Montana Wildlife & Transportation Partnership

Planning Tool Summary Report

Prepared by

The Montana Wildlife & Transportation Partnership

Data and Information Working Group

January 2023

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SUMMARY

The Montana Wildlife & Transportation Partnership Planning Tool (MWTP PT or Planning Tool) is a statewide resource for evaluating highway segments of interest for wildlife accommodations based on wildlife-vehicle conflicts and important areas for wildlife movement and conservation. In addition, the MWTP PT identifies areas with a need for further data collection and research efforts to fill information gaps. The Planning Tool provides coarse scale information to assist stakeholders and the interested public in working collaboratively to identify potential conservation efforts on and adjacent to transportation corridors across Montana.

This broad-scale assessment is not intended to translate into specific wildlife accommodation project locations or scopes. Rather, the Planning Tool is intended to assist the user in identifying relative areas of need on which to focus limited resources for further analysis and the development of project-level recommendations. Stakeholders and the interested public will need to form partnerships to complete fine-scale assessments within areas of interest to identify potential wildlife accommodation project scopes and specific locations. The MWTP PT can be used to coarsely identify state-maintained highway segments for developing additional analysis with fine scale data and other sources of information. In some locations within the state, finer-scale assessments already exist or are underway. Additional considerations are needed for locating wildlife accommodation projects and identifying specific accommodation features or strategies, which are not included in the Planning Tool, such as landowner and community interest and engineering realities. The primary audience for this product is the Montana Wildlife & Transportation Partnership Steering Committee (Steering Committee), state agencies, non-governmental organizations, and interested stakeholders.

INTRODUCTION

The Planning Tool combines wildlife and transportation information to identify areas of greatest need for wildlife accommodations along Montana highways. One of the six themes emerging from the 2018 Montana Wildlife & Transportation Summit was *Priorities, Data Collection, and Information Sharing*. The objective of this theme is to establish collective priorities (e.g., information needs, projects, geographic areas) and address challenges with data collection, management, use, and sharing. The Steering Committee appointed a Data and Information work group (DI Group) in May 2020. The DI Group is comprised of appointed representatives from Montana Department of Transportation (MDT), Montana Fish, Wildlife & Parks (FWP), and Montanans for Safe Wildlife Passage (MSWP) with expertise in data production and management, research and analysis, and geographic information systems (Appendix 1). The DI Group collected data layers to evaluate wildlife-vehicle conflict and important areas for wildlife movement and conservation along MDT maintained routes. Data layers considered for the analyses were at the continental, national, regional (i.e., Northern Great Plains, Pacific Northwest, etc.) statewide, and finer scales (e.g. species and habitat distributions) within Montana. Those data were compiled, categorized, weighted, and ranked to broadly identify highway segments (i.e., not specific locations) of greatest need for wildlife accommodations on or adjacent to the transportation network. Data were required to be complete and readily available to be included in the final product. If potentially valuable data did not meet these criteria, the DI Group included them on a list of data limitations (i.e., needs and gaps). As data outlined in the list of data limitations are updated or new data is determined valuable for assessment, this information could be integrated into future versions of the MWTP PT. This process should provide more accurate and robust identifications of areas of greatest need in future iterations of the Planning Tool.

The **Methodologies Section** describes the data development, Needs Assessment Criteria (NAC), and MWTP PT. The DI Group inventoried, compiled, categorized, and identified shortcomings for the input data. To identify areas of greatest need for wildlife accommodations, data were categorized into five NAC representing the primary factors contributing to wildlife and transportation challenges in Montana. Data were ranked to determine their contribution within NAC categories. The ranking approach enabled the DI Group to weight both individual data layers and NAC groups, thus integrating the strength of the input data and the contribution value of each NAC. The resulting five NAC layers were compiled into a single final cumulative score of areas of greatest need for wildlife accommodations along MDT maintained routes. Resulting NAC scores were assigned to 1-mile highway segments. The MWTP PT combines a descriptive summary, input scores, NAC source layers, and the final analysis layer in an approachable and informative map centric interface.

The **Datasets Section** provides the, 1) name, 2) basic description, 3) potential limitations, 4) data owner, 5) data source, and 6) GIS service (where applicable) for the data layers used as inputs for each of the NAC. Each of the five NAC, as well as their associated input datasets, reflect the percent contribution (i.e., weight) to the final cumulative score (i.e., displayed as the final analysis map) layer of greatest need for wildlife accommodations.

The **Limitations and Data/Information Needs Section** outlines identified data needs and gaps to help improve future evaluation of the areas of greatest need for wildlife accommodations on MDT maintained routes. Future iterations of the Planning Tool should follow an adaptive management process through integration of changes to data needs and gaps. This process will enable continuous refinement and improved identification of areas of greatest need, based on wildlife-vehicle conflict and important areas for wildlife movement and conservation. Data needs and gaps are parceled in two major categories- data refinement and data availability. Where data are currently available, the DI Group includes recommendations to collect additional information and assess data quality to improve the MWTP PT. Where data are currently unavailable, the DI Group includes recommendations to initiate the collection process so those data may be integrated and refined in future iterations of the MWTP PT. Both efforts would facilitate improvements in data assessment at broader scales, thus improving accuracy of identified areas of greatest need for wildlife accommodations. It is possible that finer-scale data may also support subsequent evaluation of need at localized levels in specific highway stretches. Fine-scale determinations about project locations are not currently possible, nor desired in this iteration of the MWTP PT. Data needs for future versions of the Planning Tool are organized into four categories: 1) data layers, 2) data collection, 3) wildlife data/models, and 4) projection/forecasting models.

METHODOLOGIES

As a first step, the DI Group drafted a mission statement, a target product description, and a list of Needs Assessment Criteria (NAC). The NAC were iteratively refined through integration of new information into the process and are the foundation of the MWTP PT used to identify important areas for wildlife accommodations on MDT maintained routes.

Mission Statement

The DI Group assembled data and supporting information to define and identify areas of greatest need for accommodations based on wildlife-vehicle conflict and important areas for wildlife movement and conservation. In addition, the DI Group identified areas with a need for further data collection and research efforts to fill information gaps. By focusing on specific NAC and their relative importance, the DI Group identified available data, key data gaps, strengths and limitations in available data, and new data collection or analysis needs. The DI Group developed an adaptive process and schedule to keep the needs assessment and supporting data updated to include new information as it becomes available. The work of the DI Group supports the development of collective priorities and continues to seek ways to address challenges with data collection, management, use, and information sharing.

The DI Group recommended to the Steering Committee how to share results and supporting data among partners and the general public in a manner that navigates data limitations and sensitivities. The Planning Tool was developed as an interactive map to facilitate such communication.

