Crucial Areas Assessment

Layer Documentation Summary

Montana Fish, Wildlife and Parks

8/17/2010

EQC
SEPTEMBER 14, 2010
EXHIBIT 10

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Montana Fish, Wildlife & Parks

Crucial Areas Assessment

SUMMARY: In 2008, Montana Fish, Wildlife & Parks (FWP) took the lead in conducting a Crucial Areas Assessment. The Assessment evaluated the fish, wildlife and recreational resources of Montana in order to identify crucial areas and fish and wildlife corridors. The Assessment is part of a larger conservation effort that recognizes the importance of landscape scale management of species and habitats by fish and wildlife agencies.

The result, in part, is a Web-based **Crucial Areas Planning System (CAPS)**, a new FWP mapping service aimed at future planning for a variety of development and conservation purposes so fish, wildlife, and recreational resources can be considered earlier.

The CAPS will not substitute for a site-specific evaluation of fish, wildlife, and recreational resources; nor will it substitute for consulting with local FWP biologists to gain a better understanding of conditions and management challenges in a particular area of the state.

DATA SOURCE(S): Sources for the data are numerous and are well described in each data layer methodology summary. Major sources have included: the Montana Fisheries Information System(MFISH) http://fwp.mt.gov/fishing/mFish/, , the Natural Heritage Program's Point of Occurrence Database, numerous FWP GIS Layers (http://fwp.mt.gov/doingBusiness/reference/gisData/), and numerous statewide GIS Layers (http://nris.mt.gov).

METHODS: The assessment has produced digital GIS-layer maps depicting important species and habitat information including tables with further species level details; an assessment of development and infrastructure values and concerns; and examples for residential development, energy development, and transportation projects.

> **General Recommendations** have been initially been created for residential development, oil and gas development and transportation. These are examples of the types of recommendations FWP staff would make in the field. Included in those recommendations are contact information for the FWParea biologists.

FINAL CATEGORIZATION: The final Crucial Areas Assessment has not occurred but will be based on a 4- tier approach that will provide a graduated scale of value from crucial to common. The aquatic prioritization process will use sport fish quality, species of concern distribution, watershed integrity and native fish assemblages. The terrestrial prioritization process will also be produced, using terrestrial data that include game species, species of concern, species diversity, landscape metrics, and riparian and wetland values. Connectivity for aquatic, semi-aquatic and terrestrial species (including corridors and linkage zones) will be analyzed and incorporated into the Assessment. The Assessment is scheduled to be completed in January 2011.

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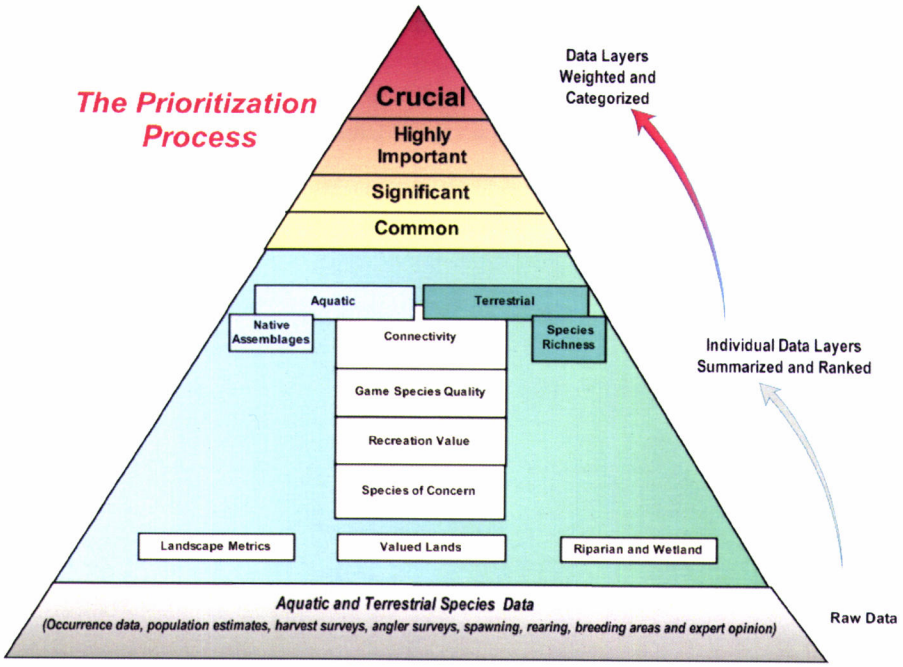
Crucial Areas Assessment



