 14, 2016. Montana Natural Heritage Program, Helena, MT. 15 pp.

**Montana Field Guide Species Account:** <http://fieldguide.mt.gov/speciesDetail.aspx?elcode=ABPBXA0010>

## **Inductive Modeling**

### **Model Limitations and Suggested Uses**

This model is based on statewide biotic and abiotic layers originally mapped at a variety of spatial scales and standardized to 90×90 meter raster pixels. Furthermore, the spatial accuracy of the training and testing data are varied (typically 20-400 meters) and may result in additional statistical noise in the model. As a result, model outputs may not be appropriate for use on smaller areas or at fine spatial scales. Model outputs should not typically be used for planning efforts on land areas smaller than one quarter of a public land survey system (PLSS) section (<64 hectares) and model outputs for some species may only be appropriate for broader regional level planning efforts. Model outputs should not be used in place of on-the-ground surveys for species, and wildlife and land management agency biologists should be consulted about the value of using model output to guide habitat management decisions for regional planning efforts or local projects. See [Suggested Contacts for State and Federal Natural Resource Agencies](#) attached to this document.

## **Inductive Model Methods**

### **Modeling Process**

Presence-only data were obtained from Montana Natural Heritage Program Databases, which serve as a clearinghouse for animal and plant observation data in Montana. These data were then filtered to ensure spatial and temporal accuracy and to reduce spatial auto-correlation (summarized in Table 1). The spatial extent of this model was limited to the known geographic range of the species, by season when applicable, in order to accurately assess potentially available habitat.

We then used these data and 19 statewide biotic and abiotic layers (Table 2) to construct the model using a maximum entropy algorithm employed in the modeling program Maxent (Phillips et al. 2006, *Ecological Modeling* 190:231-259). Entropy maximization modeling functions by first calculating constraints and then applying the constraints to estimate a predicted distribution. The mean, variance, etc. of the environmental variables at the training data locations are used to estimate the constraint distributions. Maxent requires that the final predicted distribution fulfills these constraints. Maxent avoids overfitting of models to the training data by “regularizing” or relaxing the constraints so that modeled distributions only have to be close to, rather than exactly equal to, the constraint distributions (Elith et al. 2011, *Diversity and Distributions* 17:43-57).

Maxent fits a model by first assuming the predicted distribution is perfectly uniform in geographic space and moves away from this distribution only to the extent that it is forced to by the constraints. Constrained by training data, Maxent successively modifies the coefficients for each environmental variable via random walk, accepting the modified coefficient if it increases the gain. Gain is a measure of the closeness of the model concentration around the presence samples that is similar to goodness of fit in generalized linear models. The random walk of coefficients continues until either the increase in the gain falls below a set threshold or a set maximum number of iterations are performed. The gain value at the end of a model run indicates the likelihood of suitability of the presence samples relative to the likelihood for random background points. The overall gain associated with individual environmental variables can be used as a measure of the relative importance of each variable (Merow et al. 2013, *Ecography* 36:1058-1069).

We employed a k-folds cross validation methodology, in this case using ten folds for model training and validation (Elith et al. 2011). Each fold consists of 90% of the data designated for training and 10% of the data reserved for testing. Each record is used for training nine times and testing once. Ten models are estimated and averaged to produce the final model presented here.

### Model Outputs and Evaluation

The initial model output is a spatial dataset of continuous logistic values that ranges from 0-1 with lower values representing areas predicted to be less suitable habitat and higher values representing areas predicted to be more suitable habitat (Figure 2). The standard deviation in the model output across the averaged models is also calculated (Figure 3). If enough observations were available to train and evaluate the models, the continuous output is reclassified into suitability classes - unsuitable, low suitability, moderate suitability, and high suitability. Thresholds for defining suitability classes are presented and described below (Table 4).

We evaluated the output of the Maxent model with two metrics, an absolute validation index (AVI) (Hirzel et al. 2006, *Ecological Modelling* 199:142-152) and deviance (Phillips and Dudik 2008, *Ecography* 31: 161-175). These metrics are described below in the results (Table 5). Area under the curve (AUC) values are also displayed for reference, but are not used for evaluation (Lobo et al. 2008, *Global Ecology and Biogeography* 17:145-151). Additionally, standard deviation in logistic output of the ten individual models is plotted as a map to examine spatial variance of model output. Finally, a deviance value was calculated for each test data observation as a measure of how well model output matched the location of test observations. In theory, everywhere a test observation was located, the logistic value should have been 1.0. The deviance value for each test observation is calculated as -2 times the natural log of the associated logistic output value.

Table 1: Model Data Selection Criteria and Summary

Location Data Source	Montana Natural Heritage Program Databases
Total Number of Records	3,655
Location Data Selection Rule 1	Records associated with breeding activity with $\leq 800$ meters of locational uncertainty
Number of Locations Meeting Selection Rule 1	3,037
Location Data Selection Rule 2	No overlap in locations within 1600 meters in order to avoid spatial autocorrelation
Observation Records used in Model (Locations Meeting Selection Rules 1 & 2)	704
Season Modeled	Summer Breeding
Number of Model Background Locations	40,313