Targeted product

The DI Group produced an interactive map that shows the areas of greatest need for terrestrial wildlife accommodations associated with Montana highways under MDT jurisdiction represented by the following NACs:

1. Risk to human safety and property damage resulting from wildlife-vehicle conflict.
2. Important daily and seasonal habitats for big game and carnivores.
3. Important habitats for struggling or at-risk species.
4. Important habitats for a wide range of species.
5. Highway and adjacent linear infrastructure that may impede wildlife movement.

Initial work focused on a comprehensive exploration of information which might help identify areas with the greatest need for wildlife accommodations. The DI Group considered data sources related to a range of wildlife values and transportation considerations. Transportation related data were exclusively those occurring on or in the vicinity of highways within the state of Montana and managed by MDT. Wildlife data layers were considered from state, federal, and private sources, occurring at the continental, national, regional (i.e., Northern Great Plains, Pacific Northwest, etc.), and statewide scale. Data were evaluated based on applicable content, completeness, and accuracy. The DI Group narrowed down the possible data sources and combined them into NACs. The NACs are essentially thematic categories represented as map layers that are used for assessing the level of need for wildlife accommodations within the Planning Tool.

Following creation of the NAC categories, the DI Group assigned relative importance weights to each NAC. These weights were used for combining the map layers into a final layer identifying areas of greatest need for wildlife accommodations on Montana highways. For this weighting exercise, each DI Group member first ranked each NAC based on their subjective judgement of the order of relative importance from 1 to 5, with ties allowed. The most important criterion was given a score of 100, the second most important criterion was given a score between 0 and 100 representing its relative importance, and so on. Each score was then divided by the sum of all scores for each DI Group member to scale their relative importance values between 0-1, and these values were multiplied by 100 to obtain percentage values. The mean of all DI Group members was used as the final set of relative importance weights (Table 1, page 27). This is inherently a subjective process, and opinions about the relative importance of each NAC vary among people, as evidenced by the variation among working group members (Table 1, page 27). However, stable averages are quickly reached when a diverse group of individuals is involved in the scoring. The same exercise was conducted with the Steering Committee members, and the averages changed very little, as expected.

Spatial data layers were selected from the original data source list and assigned to each NAC. The full list of spatial data layers used is listed by NAC in the Datasets section of this document. To devise weights for each layer within each NAC, the data were assigned an objective value for spatial accuracy and data quality, as described below. A relative importance weighting exercise was conducted for each layer within each NAC, identical to the process previously used to weight the contributions of each NAC to the final analysis. To calculate a combined value for each layer, the importance weights were multiplied by the sum of spatial accuracy and data quality scores for each layer. To standardize the relative score for each layer within each NAC between 0-1, the combined value for each layer was divided by the sum of the total scores for all layers within each NAC. This score was multiplied by 100 to reach a percentage value contribution of each layer within an NAC. These relative values were used to proportionally scale map layers within each NAC to produce a combined layer for that NAC.

Assigned Values for Spatial Accuracy and Data Quality

Spatial Accuracy

5 – The map is based off exact GPS locations, or a grid cell size or line transect of ≤ .1 mile
4 – The map is based off a grid cell size or line transect between > .1 – < 1 mile
3 – The map is based off a grid cell size or line transect of 1 mile (i.e., distribution of big game range at 1 mile^2, highways broken up per mile marker)
2 – The map is based off a grid cell size or line transect between >1 – < 10 miles
1 – The map is based off a grid cell size or line transect ≥ 10 miles

Data Quality

5 – Complete census or exact representation
4 – Index that DI Group is confident correlates with the truth
3 – Index of known marginal correlation with the truth
2 – Index with known poor correlation with the truth
1 – Index of unknown correlation with the truth or randomized collection with no standards

After calculating weighted values for individual layers and NACs, spatial data layers were used to generate spatially accurate representations of areas of greatest need for wildlife accommodations. Each input data source was examined to determine its spatial representation and resolution. Most transportation data was some derivation of roadway miles (0.10-mile, 1.0-mile, etc.) and wildlife data layers included polygon features, linear features, and raster based “grids” with resolution ranging from 30 meters to many square kilometers. To equitably combine data with various spatial resolutions, the DI Group used a systematic approach to evaluate the utility of grid cells of various sizes across Montana. Grid cells of 1, 25, and 100 square kilometers (1, 5 and 10km per side, respectively) were considered for evaluating individual layer scores. Scoring was based on the maximum value for each layer occurring within the grid cell. Scores were then normalized for each individual layer across the state by transforming the range of data so the minimum value equaled 0 and the maximum value equaled 100. Rescaling allowed each individual layer to be combined equally using its percent weighting factor to generate an NAC score. The DI Group assessed potential values for each NAC and determined a 25 square kilometer area was the most reasonable grid size for combining data with differing scales and provided the best representation of data at a localized scale for needs evaluation.

The DI Group chose 1.0-mile as the length of roadway to apply analysis results. Each road segment centroid was buffered by a 5x5 km analysis window where the maximum value and scaling calculations were conducted for each input layer. Each individual layer value was multiplied by its percent contribution to each NAC to calculate a total score for each NAC. The NAC values were then normalized so those values could be multiplied by the individual NAC weight to calculate a final score and layer. The NAC layers exhibited some clumping and outliers in the distribution of values, thus the bottom 50% of values were scaled relative to each other and top 50% were scaled in the same way. The final composite score was calculated in a similar fashion, but instead of using 50% of values, the mean value was used to segment the data for scaling. The results of each NAC calculation and the final composite score calculation was therefore representative of a consistent range of values at a consistent spatial scale.

To account for the use of incomplete but valuable datasets in this analysis, the DI Group made one additional adjustment to achieve an equitable evaluation of accommodation need. For example, pronghorn migration is a valuable spatial data layer but is not complete for MT. This layer is complete for North Central and North-Eastern MT, but instead of assigning a 0 value for this input layer to the rest of the state, the layer was removed from consideration when the total % contribution of input layers was calculated. Put simply, if there were three layers contributing equally inside the Pronghorn Research Area, each would comprise 33%; outside the Pronghorn Research area only two layers would be evaluated with each contributing 50% to the score. In contrast, even though grizzly bear connectivity layers only cover areas of Western MT, the dataset is complete and therefore areas in Eastern MT received a value of 0 and are considered in the percent calculation. Data layers with incomplete coverage are listed in the Datasets section.

The map layers within the MWTP PT are intended to be reviewed and updated as described in the Maintenance Plan below, to account for possible changes that might influence the needs assessment of roadway segments for wildlife accommodations (e.g., traffic volume, growth and development, or climate change). The interactive map can be used to identify information needs and direct new data collection or research efforts and to help identify locations for wildlife accommodations. Additional considerations are needed for locating wildlife accommodation projects and identifying specific accommodation features or strategies, which are not included in the needs assessment or the map, such as landowner and community interest and engineering realities. The primary audiences for our product are the Montana Wildlife & Transportation Partnership Steering Committee, state agencies, non-governmental organizations, and interested stakeholders.