CONTACT:

T.O. Smith –Strategic Planning and Data Services; **406.444.3889** tosmith@mt.gov
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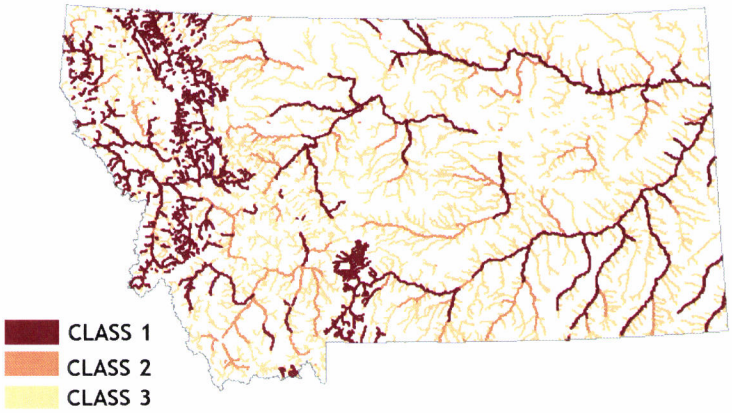
Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

AQUATIC CONNECTIVITY



SUMMARY: The aquatic connectivity layer depicts important stream corridors for fish species that require connected habitats to complete all or a portion of their life history. Corridor importance was determined using an approach that considered corridor size as well as species utilization of known corridors for eight aquatic ecoregions in Montana. Corridor size was inferred from stream order, a measurement of stream size. Corridor utilization by selected species was determined by selecting a species in each ecoregion that is most sensitive to loss of connected habitats for some or all of it's the life history needs. These 'focal species' serve as surrogates for preserving high-priority corridors for many other important sport and species of concern. Preserve the corridors and connected habitats for this focal species, and many or most other species will likely benefit.

MEASUREMENT UNIT: River segments, uniquely identified by river mile and latitude/longitude.

DATA SOURCE(S) / QUALITY: The Montana Fisheries Information System (MFISH) (http://fwp.mt.gov/fishing/mFish/) was the source of fish distribution data utilized in this layer. Data within MFISH include Montana Fish, Wildlife & Parks data and collector permit holders from state and federal agencies and non-governmental organizations, 1998 - present. Distribution and abundance data were updated by FWP biologists using this raw survey data.

DATA SOURCES

- ✓ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

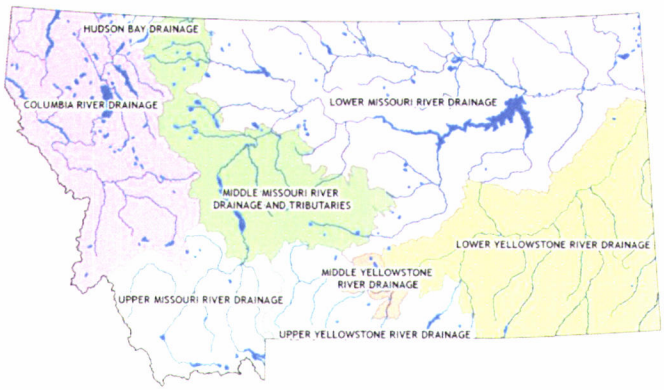
DATA EXTRAPOLATION TECHNIQUE USED

- ○ None
- ○ Modeling of habitat-species associations (deductive)
- ✓ Statistical modeling (inductive)
- ✓ Extrapolation to habitat unit (e.g. stream section)
- ✓ Extrapolation based on expert opinion

The Montana FWP Yellowstone cutthroat trout assessment, 2008, was the source of cutthroat distribution data for streams in the upper Yellowstone aquatic ecoregion. Stream order methodology developed by the National Hydrography Dataset (NHD), 2009.