Table 2: Environmental Layer Information

Layer	Identifier	Original Scale	Description
Land Cover	catesys	30m	Categorical. Landcover classes (25) from the 2016 Montana Spatial Data Infrastructure Land Cover Framework; Level 2 classes used with a few minor changes including removal of linear and point features: Alpine Grassland and Shrubland, Alpine Sparse and Barren, Conifer-dominated Forest and Woodland (mesic-wet), Conifer-dominated Forest and Woodland (xeric-mesic), Deciduous dominated forest and woodland, Mixed deciduous/coniferous forest and woodland, Lowland/Prairie Grassland, Montane Grassland, Agriculture, Introduced Vegetation/Pasture/Hay, Developed, Mining and Resource Extraction, Wetland or Marsh, Floodplain and Riparian, Open Water, Wet meadow, Harvested Forest, Insect-Killed Forest, Introduced Vegetation, Recently burned, Deciduous Shrubland, Sagebrush Steppe or Desert Scrub, Sagebrush or Saltbush Shrubland, Bluff/Badland/Dune, Cliff/Canyon/Talus <a href="http://geoinfo.msl.mt.gov/msdi/land_use_land_cover">http://geoinfo.msl.mt.gov/msdi/land_use_land_cover</a>
Geology	catgeol	vector	Categorical. Basic rock classes (5) as defined by USGS (plus water for large water bodies): Sedimentary, Unconsolidated, Metamorphic, Plutonic, and Volcanic. <a href="https://mrddata.usgs.gov/geology/state/state.php?state=MT">https://mrddata.usgs.gov/geology/state/state.php?state=MT</a>
Soil Order	catsoilord	Vector	Categorical. Major soil orders (7) as defined by USDA based on STATSGO2 general statewide soil maps, along with non-soil (Rock, Water) classifications: Entisols, Inceptisols, Aridisols, Mollisols, Alfisols, Andisols, and Vertisols. <a href="http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx">http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx</a>
Soil Regime	catsoiltemp	vector	Categorical. Soil Moisture and Temperature regimes (11) classification pairs as defined by USDA (plus water): Cryic/Udic, Cryic/Udic Ustic, Cryic/Typic Ustic, Cryic/Aridic Ustic, Cryic/Typic Xeric, Frigid/Aquic, Frigid/Udic, Frigid/Typic Ustic, Frigid/Aridic Ustic, Frigid/Typic Xeric, Mesic/Ustic Aridic. <a href="http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx">http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx</a>
Elevation	contelev	≈10m	Continuous. Elevation in meters above mean sea level. <a href="https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5">https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5</a>
Aspect (East-West)	contewasp	≈10m	Continuous. Aspect of slopes, ranging from 1 (east) to -1 (west). <a href="https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5">https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5</a>
Aspect (North-South)	contnsasp	≈10m	Continuous. Aspect of slopes, ranging from 1 (north) to -1 (south). <a href="https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5">https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5</a>
Slope	contslope	≈10m	Continuous. Percent slope (x100) of landscape. <a href="https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5">https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5</a>
Ruggedness	contvrm	≈10m	Continuous. Vector ruggedness measure (0 to 1). <a href="https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5">https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5</a>
Summer Solar Radiation	contsumrad	≈10m	Continuous. Solar radiation (WH/m <sup>2</sup> ) for the day of the summer solstice. <a href="https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5">https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5</a>
Winter Solar Radiation	contwinrad	≈10m	Continuous. Solar radiation (WH/m <sup>2</sup> ) for the day of the winter solstice. <a href="https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5">https://www.sciencebase.gov/catalog/item/4f70aa9fe4b058caae3f8de5</a>
Annual NDVI	contndvi	900m	Continuous. Normalized Difference Vegetation as a measure of yearly mean greenness from the MODIS Terra satellite. <a href="ftp://mco.cfc.umt.edu/ndvi/terra/yearly_normals/">ftp://mco.cfc.umt.edu/ndvi/terra/yearly_normals/</a>
Annual Precipitation	contprecip	≈800m	Continuous. Average annual precipitation (mm) for 1981-2010. <a href="http://www.prism.oregonstate.edu/normals/">http://www.prism.oregonstate.edu/normals/</a>
Percent Winter Precipitation	contwinpcp	≈800m	Continuous. Average percent (0 to 1) of the total annual precipitation that occurs during winter (Nov-Apr) for 1981-2010. <a href="http://www.prism.oregonstate.edu/normals/">http://www.prism.oregonstate.edu/normals/</a>
Max Summer Temp	conttmax	800m	Continuous. Average maximum temperature (°C) in July for 1981-2010. <a href="ftp://mco.cfc.umt.edu/tmax/monthly_normals/">ftp://mco.cfc.umt.edu/tmax/monthly_normals/</a>
Min Winter Temp	conttmin	800m	Continuous. Average minimum temperature (°C) in January for 1981-2010. <a href="ftp://mco.cfc.umt.edu/tmin/monthly_normals/">ftp://mco.cfc.umt.edu/tmin/monthly_normals/</a>
Degree Days	contddays	800m	Continuous. Average annual total of degree days (°F) above 32°F for 1981-2010. <a href="http://services.cfc.umt.edu/arcgis/rest/services/Atlas/Temperature_CropDegreeDays32F/ImageServer">http://services.cfc.umt.edu/arcgis/rest/services/Atlas/Temperature_CropDegreeDays32F/ImageServer</a>
Distance to Stream	contstrmed	vector	Continuous. Distance to major streams in meters, based on major streams identified in TIGER files or USGS topographic maps (Stream_Lake_1993 dataset). <a href="http://ftp.geoinfo.msl.mt.gov/Data/Spatial/NonMSDI/Shapefiles/">http://ftp.geoinfo.msl.mt.gov/Data/Spatial/NonMSDI/Shapefiles/</a>
Distance to Forest Cover	contfrsted	30m	Continuous. Distance to any forest land cover type in meters. <a href="http://geoinfo.msl.mt.gov/msdi/land_use_land_cover">http://geoinfo.msl.mt.gov/msdi/land_use_land_cover</a>

## Inductive Model Results

Table 3: Environmental Layer Contributions to Model Fit

Layer ID	Percent Contribution <sup>a</sup>	Layer ID	Percent Contribution <sup>a</sup>
contfrsted	27.0%	contewasp	0.8%
contwinpcp	16.2%	contndvi	0.7%
catesys	15.1%	catsoiltemp	0.5%
conttmin	10.9%	contstrmed	0.5%
catsoilord	8.8%	catgeol	0.4%
constrisum	5.5%	constrwin	0.3%
contddays	5.2%	contnsasp	0.2%
conttmax	3.4%	contprecip	0.2%
conslope	2.4%	contvrm	0.2%
contelev	1.5%		

<sup>a</sup> Relative contributions of the layers to the model based on changes in fit (gain) during iterations of the training algorithm.

Table 4: Habitat Suitability Thresholds

Measure	Value
Low Logistic Threshold <sup>a</sup>	0.054
Moderate Logistic Threshold <sup>b</sup>	0.332
Optimal Logistic Threshold <sup>c</sup>	0.819
Area of entire modeled range (percent of Montana)	255,674.1 km <sup>2</sup> (67.2%)
Total area of predicted suitable habitat within modeled range	160,855.9 km <sup>2</sup>
Area of predicted low suitability habitat within modeled range	118,535.3 km <sup>2</sup>
Area of moderate suitability habitat within modeled range	40,489.3 km <sup>2</sup>
Area of predicted optimal habitat within modeled range	1,831.3 km <sup>2</sup>

<sup>a</sup> The logistic threshold between unsuitable and low suitability as determined by Maxent which balances training data omission error with predicted area.

<sup>b</sup> The logistic threshold value where the percentage of test observations above the threshold is what would be expected if the observations were randomly distributed across logistic value classes (Hirzel et al. 2006). This is equivalent to a null model. When sample sizes are small, it may be undetermined.

<sup>c</sup> The logistic threshold where the percentage of test observations above the threshold is 10 times higher than would be expected if the observations were randomly distributed across logistic value classes. When sample sizes are small, it may be undetermined.

Table 5: Evaluation Metrics

Metric	Value
Low AVI <sup>a</sup>	97.7%
Moderate AVI <sup>a</sup>	73.6%
Optimal AVI <sup>a</sup>	9.4%
Average Testing Deviance ( $\bar{x} \pm sd$ ) <sup>b</sup>	1.689 $\pm$ 1.526
Training AUC <sup>c</sup>	0.877
Test AUC <sup>d</sup>	0.869

<sup>a</sup> Absolute Validation Index: The proportion of test locations that fall above the low, moderate, or optimal logistic threshold.