DATASETS

Percent values in parentheses represent final values from the scoring exercises (described above) and were used to combine layers into the overall final analysis for important areas for wildlife accommodations on Montana highways. See Appendix 3 for NAC and map layer values.

Criterion 1: Risk to Human Safety and Property Damage Resulting from Wildlife-Vehicle Conflict (35%)

- MHP Animal Crash Data (18.26%)

  -Basic Description: Animal Crash Data (total numbers of carcasses) collected by Montana Highway Patrol at the location of an incident.

  -Limitations: Accuracy depends on user input on Montana highways. Data are only representative of incidences where wildlife was the cause of a crash over the last 10 years. Data are variable on Indian Reservations and National Parks.

  -Data Owner: Montana Highway Patrol

  -Data Source: Montana Department of Transportation, Traffic Safety Section

  -GIS Service: https://services1.arcgis.com/dKlvxNSUvl36IGMp/arcgis/rest/services/Animal_Crashes_2010_2019/FeatureServer

- MDT Carcass Data (12.99%)

  -Basic Description: Total numbers of carcasses that are collected on the road for state-maintained roads.

  -Limitations: Data available per 0.10 -mile. Collection and reporting are not standard across the state and effort varies greatly from MDT Section to Section. Collection is opportunistic and many locations are general. Data are variable on Indian Reservations and National Parks.

  -Data Owner: Montana Department of Transportation

  -Data Source: Montana Department of Transportation, Traffic Safety Section

  -GIS Service: https://mdt.maps.arcgis.com/home/item.html?id=9d07ff10638e4ea5bc6bba63606dbc8f

- MDT Traffic Volume Data (3.65%)

  -Basic Description: Annual Average Daily Traffic (AADT) is the average 24hr traffic volume at a given location along a route over the full 365 days in a year. Data are updated annually. Traffic segments were weighted using the Killed% to AADT curve (**Figure 1**).

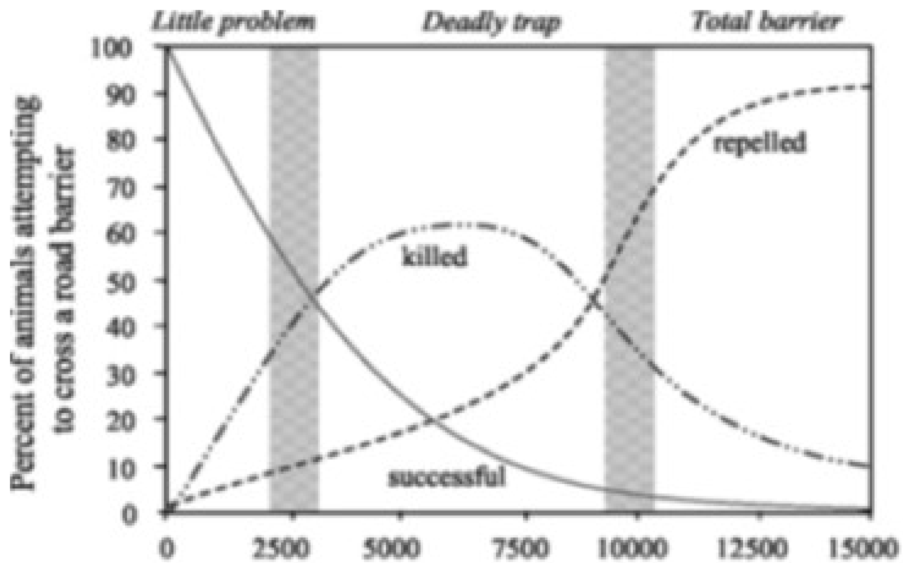

Figure 1: Conceptual model of the effect of traffic volume on the percentage of animals that successfully cross a road, are repelled by traffic noise and vehicle movement, or get killed as they attempt to cross. The conceptual model indicates that most collisions occur on intermediate (i.e., two-lane) roads (from Seiler 2003). Here, DI Group used this as a proxy for the risk to human safety and property damage. For example, at low annual average daily traffic (AADT) (i.e., <2500) there is less potential for animal vehicle collisions (AVC) because there is lower interaction between vehicles and animals on the roadway. At high AADT (i.e., >10,000) there is less potential for AVC because the high AADT and disturbance repels wildlife from traffic noise and presence of vehicles. The mid-range AADT (2500-10,000) has the highest potential for AVC because wildlife is attempting to cross the road and vehicles are present.

-Limitations: Data represent the average annual traffic volume for 24 hrs. Data does not identify seasonal or hourly fluctuations in traffic volume.

-Data Owner: Montana Department of Transportation

-Data Source: Montana Department of Transportation, Traffic Data Collection and Analysis Section

-GIS Service: https://app.mdt.mt.gov/arcgis/rest/services/Standard/Traffic/MapServer

Criterion 2: Important Daily and Seasonal Habitats for Big Game and Carnivores (19%)

Big Game and Carnivore General Distributions

- Bighorn Sheep Distribution (1.28%)

  -Basic Description: General and winter range delineated by local biologists from Montana Fish, Wildlife & Parks. Last updated in 2008.

  -Limitations: 1 sq. mile resolution. Data updates are infrequent. Data are not available on Indian Reservations and National Parks.

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: GIS Data Access Page

  -GIS Service: GIS Service Link

- Mountain Goat Distribution (1.28%)

  -Basic Description: General and winter range delineated by local biologists from Montana Fish, Wildlife & Parks. Last updated in 2008.

  -Limitations: 1 sq. mile resolution. Data updates are infrequent. Data are not available on Indian Reservations and National Parks.

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: GIS Data Access Page

  -GIS Service: GIS Service Link

- Moose Distribution (1.31%)

  -Basic Description: General and winter range delineated by local biologists from Montana Fish, Wildlife & Parks. Last updated in 2008.

  -Limitations: 1 sq. mile resolution. Data updates are infrequent updates. Data are not available on Indian Reservations and National Parks.

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: GIS Data Access Page

  -GIS Service: GIS Service Link

- White-tailed Deer Distribution (1.29%)

  -Basic Description: General and winter range delineated by local biologists from Montana Fish, Wildlife & Parks. Last updated in 2008.

  -Limitations: 1 sq. mile resolution. Data updates are infrequent. Data are not available on Indian Reservations and National Parks.

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: GIS Data Access Page

  -GIS Service: GIS Service Link

- Mule Deer Distribution (1.37%)

  -Basic Description: General and winter range delineated by local biologists from Montana Fish, Wildlife & Parks. Last updated in 2008.

  -Limitations: 1 sq. mile resolution. Data updates are infrequent. Data are not available on Indian Reservations and National Parks.

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: GIS Data Access Page

  -GIS Service: GIS Service Link

- Elk Distribution (1.30%)

  -Basic Description: General and winter range delineated by local biologists from Montana Fish, Wildlife & Parks. Last updated in 2008.