METHODS: We considered aquatic corridors for species within and among eight different aquatic ecoregions within Montana. Eight aquatic ecoregions were delineated based on major drainage area and species composition (warm vs coldwater species). Focal species were selected for each aquatic ecoregion through a ranking process that considered species mobility characteristics (long distance migrations of greater than 10 miles or movement within and among metapopulations) and threat vulnerability (climate change, manmade infrastructure, and habitat alteration). Species selected for each ecoregion were: **sauger** (lower Missouri & lower Yellowstone), **burbot** (middle Missouri &

middle Yellowstone), **Yellowstone cutthroat Trout** (upper Yellowstone), **bull trout** (Hudson Bay & Columbia), and **Arctic grayling** (upper Missouri). Stream orders were delineated for all streams in Montana using an NHD algorithm. Migratory Yellowstone cutthroat trout are assumed to be present upstream to natural or manmade barriers. Barrier information for Yellowstone streams was obtained from the Yellowstone cutthroat trout assessment, 2008. Stream order methodology developed by the National Hydrography Dataset (NHD), 2009.



Aquatic Ecoregions used to categorize corridors.

FINAL CATEGORIZATION: Stream order (SO) and focal species information were integrated to create a corridor priority system. Four categories were created, representing a gradient, based on current knowledge and past research that suggests increasing corridor importance as SO increases. Highest priority corridors are those habitats where focal species exist, regardless of abundance or SO. High priority corridors are areas where large rivers occur (SO>4), but no focal species are present. Moderate priority streams are moderate size (SO=4 or 3) with no focal species present. Undesignated waters are small streams (SO<3) with no focal species present. We chose not to rank small streams because certain tributaries that connect to large river systems are important and would be undervalued using this rule-based approach for valuing aquatic connectivity.

CLASS	RANGE OF VALUES	RIVER MILES
1	Presence of Focal Species regardless of stream size	9,525 (5%)
2	Stream order ≥ 5 & no focal species present	2,998 (2%)
3	Stream order 3 or 4 & no focal species present	23,904 (13%)
4	Stream order less than 3& no focal species present	146,768 (80%)

CONTACT: Adam Petersen– Data Services Section; 406.444.1275 apetersen@mt.gov

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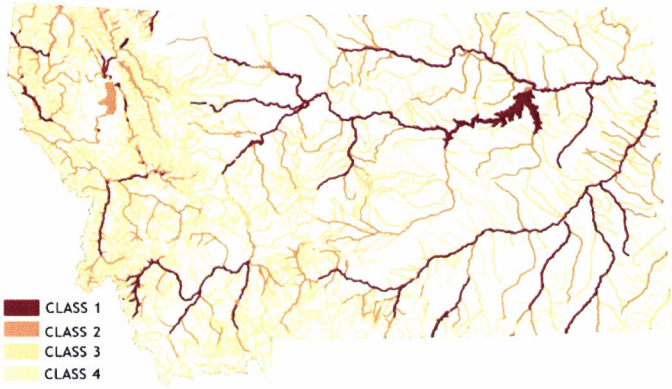
FISH NATIVE SPECIES RICHNESS



SUMMARY: Ecologists have frequently proposed that habitats high in species richness are more functionally diverse, and this natural diversity produces an increase in ecological stability, resiliency and maintenance of food web dynamics. To account for native biodiversity as an important aquatic resource value, we created a species richness layer using a count of native fishes present in waterbodies and stream reaches within eight aquatic ecoregions in Montana.

MEASUREMENT UNIT: River segments for flowing water and entire waterbody for lakes/reservoirs. River segments are uniquely identified by river mile and latitude/longitude.

DATA SOURCE(S) / QUALITY: The Montana Fisheries Information System (MFISH) (http://fwp.mt.gov/fishing/mFish/) was the source of most data utilized in this assessment. Fish distribution data were extrapolated by local fisheries biologists from fisheries surveys conducted by Montana Fish, Wildlife & Parks (FWP) and collector permit holders from state and federal agencies and non-governmental organizations, 1998 - present.