<sup>b</sup> 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. For example, the equivalent deviance values for the low, moderate and optimal logistic thresholds of this model would be 5.823, 2.208 and 0.399, respectively. Deviances for individual test locations are plotted in Figure 6.

<sup>c</sup> The area under a curve obtained by plotting the true positive rate against 1 minus the false positive rate for model training observations (averaged over 10 folds). Values range from 0 to 1 with a random or null model performing at a value of 0.5.

<sup>d</sup> The same metric described in c, but calculated for test observations.

Figure 1. Jackknife assessment of contribution by individual environmental layers to training gain.

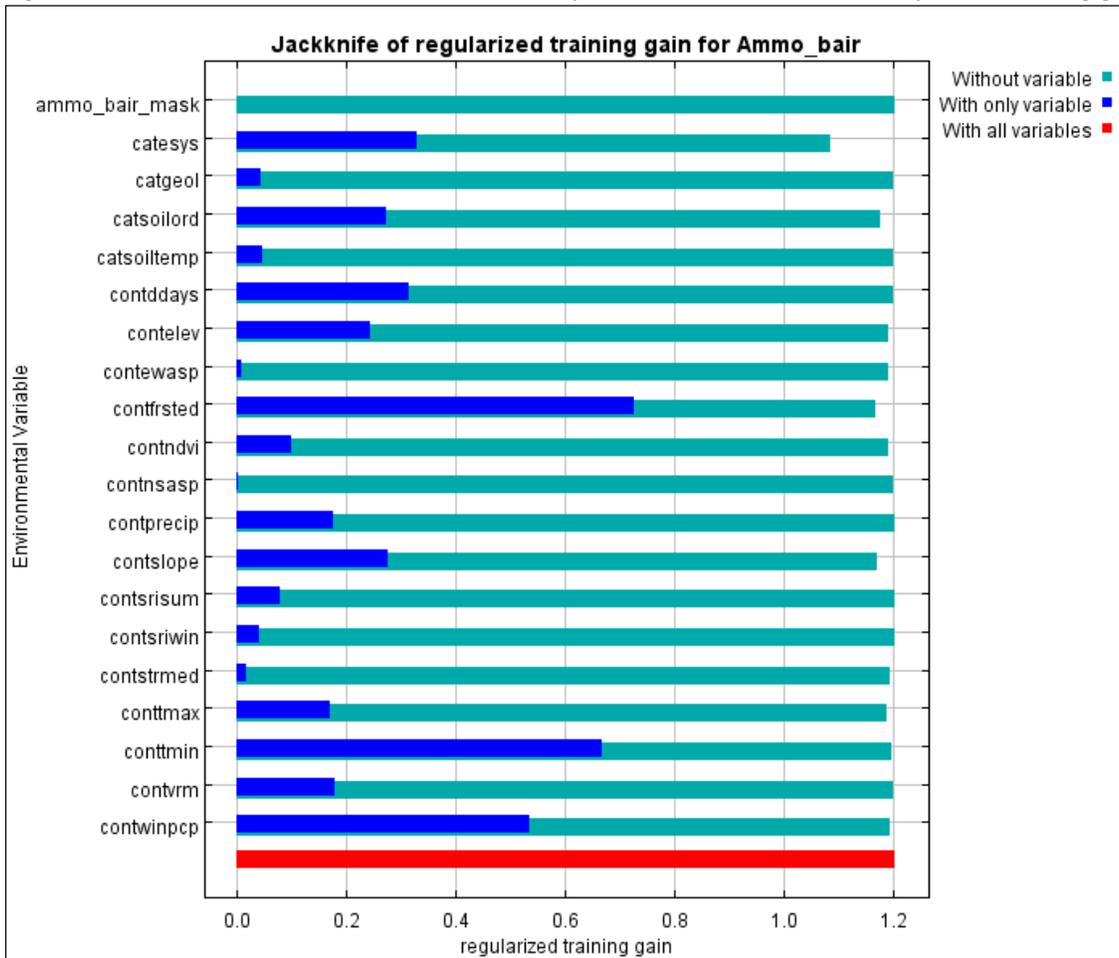
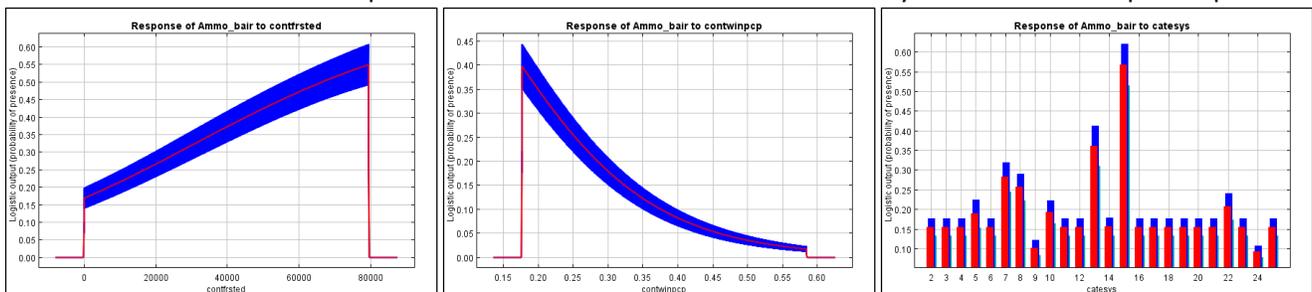


Figure 2. Response curves for the top three contributing environmental layers, mean value in red, +/- one standard deviation in blue. Response curves for additional environmental layers are available upon request.



### Inductive Model Map Outputs

Figure 3. Continuous habitat suitability model output (logistic scale).