  -Limitations: 1 sq. mile resolution. Data updates are infrequent. Data are not available on Indian Reservations and National Parks.

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: GIS Data Access Page

  -GIS Service: GIS Service Link

- Pronghorn Distribution (1.21%)

  -Basic Description: General and winter range delineated by local biologists from Montana Fish, Wildlife & Parks. Last updated in 2008.

-Limitations: 1 sq. mile resolution. Data updates are infrequent. Data are not available on Indian Reservations and National Parks.

-Data Owner: Montana Fish, Wildlife & Parks

-Data Source: GIS Data Access Page

-GIS Service: GIS Service Link

- Black Bear Distribution (1.25%)

  -Basic Description: General and winter range delineated by local biologists from Montana Fish, Wildlife & Parks. Last updated in 2008.

  -Limitations: 1 sq. mile resolution. Data updates are infrequent. Data are not available on Indian Reservations and National Parks.

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: GIS Data Access Page

  -GIS Service: GIS Service Link

- Wolf Distribution (0.77%)

  -Basic Description: Predicted annual wolf density in Montana from 2007 to 2019. The number of wolves per 1,000 sq. km was estimated for 600 sq. km grid cells using an integrated patch occupancy model (Sells et al. 2020).

  -Limitations: Coarse resolution

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: https://gis-mtfwp.opendata.arcgis.com/datasets/ec4443ee80d64ff0b0c8a346ad1ff959_0

  -GIS Service: https://services3.arcgis.com/Cdxz8r11hT0MGzg1/arcgis/rest/services/WILD_WOLF_DENSITY/FeatureServer

- Fisher Distribution (0.79%)

  -Basic Description: Predicted fisher occupancy within 7.5 x 7.5-km grid cells in Montana, Idaho, and northeastern Washington based on 2018-19 survey data summarized in Krohner et al. 2022.

  -Limitations: Coarse resolution

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: https://gis-mtfwp.opendata.arcgis.com/datasets/401b5ff28f994906ad228904827479f8_0

  -GIS Service: https://services3.arcgis.com/Cdxz8r11hT0MGzg1/arcgis/rest/services/WILD_FISHER_OCCUPANCY/FeatureServer

- Wolverine Distribution (0.74%)

    -Basic Description: Spatial occupancy model for wolverine occupancy in Idaho, Montana, Washington, and Wyoming, USA in 2016 and 2017. The probability of occupancy on plot and standard error were modeled for 15-km × 15-km cells (Lukacs et al. 2020).

    -Limitations: Coarse resolution

    -Data Owner: Montana Fish, Wildlife & Parks

    -Data Source: https://gis-mtfwp.opendata.arcgis.com/datasets/8589d93f37034b6c8821ffe34c3364b4_0

    -GIS Service: https://services3.arcgis.com/Cdxz8r11hT0MGzg1/arcgis/rest/services/WILD_WOLVERINE_OCCUPANCY/FeatureServer

- Mountain Lion RSF (1.54%)

    -Basic Description: Mountain lion winter resource selection function (RSF) model developed by Robinson et al. 2015 and updated in 2018 as part of the Montana Mountain Lion Monitoring and Management Strategy (MFWP 2019).

    -Limitations: Unknown update frequency.

    -Data Owner: Montana Fish, Wildlife & Parks

    -Data Source: N/A - Can be requested from owner

    -GIS Service: N/A - Not available

Connectivity Models

- Wolverine Connectivity (1.50%)

    -Basic Description: Modeled predictions of wolverine habitat connectivity across the U.S. (Carroll et al. 2020).

    -Limitations: Based on GPS collar movement data from the Greater Yellowstone Ecosystem. Model extrapolated to other ecosystems and ecological conditions.

    -Data Owner: Montana Fish, Wildlife & Parks

    -Data Source: N/A - Can be requested from owner

    -GIS Service: N/A - Not available

- Northern Rockies Black Bear Connectivity (1.37%)

  -Basic Description: Black Bear movement corridor strength predicted from a factorial least cost path analysis across a resistance map (Cushman et al. 2013). This layer shows the major nodes through which large numbers of least cost routes pass.

  -Limitations: Model does not fully cover Black Bear range in Montana.

  -Data Owner: Samuel Cushman - US Forest Service Rocky Mountain Research Station

  -Data Source: https://databasin.org/datasets/507f5ae4d8da4bcdbf350056ab00ef6d/

  U.S. Northern Rockies Black Bear Movement Corridor Intensity - ScienceBase-Catalog

  -GIS Service: https://www.sciencebase.gov/arcgis/rest/services/Catalog/5525c354e4b026915857c5f6/MapServer/

- Pronghorn Spring/Fall Connectivity (1.68%)

  -Basic Description: Indicates predicted connectivity during both spring and fall migratory seasons, based off integrated-step selection function probability models derived from pronghorn female GPS collar data collected 2004-2011 in a portion of the Hi-Line region (Jakes 2015).

  -Limitations: In Montana, only covers Northern Montana ‘Hi-Line’ region - from Eastern border of Glacier National Park to the MT/ND border and from Canadian border South to Marias and Missouri Rivers.

  -Data Owner: Andrew Jakes

  -Data Source: N/A - Can be requested from author

  -GIS Service: N/A - Not available

Criterion 3: Important Habitats for Struggling or At-risk Species (SOC 1 or 2 and Federally Listed) (12%)

Montana Natural Heritage Program Species of Concern Tier 1 and 2 Predictive Distribution Maps

- White-tailed Prairie Dog (0.78%)

  -Basic Description: Modeled habitat

  -Limitations: May be based on limited input data and unknown update frequency.

  -Data Owner: Montana Natural Heritage Program

  -Data Source: Montana Natural Heritage Program Animal Information

  -GIS Service: N/A - Can be requested from data source link

- Northern Short-tailed Shew (0.67%)

  -Basic Description: Known Montana range

  -Limitations: Low resolution range polygons and no representation of population density.

  -Data Owner: Montana Natural Heritage Program

  -Data Source: Montana Natural Heritage Program Animal Information

  -GIS Service: N/A - Can be requested from data source link

- Northern Bog Lemming (0.72%)

  -Basic Description: Modeled habitat

  -Limitations: May be based on limited input data and unknown update frequency.

  -Data Owner: Montana Natural Heritage Program

  -Data Source: Montana Natural Heritage Program Animal Information

  -GIS Service: N/A - Can be requested from data source link

- Dwarf Shrew (0.72%)

  -Basic Description: Modeled habitat

  -Limitations: May be based on limited input data and unknown update frequency.

  -Data Owner: Montana Natural Heritage Program

  -Data Source: Montana Natural Heritage Program Animal Information

  -GIS Service: N/A - Can be requested from data source link

- Bison (0.77%)

  -Basic Description: Known Montana range (wild herds)

  -Limitations: Low resolution range polygons and no representation of population density.