DATA SOURCES

- ✓ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED

- ○ None
- ○ Modeling of habitat-species associations (deductive)
- ○ Statistical modeling (inductive)
- ✓ Extrapolation to habitat unit (e.g. stream section)
- ✓ Extrapolation based on expert opinion

METHODS: We created a species richness layer based on a count of native fishes present in waterbody reaches within eight aquatic ecoregions in the State. Ecoregions were based on the intersection of major watershed (4th Code HUC) boundaries and generalized species composition (warm vs coldwater) . Ecoregions were evaluated separately for their species richness because large differences in species richness are inherently associated with drainage patterns, geographical extents, and inherent differences in productivity.

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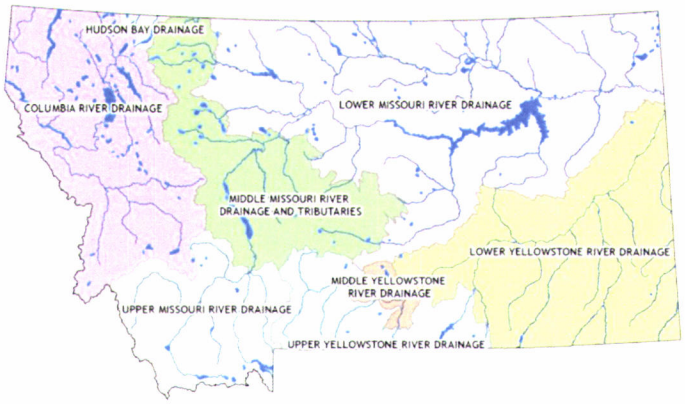

Native fish species distributions were extrapolated by local biologists from fisheries surveys conducted by Montana Fish, Wildlife & Parks (FWP) and collector permit holders from state and federal agencies and non-governmental organizations, 1998 - present. Species distributions were reviewed with biologists and regional FWP staff and extrapolated to to the nearest 0.1 miles. The numbers of unique native fish species within a stream segment or waterbody were counted, regardless of rarity.

Aquatic ecoregions used to categorized species richness

FINAL CATEGORIZATION: Four categories, representing a gradient of diversity from high to low, were created based on breaks that differed between ecoregion. Categorical designations (n=4), were created using Jenks' natural breaks methodology for each of the eight aquatic ecoregions in Montana.

CLASS	RANGE OF VALUES	RIVER MILES	# LAKES
1	100 - ~90 % of max species count within an ecoregion	2144	7
2	~70 - 90 % of max species count within an ecoregion	5620	34
3	~30 - 70 % of max species count within abn ecoregion	8863	80
4	<30 % of max species count within an ecoregion	22145	229

CONTACT: Bill Daigle – Data Services Section; 406.444.3737 bdaigle@mt.gov

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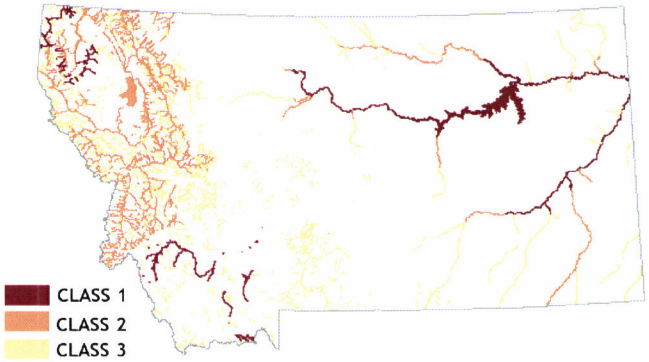
Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

FISH SPECIES OF CONCERN



SUMMARY: This layer highlights federally listed Threatened or Endangered fish species and species that are considered rare or declining by the joint Fish, Wildlife and Parks and Montana Natural Heritage Program (MTNHP) Species of Concern (SOC) Report (http://mtnhp.org/SpeciesOfConcern/). Species were ranked by their ESA status or SOC status. This assessment only includes 23 fish species and does not include aquatic invertebrates or plant species.

MEASUREMENT UNIT: River segments for flowing water and entire water bodies for lakes/reservoirs. River segments are uniquely identified by river mile and latitude/longitude.