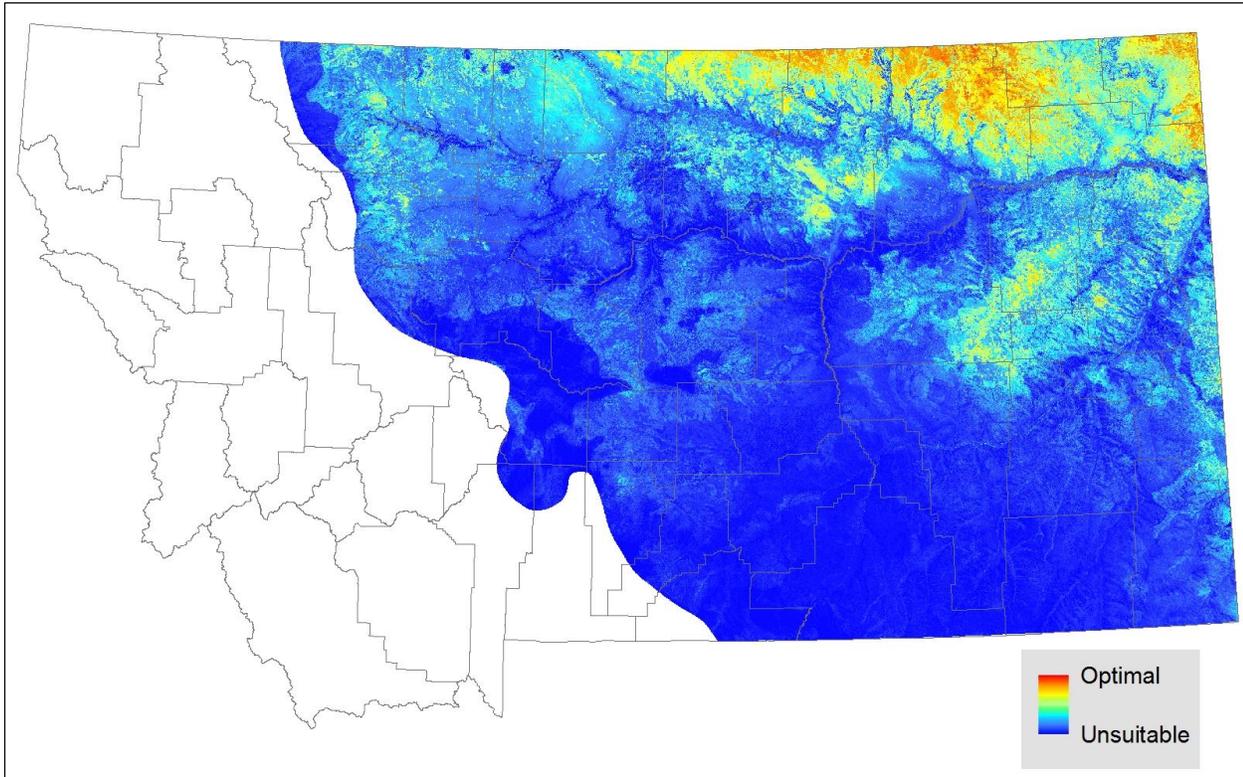


Figure 4. Standard deviation in the model output across the averaged models.

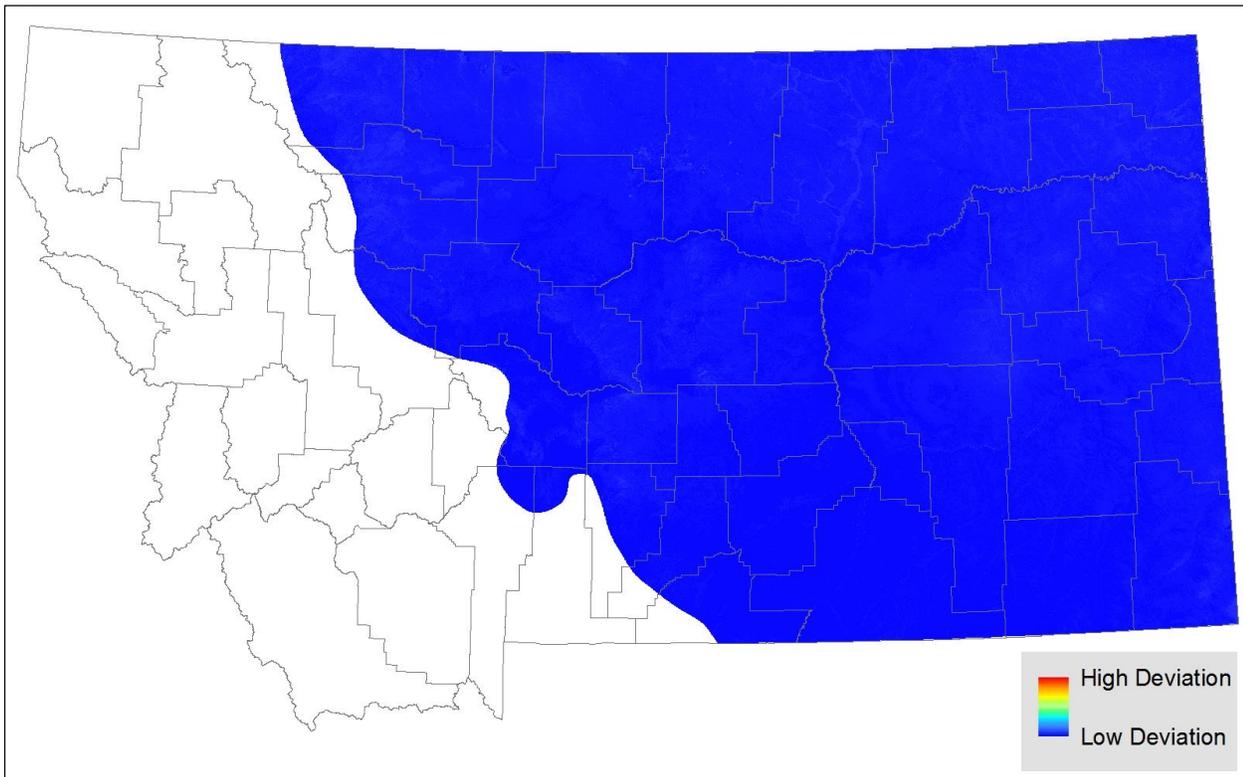


Figure 5. Continuous habitat suitability model output with the 704 observations used for modeling.