  -Data Owner: Montana Natural Heritage Program

  -Data Source: Montana Natural Heritage Program Animal Information

  -GIS Service: N/A - Can be requested from data source link

- Arctic Shrew (0.67%)

  -Basic Description: Known Montana range

  -Limitations: Low resolution range polygons and no representation of population density.

  -Data Owner: Montana Natural Heritage Program

  -Data Source: Montana Natural Heritage Program Animal Information

  -GIS Service: N/A - Can be requested from data source link

- Idaho Pocket Gopher (0.72%)

  -Basic Description: Modeled habitat

  -Limitations: May be based on limited input data and unknown update frequency.

  -Data Owner: Montana Natural Heritage Program

  -Data Source: Montana Natural Heritage Program Animal Information

  -GIS Service: N/A - Can be requested from data source link

- Black-footed Ferret (0.90%)

  -Basic Description: Known Montana range

  -Limitations: Low resolution range polygons and no representation of population density.

  -Data Owner: Montana Natural Heritage Program & USFWS

  -Data Source: Montana Natural Heritage Program Animal Information

  -GIS Service: N/A - Can be requested from data source link

Other Species Distribution and Connectivity Models

- Grizzly Bear Range (1.34%)

  -Basic Description: Distribution based on expert judgement assembled by state and federal grizzly bear specialists from current records and local knowledge.

  -Limitations: Does not represent the entire distribution of grizzly bears, but instead regions where people can expect to consistently find grizzly bears. Update frequency is unknown.

  -Data Owner: USFWS

  -Data Source: USFWS | Grizzly Bear

  https://www.fws.gov/mountain-prairie/es/species/mammals/grizzly/usfws_A001_V01_Ursus_arctos_horribilis_area_of_influence.zip

  -GIS Service: N/A - Can be downloaded from the data source link.

- Grizzly Bear connectivity (1.41%)

  -Basic Description: Maximum values from combined NCDE-GYE Grizzly Bear predictive movement model for male grizzly bears (Peck et al. 2017) and Transboundary Grizzly Bear connectivity model based on genetic analyses of male and female grizzly bears (Proctor et al. 2015).

  -Limitations: This layer is a combination of two separate layers that cover complementary areas. While the combined layer represents the best current information about grizzly bear genetic connectivity across the range in Montana, the component layers represent different biological processes. The Peck et al (2017) layer is based on movement analyses from GPS-collared male bears in the NCDE and GYE and represents the likely pathways male bears would use to move (and therefore spread genes) between the two ecosystems, which has not yet been documented. The Proctor et al. (2015) layer covers the NCDE and GYE areas in Montana and represents predicted gene-flow pathways based on analyses of existing genetic samples from male and female bears collected in those areas and further north in Canada. Neither layer represents potential movement pathways to the Bitterroot Ecosystem or other parts of Montana, and female range expansion or genetic connectivity from the NCDE to the GYE is also not represented in this combined layer.

  -Data Owner: Authors

  -Data Source: https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.1969;

  https://databasin.org/datasets/dfbc14e3e7bd4a5c94d7a6fb7a6008d1

  -GIS Service: N/A - Peck source can be requested from authors. Proctor source can be downloaded from data source link.

- Lynx Range (1.56%)

  -Basic Description: Spatial predictions of relative habitat probability for Canada lynx across the northwest United States and Canada. (Olson et al. 2021).

  -Limitations: Predictions represents potential lynx distribution rather than actual distribution or occupancy.

  -Data Owner: US Forest Service

  -Data Source: Improved prediction of Canada lynx distribution through regional model transferability and data efficiency - Olson - 2021 - Ecology and Evolution - Wiley Online Library

  -GIS Service: N/A - data set can be requested from author

- Lynx Connectivity (1.77%)

  -Basic Description: Modeled lynx habitat connectivity in the Northern Rockies (Squires et al. 2013). Models are different for winter and summer corridors.

  -Limitations: Model is narrow in spatial extent and only covers a portion of lynx range within Montana.

  -Data Owner: John Squires - US Forest Service Rocky Mountain Research Station

  -Data Source: https://databasin.org/datasets/4b13d8478c664b05a4b2b1cd605c5bb7

  -GIS Service: N/A - data set can be requested from author

Criterion 4: Important Habitats for a Wide Range of Species (14%)

Montana FWP State Wildlife Action Plan (SWAP)

- Tier 1 Community Types (4.68%)

  -Basic Description: Biodiverse habitat types (i.e., riparian, wetlands, etc.) identified as Tier 1 terrestrial community types defined for the Montana Fish, Wildlife and Parks State Wildlife Action Plan (SWAP) 2014. Communities were based on the Montana Landcover Level 2 GIS layer.

  -Limitations: Updated relatively infrequently (approximately 10 year intervals), although current landcover may be used.

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: N/A - Can be requested from owner

  -GIS Service: N/A - Not available

- Tier 1 Terrestrial Focus Areas (1.68%)

  -Basic Description: Areas identified as priority areas for terrestrial conservation efforts within the Montana State Wildlife Action Plan (SWAP) 2014.

  -Limitations: No planned update and focus areas are coarse scale.

  -Data Owner: Montana Fish, Wildlife & Parks

  -Data Source: https://gis-mtfwp.opendata.arcgis.com/datasets/0b4106262f154e5295fda61ef6c8f1cf_0

  -GIS Service: https://services3.arcgis.com/Cdxz8r11hT0MGzg1/arcgis/rest/services/CNSVTN_SWAP_TERR_FOCAL_AREAS/FeatureServer

Climate Models

- Riparian Climate Corridors (1.28%)

  -Basic Description: Identified riparian areas (based on HUC 6 quintile values) important for climate adaptation (Krosby et al. 2018).

  -Limitations: Layer only covers western Montana and biological meaning is vague.

  -Data Owner: Krosby et al. (2018) authors

  -Data Source: https://databasin.org/galleries/58411c761def4a54a477bebc48a57db1

  -GIS Service: N/A - Can be downloaded from data source link.

- Climate Corridors (2.17%)

  -Basic Description: Current climates and their future analogs to identify persistent wildlife routes (Carroll et al. 2018). Representation of "climate corridors", areas that form the best route between current climate types and where those climates will occur in the future under climate change.

  -Limitations: Layer is coarse resolution and biological meaning is vague.

  -Data Owner: Carroll et al. (2018) authors

  -Data Source: https://adaptwest.databasin.org/pages/climate-connectivity-north-america

  -GIS Service: N/A - Can be downloaded from data source link.

Habitat Connectivity Models

- Western US Connectivity (1.12%)

  -Basic Description: Prediction models of connectivity among Western US protected areas (Dickson et al. 2016). A flow-based model of ecological connectivity between individual protected area centroids was implemented using Circuitscape software.

  -Limitations: Models contain large edge effects and are species agnostic and therefore vague in biological meaning.

  -Data Owner: Conservation Science Partners, Inc

  -Data Source: https://databasin.org/datasets/7e62c9930e734bbf8ab32d50db97f0c3

  -GIS Service: N/A - Can be downloaded from data source link.

- Local Connectedness (2.61%)

  -Basic Description: High resolution layer with climate considerations and refugia (TNC 2020). Local connectedness estimates how easily species can access their local neighborhoods based on the arrangement of roads, industrial agriculture, development, and other human structures. Note: In the Montana Fish, Wildlife & Parks State Wildlife Action Plan (SWAP) from 2014, an 'intact landscape blocks' GIS layer was produced that was highly correlated to the TNC 2020 layer. As such, it is appropriate to use only one of these layers and thus, the TNC 2020 layer was selected, which is an intersected, seamless layer from Anderson et al. (2019), Anderson et al. (2018), and Buttrick et al. (2015). Use the Data Source link below to obtain the TNC 2020 seamless layer.

  -Limitations: Relevancy and utility can be impacted by quickly changing human influence on the landscape.

  -Data Owner: The Nature Conservancy

  -Data Source: https://www.conservationgateway.org/ConservationPractices/ClimateChange/Pages/RCN-Downloads.aspx

  -GIS Service: N/A - Can be downloaded from data source link.

Criterion 5: Highway and Adjacent Linear Infrastructure that may Impede Wildlife Movement (21%)

- Traffic Volume (6.04%)

  -Basic Description: 2020 Annual Average Daily Traffic is the average 24hr traffic volume at a given location along a route over the full 365 days/year. Data is updated annually. Traffic segments were weighted using the repelled% to AADT curve (**Figure 2**).

  -Limitations: Data only captures the average annual traffic volume for 24 hours - no seasonal variation in traffic is represented.

  -Data Owner: Montana Department of Transportation

  -Data Source: Montana Department of Transportation, Traffic Data Collection and Analysis Section

  -GIS Service: https://app.mdt.mt.gov/arcgis/rest/services/Standard/Traffic/MapServer

- Projected Future Traffic Volume (3.82%)

  -Basic Description: 2040 compound annual growth rate based on the last 20 years of traffic volumes at a given location along a route. This dataset is used to project future traffic volumes and is updated annually. Traffic segments were weighted using the repelled% to AADT curve (**Figure 2**).

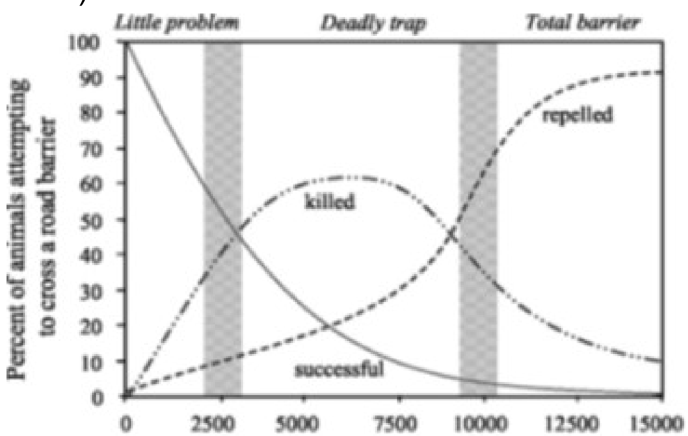

Figure 2: Conceptual model of the effect of traffic volume on the percentage of animals that successfully cross a road, are repelled by traffic noise and vehicle movement, or get killed as they attempt to cross. The conceptual model indicates that most animal-vehicle collisions occur on intermediate volume roads (Seiler 2003). For example, the higher the traffic volume, the less likely that wildlife will successfully cross a roadway and the more of an impediment the roadway is to wildlife.

-Limitations: Dataset only provides the estimated average annual traffic volume for 24hrs for 2040. Dataset does not identify seasonal or hourly fluctuations in traffic volume.

-Data Owner: Montana Department of Transportation

-Data Source: Montana Department of Transportation, Traffic Data Collection and Analysis Section

-GIS Service: https://app.mdt.mt.gov/arcgis/rest/services/Standard/Traffic/MapServer

- Speed Limit (3.76%)

  -Basic Description: The posted speed limit on a given section of road.

  -Limitations: Data only represents State Maintained roads outside of city limits.

  -Data Owner: Montana Department of Transportation

  -Data Source: Montana Department of Transportation, Geospatial Information Section

  -GIS Service: https://app.mdt.mt.gov/arcgis/rest/services/ALTIS/ALTIS_API/MapServer/24

- Adjacent Linear Features (2.84%)

  -Basic Description: A subset of roads and railroads within 100 meters of MDT's On-System routes. The subset of data is weighted by type (1.0 for Railroad | 1.5 for Unpaved Roads | 2.0 for Paved Roads) and aggregated to the nearest 1.0-mile route segment.

  -Limitations: Dataset is a complex mixture of geometric features and attributes for these features are derived from many different sources. Dataset was last updated in May 2015.

  -Data Owner: Montana State Library

  -Data Source: https://geoinfo.msl.mt.gov/msdi/transportation/

  -GIS Service: https://gisservicemt.gov/arcgis/rest/services/MSDI_Framework/Transportation/MapServer

- Surface Width (4.41%)

  -Basic Description: Driving surface width from seal and cover width, identified by construction plans or field inventory.

  -Limitations: Surface width was doubled for Interstates since the dataset only represents one side of the Interstate.

  -Data Owner: Montana Department of Transportation

  -Data Source: Montana Department of Transportation, Geospatial Information Section

  -GIS Service: https://app.mdt.mt.gov/arcgis/rest/services/ALTIS/ALTIS_API/MapServer/31

LIMITATIONS AND DATA/INFORMATION NEEDS

Data Layers

Road layers:

- Specifically, for interstate highways or any road surface with a median bisecting travel lane, road widths are currently measured by assessing one directional surface (i.e., east bound traffic on I-90).
- Seasonality of traffic volume layer needs to be created and assessed. There is likely great variation in seasonal traffic volume, particularly in Western Montana.
- Hourly differentiation of traffic volume layer needs to be created and assessed, potentially to include types of vehicles (i.e., cars versus trucks).
- Non-MDT roads were not assessed in this process but could be considered in future iterations based on animal-vehicle collisions and carcass data.