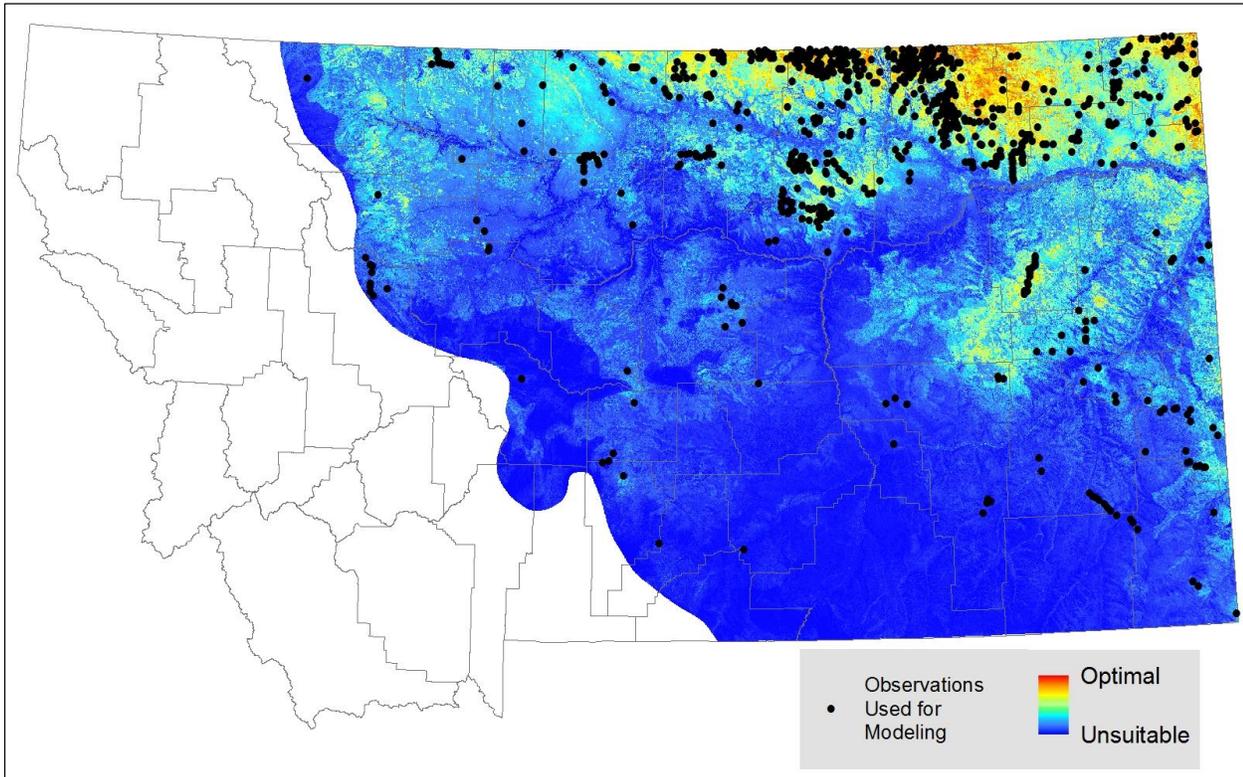


Figure 6. Continuous habitat suitability model output with relative deviance for each observation. Symbol size corresponds to the difference between 1.0 and the optimal, moderate, and low habitat suitability threshold.

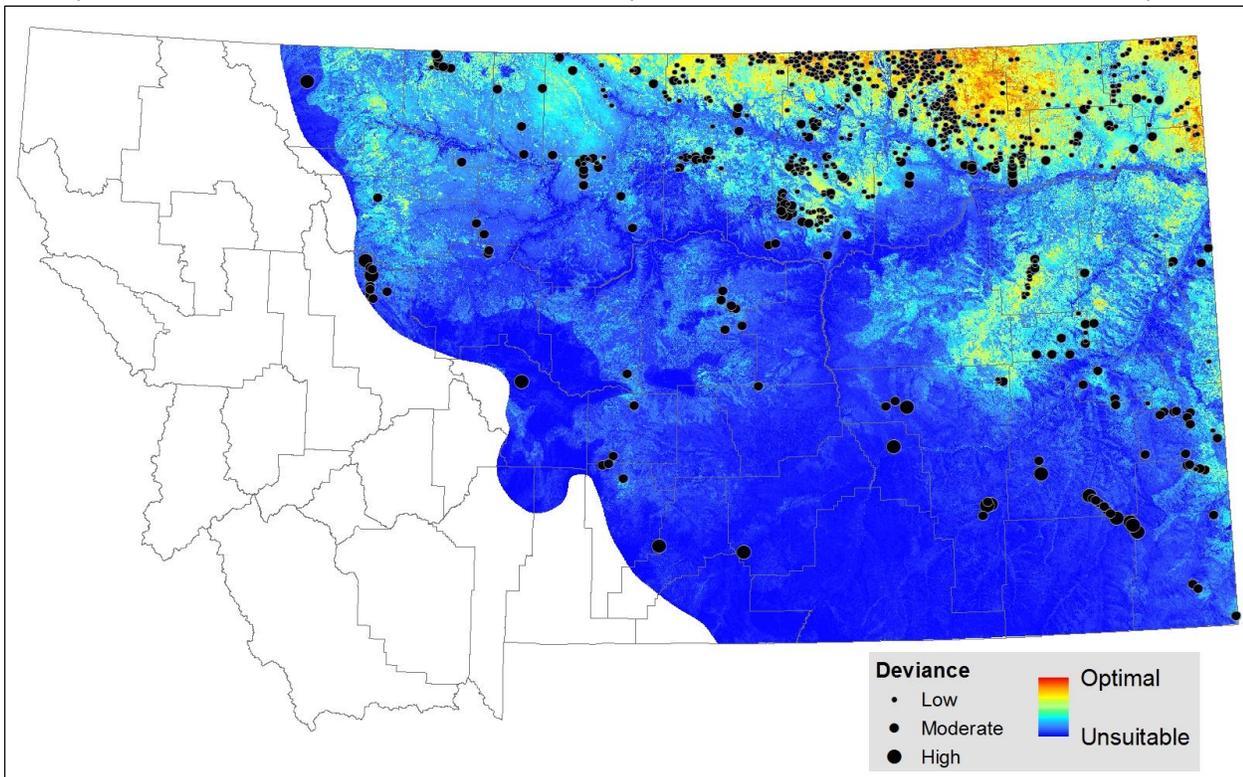


Figure 7. Continuous habitat suitability model output with all 3,655 observations (black) and survey locations that could have detected the species (gray).

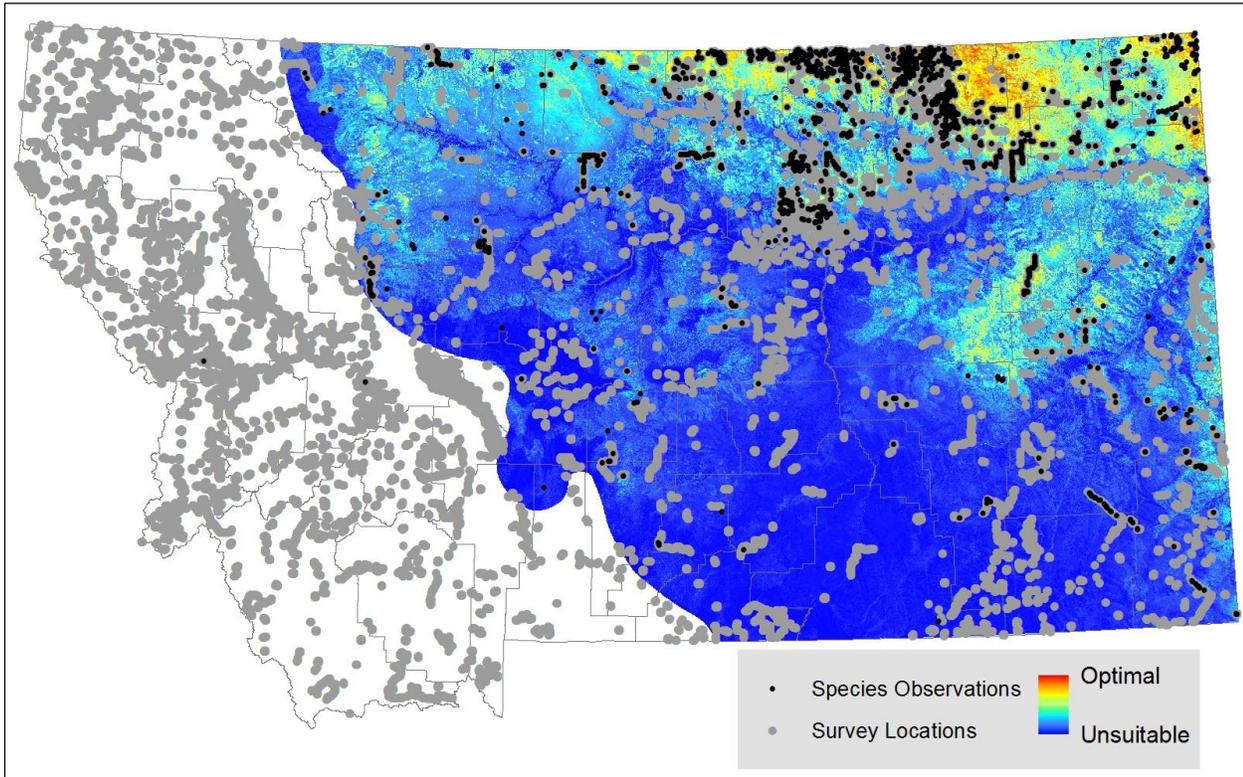


Figure 8. Model output classified into habitat suitability classes.

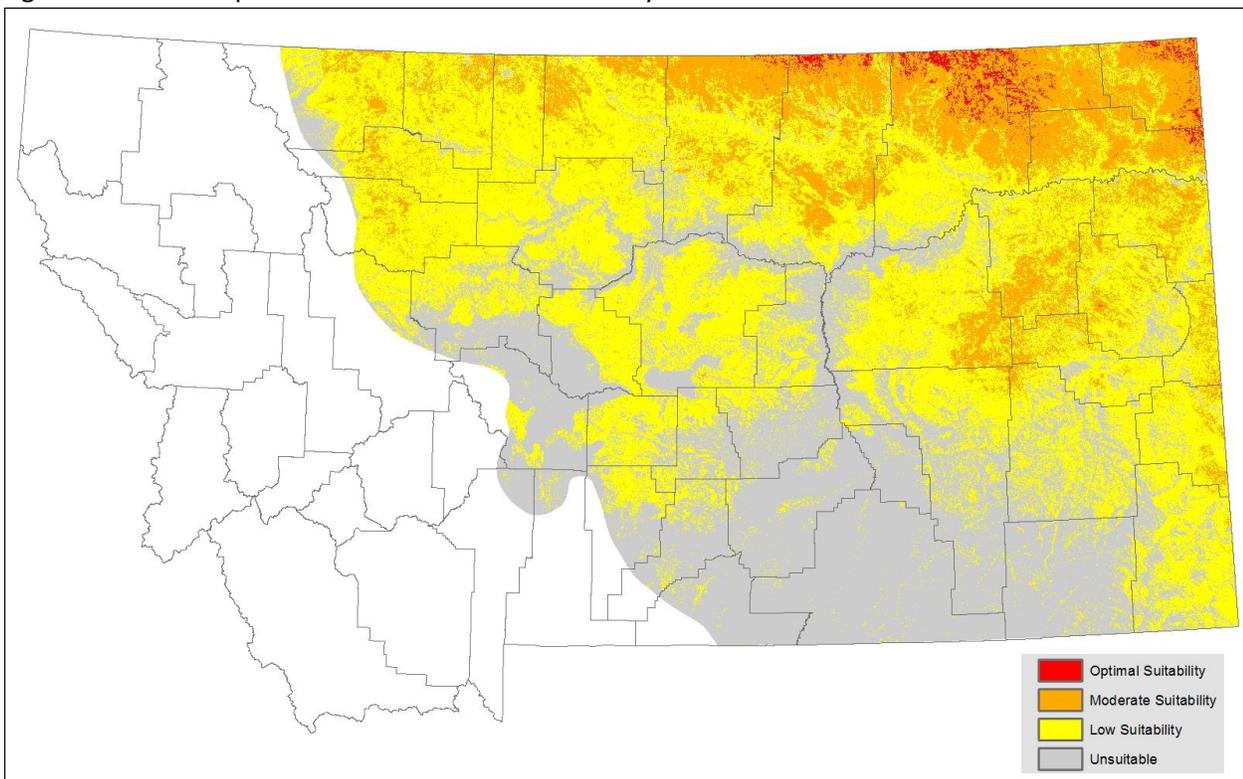
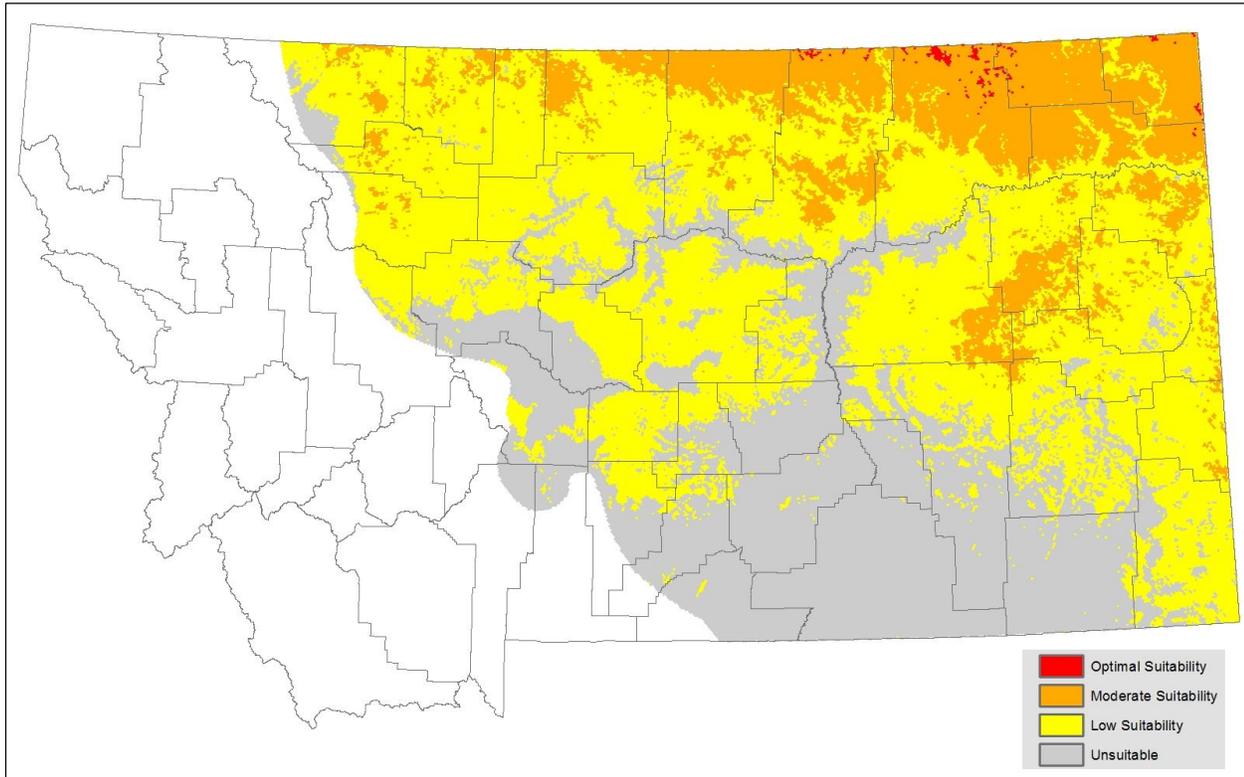