Canal layers:

Currently, canals are part of the natural rivers/stream/creeks/stream hydrology layer. Canals need to be identified as a separate layer and updated with specifications. Some examples are

- the entity which manages the canal/ditch
- the width of the canal/ditch

Fence layers:

A statewide layer representing fences along and adjacent to transportation corridors is needed, as certain kinds of fences and fence designs impose more of a movement barrier to some wildlife species than others. Additionally, adequate fencing can serve as a barrier to wildlife entering road corridors and therefore reduce wildlife-vehicle collisions. When paired with wildlife accommodations designed to promote wildlife movement safely across highways, such exclusionary fencing can help direct wildlife movements and promote connectivity. This layer should include fence characteristics (e.g., woven wire, multi-strand barbed wire, height, etc.).

An additive layer of linear features

A statewide layer accounting for parallel linear features that are adjacent to roads within the transportation corridor is needed. The Data and Information Working Group has created an initial layer (a novel approach), but more detail can be provided for each linear feature type and amassed using standardized procedures (i.e., weighting).

Data Collection

- A more standardized and detailed collection and reporting approach used by MDT for wildlife carcass collection is needed
- A more standardized approach for animal crash data collected by Montana Highway Patrol and other law enforcement agencies is needed.
- Missing animal crash data and carcass data on both Reservations and National Parks. As a first step, contact Tribal and National Park personnel to discuss current data limitations and needs, as well as standardizing data collection opportunities within these areas to those along state-maintained highways.
- A more standardized collection and reporting protocol used in citizen science approaches is needed. Currently, multiple organizations have applications to collect citizen-science data related to wildlife and transportation interactions. Among the information gathered, data collection may include species identification, time stamped locations where wildlife is observed crossing highways, wildlife carcass locations, locations where wildlife are seen adjacent to highways, and locations where wildlife are not observed.

Wildlife Data/Models

Wildlife distribution and connectivity layers:

Many of the wildlife data layers are updated periodically, regularly, and/or as new information becomes available. As new results become available, they can be incorporated into new versions of the MWTP PT as described in the Maintenance Plan below. Distribution layers are periodically updated. For example, wolf density layers are updated annually, while wolverine and fisher surveys are completed every five years. Some of the layers could be improved with additional analyses. For example, an effort is underway to model male and female grizzly bear connectivity among all the recovery ecosystems in Montana using GPS collar data. Also, a new project is beginning to develop and validate predictive winter range models for big game, which may offer finer-scale data than those incorporated into this first version of the Planning Tool. Depending on accuracy of winter range models, similar models will also be developed for big game summer range and migration habitat. Additionally, accurate layers representing the current distribution of some species were not available for incorporation into the first version of the Planning Tool. For example, recent data on the actual distribution of lynx, marten, and swift foxes in Montana does not exist, so these species were not included. Layers identifying lynx connectivity areas and suitable habitat were used, but current lynx habitat models do not differentiate between occupied and unoccupied areas and so do not represent current distribution. Survey plans are being made for these species, so that data on their distribution will be included in future iterations. In future iterations of the tool, investigations could also include whether and to what extent there is support for using existing data for all terrestrial species to identify areas of interest for wildlife accommodations.

Projection/Forecasting Models

Predicted future changes in wildlife distribution or connectivity across the landscape due to climate change or human development were not incorporated. Because it is important to ensure that investments in wildlife accommodations will be relevant and viable throughout the service life of the infrastructure, this is an important gap that needs to be addressed in future iterations of the MWTP PT. One solution is performing scenario modeling where anthropogenic influences fluctuate (i.e., increase/decrease) by varying amounts into the future. These influences include climate change, habitat loss/restoration, transportation development/mitigation efforts, etc. Specific to transportation corridors and infrastructure, predictions of population growth and distribution, overall traffic volume, and needs for goods and services (i.e., commercial truck traffic) can be evaluated.

MWTP PT MAINTENANCE PLAN

Appropriate datasets will be updated annually within the current version of the MWTP PT. For example, carcass, collision, and wildlife survey data are updated annually or at regular intervals, and the most current data will be incorporated into the MWTP PT. This will be handled by MDT and MFWP GIS and technical staff on an annual schedule. The version of the Planning Tool accessible online should always be considered the most recent version.

Larger changes to the Planning Tool, such as modifying or adding needs assessment criterion, adding new layers to improve a needs assessment criterion, or revisions to data analysis methods, can be incorporated into new versions of the MWTP PT in the future. For example, MDT is currently working on creating a layer of completed wildlife accommodation projects for inclusion into subsequent iterations of the Planning Tool. However, these types of changes take considerable time and will require reconvening the DI Group to determine the best approach to integrating additional methods, data, or functionality into the MWTP PT. Such Planning Tool updates will be considered and authorized by the Steering Committee at 5-year intervals. The Steering Committee may decide that changes to the MWTP PT are not warranted at a 5-year interval or may be needed sooner if changes are determined critical by the DI Group, meaning that new versions of the Planning Tool could be released at intervals other than 5 years.

Table 1: The final needs assessment criteria (NAC) importance weights, using the mean scores of working group members.

	Working Group Member #1	Working Group Member #2	Working Group Member #3	Working Group Member #4	Working Group Member #5	Working Group Member #6	Working Group Member #7	**Working Group Mean (Final) Importance Weight**
Risk to human safety and property damage from wildlife-vehicle conflict.	50%	22%	36%	42%	34%	29%	32%	35%
Important daily and seasonal habitats for big game and carnivores.	8%	28%	18%	17%	22%	21%	16%	19%
Important habitats for struggling or at-risk species.	8%	13%	14%	14%	11%	14%	10%	12%
Important habitats for a wide range of species.	8%	17%	14%	14%	11%	14%	16%	14%
Highway and adjacent linear infrastructure that may impede wildlife movement.	25%	21%	18%	13%	22%	21%	26%	21%

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APPENDIX 1: MWTP Committees and Members

MT Wildlife & Transportation Partnership Steering Committee

Current Members:

Stephanie Adams – Montanans for Safe Wildlife Passage

Dwane Kailey – Montana Department of Transportation

Tom Martin – Montana Department of Transportation

Ken McDonald – Montana Fish, Wildlife & Parks

Deb O'Neill – Montana Fish, Wildlife & Parks

Kylie Paul – Montanans for Safe Wildlife Passage

Former Members:

Paul Sihler – Montana Fish, Wildlife & Parks

Charlie Sperry – Montana Fish, Wildlife & Parks

Mike Tooley – Montana Department of Transportation

Lynn Zanto – Montana Department of Transportation

Data and Information Working Group

Brian Andersen – Montana Department of Transportation

Liz Fairbank – Montanans for Safe Wildlife Passage

Justin Gude – Montana Fish, Wildlife & Parks

Andrew Jakes – Montanans for Safe Wildlife Passage

Adam Messer – Montana Fish, Wildlife & Parks

Gabe Priebe – Montana Department of Transportation

Paul Sturm – Montana Department of Transportation

Planning and Information Team (PIT Crew)

Current Members:

Lauri Hanauska-Brown – Montana Fish, Wildlife & Parks

Brooke Shifrin – Montanans for Safe Wildlife Passage

Deb Wambach – Montana Department of Transportation

Former Members:

Barb Beck – Montana Fish, Wildlife & Parks

Nick Clarke – Montanans for Safe Wildlife Passage

Hannah Jaicks – Montanans for Safe Wildlife Passage

Renee Lemon – Montana Fish, Wildlife & Parks

Laramie Maxell – Montanans for Safe Wildlife Passage

Linnaea Schroeer – Montana Fish, Wildlife & Parks

APPENDIX 2: Acronyms

AADT – Annual Average Daily Traffic

AVC – Animal Vehicle Collision

DI Group – Data and Information Working Group

GIS – Geographic Information System

GPS – Global Positioning System

GYE – Greater Yellowstone Ecosystem

HUC – Hydrologic Unit Code

MDT – Montana Department of Transportation

MFWP – Montana Fish, Wildlife & Parks

MWTP PT – Montana Wildlife & Transportation Planning Tool

NAC – Needs Assessment Criteria

NCDE – Northern Continental Divide Ecosystem

PIT – Planning and Information Team

RSF – Resource Selection Function

SWAP – State Wildlife Action Plan

TNC – The Nature Conservancy

USFWS – United States Fish & Wildlife Service

APPENDIX 3: Needs Assessment Criteria and Map Layer Values

NAC	NAC Weight	Map Layer	MEAN NAC SCORE	MEAN NAC %	FULL MAP LAYER	SPATIAL ACCURACY	DATA QUALITY	OVERALL NAC %
1 – Risk to human safety and property damage resulting from wildlife-vehicle conflict.	0.349033							
		MHP Animal Crash Data	4.5	52.33%	Y	5	4	50.0%
		MDT Carcass Data	3.2	37.21%	Y	5	3	40.0%
		MDT Traffic Volume Data	0.9	10.47%	Y	4	5	10.0%
		Totals	**8.6**	**100.00%**				**100.00%**
2 - Important daily and seasonal habitats for big game and carnivores.	0.186676							
		Big Game & Carnivore General Distribution						
		Bighorn Sheep Distribution (General/Winter Range)	0.51	6.85%	N	3	5	6.36%
		Mountain Goat Distribution (General/Winter Range)	0.51	6.85%	N	3	5	6.36%
		Moose Distribution (General/Winter Range)	0.52	7.02%	N	3	5	6.52%
		White-tailed Deer Distribution (General/Winter Range)	0.51	6.91%	N	3	5	6.42%
		Mule Deer Distribution (General/Winter Range)	0.54	7.32%	N	3	5	6.80%
		Elk Distribution (General/Winter Range)	0.52	6.98%	N	3	5	6.48%
		Antelope Distribution (General/Winter Range)	0.48	6.46%	N	3	5	6.00%
		Black Bear Distribution (General)	0.50	6.72%	N	3	5	6.24%
		Wolf distribution – Wolf Density (iPOM):	0.31	4.13%	Y	1	4	6.14%
		Fisher distribution - Occupancy Model:	0.32	4.24%	Y	1	4	6.30%
		Wolverine distribution –Occupancy Model:	0.29	3.96%	Y	1	4	5.89%
		Mountain Lion RSF	0.61	8.25%	Y	5	4	6.81%
		Connectivity Models						
		Wolverine Connectivity	0.60	8.02%	Y	4	3	8.52%
		Northern Rockies Black Bear Connectivity	0.54	7.31%	N	4	3	7.76%
		Pronghorn Spring / Fall Connectivity Model	0.67	8.99%	N	5	4	7.42%
		Totals	**7.43**	**100.00%**				**100.00%**

NAC	NAC Weight	Map Layer	MEAN NAC SCORE	MEAN NAC %	FULL MAP LAYER	SPATIAL ACCURACY	DATA QUALITY	OVERALL NAC %
3 - Important habitats for struggling or at-risk species.	0.120223							
		MTNHP SOC 1&2 Predictive Distribution Maps						
		White-tailed Prairie Dog Modeled Habitat	0.40	6.47%	Y	2	3	8.08%
		Northern Short-tailed Shrew Range	0.35	5.58%	Y	2	3	6.96%
		Northern Bog Lemming Modeled Habitat	0.37	5.98%	Y	2	3	7.46%
		Dwarf Shrew Modeled Habitat	0.37	5.98%	Y	2	3	7.46%
		Bison Range	0.40	6.37%	Y	2	3	7.95%
		Arctic Shrew Range	0.35	5.58%	Y	2	3	6.96%
		Idaho Pocket Gopher Modeled Habitat	0.37	5.98%	Y	2	3	7.46%
		Black-footed Ferret Range	0.47	7.47%	Y	2	3	9.32%
		Other Species Distribution and Connectivity Models						
		Grizzly Bear - Where may be present	0.70	11.15%	Y	4	4	8.70%
		Grizzly Bear Dispersal Paths/Transborder Grizzly Connectivity (Proctor et al)	0.73	11.74%	N	4	4	9.16%
		Lynx Habitat Probability	0.81	12.99%	N	5	4	9.01%
		Northern Rockies lynx connectivity (Squires et al. 2013)	0.92	14.73%	N	5	3	11.49%
		Totals	**6.2414**	**100.00%**				**100.00%**
4 - Important habitats for a wide range of species.	0.135392							
		FWP Montana State Wildlife Action Plan (SWAP)						
		Tier 1 Community Types (e.g., riparian, wetlands)	2.14	34.55%	Y	5	4	23.8%
		Tier 1 Terrestrial Focal Areas	0.77	12.39%	Y	1	3	19.2%
		Riparian climate corridors HUC 6 Quintile value	0.59	9.49%	N	1	3	14.7%
		Habitat Connectivity Models						
		Connectivity among western U.S. protected areas (Dickson et al. 2016)	0.51	8.26%	Y	1	3	12.8%
		Riparian Climate Corridors (Carroll et al.)	0.99	16.00%	Y	5	3	12.4%
		Local connectedness (TNC 2020)	1.20	19.31%	Y	5	2	17.1%
		Totals	**6.20**	**100.00%**				**100.00%**

NAC	NAC Weight	Map Layer	MEAN NAC SCORE	MEAN NAC %	FULL MAP LAYER	SPATIAL ACCURACY	DATA QUALITY	OVERALL NAC %
5 - Highway and adjacent linear infrastructure that may impede wildlife movement.	0.208676							
		Traffic Volume	2.61	30.39%	Y	4	5	28.95%
		Projected future traffic volume @ 2040	1.46	17.06%	Y	4	4	18.29%
		Speed Limit	1.80	21.01%	Y	5	5	18.02%
		Surface width	1.23	14.30%	Y	**5**	**4**	13.62%
		# Adjacent linear transportation corridors (roads and railways)	1.48	17.24%	Y	4	3	21.12%
		Totals	**8.57**	**100.00%**				**100.00%**