Figure 9. Model output classified into habitat suitability classes and aggregated into hexagon at a scale 259 hectares per hexagon. This is the finest scale suggested for management decisions and survey planning.



## **Deductive Modeling**

### **Model Limitations and Suggested Uses**

Species associations with ecological systems should be used to generate potential lists of species that may occupy broader landscapes for the purposes of landscape-level planning. Users of this information should be aware that the land cover data used to generate species associations was only intended to be used at broader landscape scales. Land cover mapping accuracy is particularly problematic when the systems occur as small patches or where the land cover types have been altered over the past decade. Thus, particular caution should be used when using the associations in assessments of smaller areas (e.g. less than one quarter of a public land survey system (PLSS) section, <64 hectares). Model outputs should not be used in place of on-the-ground surveys for species, and wildlife and land management agency biologists should be consulted about the value of using model output to guide habitat management decisions for regional planning efforts or local projects. See [Suggested Contacts for State and Federal Natural Resource Agencies](#) attached to this document. Data used in model evaluation often have locational uncertainties that exceed the 30-meter pixel size of the land cover dataset, potentially intersecting incorrect ecological systems. Additionally, the habitat within a pixel may have been assigned to the wrong ecological system or the habitat may have been modified. As a result, evaluation metrics may be skewed low due to these errors, especially for species occupying ecotones or patchy ecological systems. Finally, users should note that although a species may be associated with a particular ecological system within its known geographic range, portions of that ecological system may occur outside of the species' known geographic range and are not mapped in this model.

## **Deductive Model Methods**

### **Modeling Process**

This model is based on the 2016 statewide land cover classifications at 30×30 meter raster pixels ([http://geoinfo.msl.mt.gov/msdi/land\\_use\\_land\\_cover](http://geoinfo.msl.mt.gov/msdi/land_use_land_cover)). Level 3 ecological systems (90) were used for this model and these data were originally mapped at a scale of 1:100,000. In general, species were associated as using an ecological system if structural characteristics of used habitat documented in the literature were present in the ecological system or large numbers of point observations were associated with the ecological system. However, species were not associated with an ecological system if there was no support in the literature for use of structural characteristics in an ecological system, even if point observations were associated with that system. Species were either commonly associated, occasionally associated, or not associated with each ecological system. This assignment was based on the degree to which the structural characteristics of an ecological system matched the preferred structural habitat characteristics for each species in the literature. The percentage of observations associated with each ecological system relative to the percent of Montana covered by each ecological system was also used to guide assignments of habitat quality. Associations are shown in Table 6.

### **Model Outputs and Evaluation**

The model output is a spatial dataset of categorical habitat suitability based on ecological system associations (commonly or occasionally associated) within the species' known range. We evaluated this model output based on known or potential distribution and habitat use in Montana and absolute validation indices (AVI) (Hirzel et al. 2006, *Ecological Modelling* 199:142-152) using presence-only data (summarized above in Table 1).

## Deductive Model Results

Table 6: Ecological Systems Associated with Baird's Sparrow

Ecological System	Code	Association	Count <sup>a</sup>
Great Plains Mixedgrass Prairie	7114	Common	409
Great Plains Sand Prairie	7121	Common	26
Great Plains Riparian	9326	Common	14
Great Plains Prairie Pothole	9203	Common	5
Rocky Mountain Lower Montane, Foothill, and Valley Grassland	7112	Common	4
Great Plains Saline Depression Wetland	9256	Common	2
Great Plains Shrubland	5262	Common	0
Great Plains Closed Depressional Wetland	9252	Occasional	6
Great Plains Open Freshwater Depression Wetland	9218	Occasional	3
Emergent Marsh	9222	Occasional	1

<sup>a</sup> A count of the observation records intersecting each ecological system, based on the 704 observation records used in the inductive model (see Table 1). This may be zero if the number of observations is low or if the ecological system is patchy.

Table 7: Area of Range and Ecological System (ES) Classes

Measure	Value
Area of entire modeled range (percent of Montana)	255,674.1 km <sup>2</sup> (67.2%)
Area of Commonly and Occasionally Associated ES	10,495.0 km <sup>2</sup>
Area of Commonly Associated ES	10,445.0 km <sup>2</sup>
Area of Occasionally Associated ES	49.0 km <sup>2</sup>

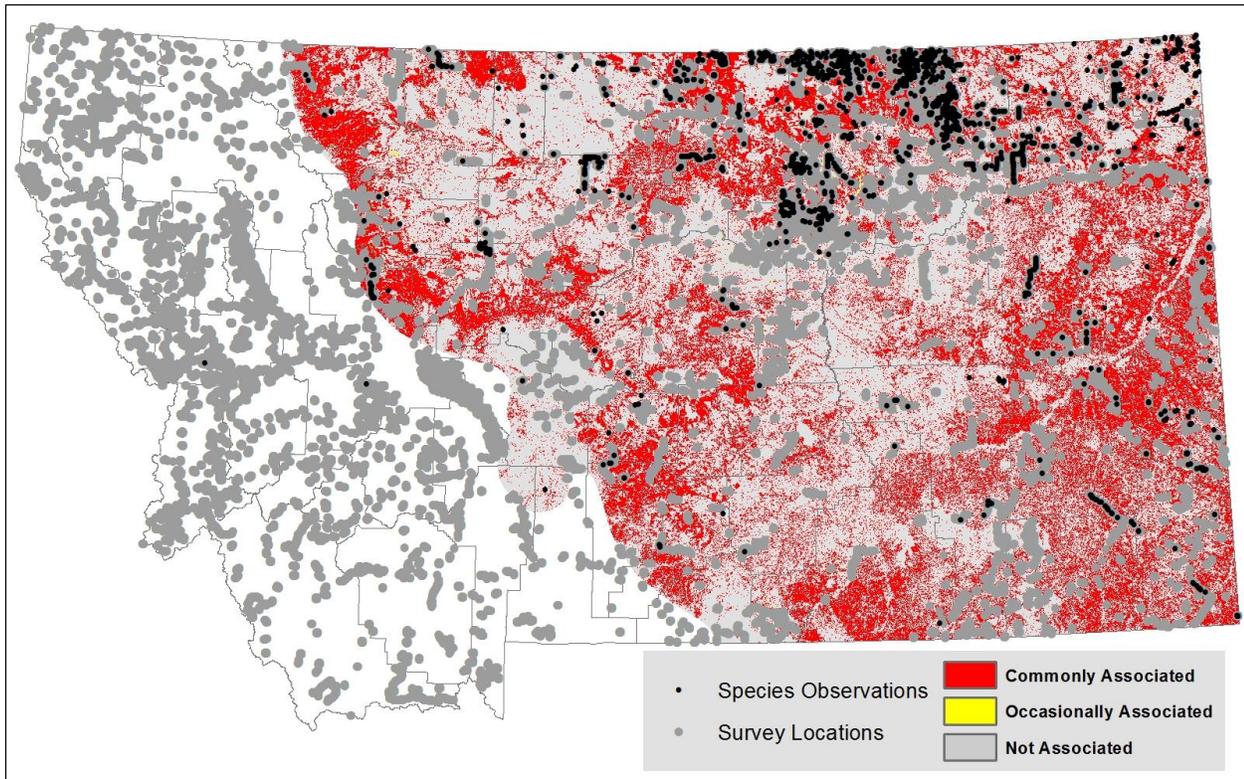
Table 8: Evaluation Metrics

Metric	Value
Commonly and Occasionally Associated ES AVI <sup>a</sup>	66.9%
Commonly Associated ES AVI <sup>a</sup>	65.4%
Occasionally Associated ES AVI <sup>a</sup>	1.4%

<sup>a</sup> Absolute Validation Index: The proportion of test locations that fall within the class(es).

### Deductive Model Map Output

Figure 10. Deductive model output classified into habitat associations.

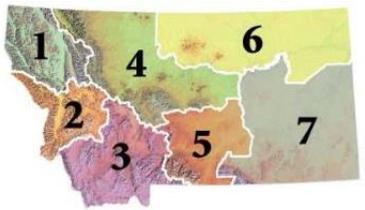


## Suggested Contacts for State and Federal Natural Resource Agencies

As required by Montana statute (MCA 90-15), the Montana Natural Heritage Program works with state, federal, tribal, nongovernmental organizations, and private partners to ensure that the latest animal and plant distribution and status information is incorporated into our databases so that it can be used to inform a variety of planning processes and management decisions. In addition to the information you receive from us, we encourage you to contact state and federal resource management agencies in the area where your project is located. They may have additional data or management guidelines relevant to your efforts. In particular, we encourage you to contact the Montana Department of Fish, Wildlife, and Parks for the latest data and management information regarding hunted and high profile management species and to use the U.S. Fish and Wildlife Service’s Information Planning and Conservation (IPAC) website <http://ecos.fws.gov/ipac/> regarding U.S. Endangered Species Act listed Threatened, Endangered, or Candidate species.

For your convenience, we have compiled a list of relevant agency contacts and links below:

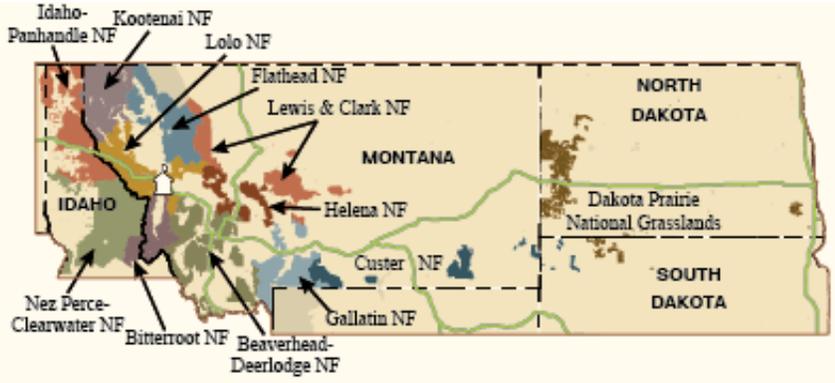
### Montana Fish, Wildlife, and Parks

Fish Species	Zachary Shattuck <a href="mailto:zshattuck@mt.gov">zshattuck@mt.gov</a> (406) 444-1231 or Lee Nelson <a href="mailto:leenelson@mt.gov">leenelson@mt.gov</a> (406) 444-2447
American Bison Black-footed Ferret Black-tailed Prairie Dog Bald Eagle Golden Eagle Common Loon Least Tern Piping Plover Whooping Crane	Lauri Hanauska-Brown <a href="mailto:LHanauska-Brown@mt.gov">LHanauska-Brown@mt.gov</a> (406) 444-5209
Grizzly Bear Greater Sage Grouse Trumpeter Swan Big Game Upland Game Birds Furbearers	John Vore <a href="mailto:jvore@mt.gov">jvore@mt.gov</a> (406) 444-5209
Managed Terrestrial Game and Nongame Animal Data	Adam Messer – MFWP Data Analyst (406) 444-0095, <a href="mailto:amesser@mt.gov">amesser@mt.gov</a>
Fisheries Data	Bill Daigle – MFWP Fish Data Manager (406) 444-3737, <a href="mailto:bdaigle@mt.gov">bdaigle@mt.gov</a>
Wildlife and Fisheries Scientific Collector’s Permits	<a href="http://fwp.mt.gov/doingBusiness/licenses/scientificWildlife/default.html">http://fwp.mt.gov/doingBusiness/licenses/scientificWildlife/default.html</a> Merissa Hayes for Wildlife (406) 444-7321 <a href="mailto:merhayes@mt.gov">merhayes@mt.gov</a> Beth Giddings for Fisheries (406) 444-7319 <a href="mailto:begiddings@mt.gov">begiddings@mt.gov</a>
Fish and Wildlife Recommendations for Subdivision Development	Renee Lemon <a href="mailto:RLemon@mt.gov">RLemon@mt.gov</a> (406) 444-3738) and see: <a href="http://fwp.mt.gov/fishAndWildlife/livingWithWildlife/buildingWithWildlife/subdivisionRecommendations/">http://fwp.mt.gov/fishAndWildlife/livingWithWildlife/buildingWithWildlife/subdivisionRecommendations/</a>
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**U.S. Fish and Wildlife Service:**

Information Planning and Conservation (IPAC) website: <http://ecos.fws.gov/ipac/>

Montana Ecological Services Field Office: <http://www.fws.gov/montanafieldoffice/> (406) 449-5225