DATA SOURCE(S) / QUALITY: The Montana Fisheries Information System (MFISH) (http://fwp.mt.gov/fishing/mFish/) was the source of data utilized in this assessment. Fish distribution data were extrapolated from fisheries surveys conducted by Montana Fish, Wildlife & Parks (FWP) and collector permit holders from state and federal agencies and non-governmental organizations, 1998 – present.

DATA SOURCES
- ✓ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED
- None
- Modeling of habitat-species associations (deductive)
- Statistical modeling (inductive)
- ✓ Extrapolation to habitat unit (e.g. stream section)
- ✓ Extrapolation based on expert opinion

Species state rank information from FWP-MTNHP SOC Report, July 2009. Genetic data from interagency Yellowstone and westslope cutthroat trout assessments, 2009.

METHODS: SOC fish species distributions were reviewed with FWP biologists. Distributions of SOC fish species were delineated to the nearest 0.1 mile. Only populations considered genetically intact or of conservation concern (>90% genetically pure) were considered species of concern for bull trout and both westslope and Yellowstone cutthroat trout.

Distribution of all SOC fish are displayed by their state or federal rank, with higher ranking species shown when species overlap occurs.

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FINAL CATEGORIZATION: Four categories were used to assess fish Species of Concern, regardless of their abundance (ie. rare, common). Class 1 areas are habitats occupied by SOC 1 species, or those with species that are federally Endangered. SOC 1 species are considered critically imperiled because of extreme rarity or because some factor of its biology makes it especially vulnerable to extinction. Class 2 habitats are areas where multiple SOC 2 species overlap or Threatened fish species are present. SOC 2 species are imperiled because of rarity or some other factors make it very vulnerable to extinction throughout its range. Class 3 habitats are areas occupied by a single SOC 2 or one or more SOC 3 species. SOC 3 species are considered rare throughout their range, or found locally in a restricted range, or are vulnerable to extinction throughout their range. Class 4 habitats do not have Species of Concern present.

CLASS	RANGE OF VALUES	RIVER MILES*	# LAKES*
1	SOC 1 or Endangered species present	1557 (10%)	19 (14%)
2	Multiple SOC 2 or Threatened species present	5285 (32%)	55 (41%)
3	One SOC 2 or ≥ one SOC 3 species present	9441 (58%)	59 (44%)
4	No SOCs species present	82,256	4154

***Percentages associated with rated waterbodies only.**

CONTACT: Bill Daigle – Data Services Section; 406.444.3737; bdaigle@mt.gov

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Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

AQUATIC

Montana Fish, Wildlife & Parks
Crucial Areas Assessment

GAME FISH QUALITY

SUMMARY: This layer depicts the relative quality of 46 cold and warm water game fish populations available to anglers in Montana.

MEASUREMENT UNIT: River segments for flowing water and entire waterbody for lakes/reservoirs. River segments are uniquely identified by river mile and latitude/longitude.

DATA SOURCE(S) / QUALITY: The Montana Fisheries Information System (MFISH) (http://fwp.mt.gov/fishing/mFish/) was the source of most data utilized in this assessment. Fish distribution, size, and relative abundance data were extrapolated from fisheries surveys conducted by Montana Fish, Wildlife & Parks (FWP) and collector permit holders from State and Federal Agencies and Non-Governmental Organizations, 1998 - present. Distribution and abundance data were updated by FWP biologists using raw survey data. FWP biologists also used survey data and knowledge of game fish populations to delineate stream reaches with unique or exceptionally large game species present.

DATA SOURCES

- ✓ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED

- None
- Modeling of habitat-species associations (deductive)
- Statistical modeling (inductive)
- ✓ Extrapolation to habitat unit (e.g. stream section)
- ✓ Extrapolation based on expert opinion

METHODS: Each game fish species within a waterbody (stream or lake) received a score based on 1) their size, 2) relative abundance and 3) a tier based on angler preference. Regulated species were assigned to a tier based on daily possession limit: Tier 1*, <= 5 fish/day and Tier 2**, > 5 fish/day. Unregulated species recognized as sport fish by the International Game Fish Association were assigned Tier 3. Tiers 1 – 3 were assigned 4, 2, or 1 points, respectively.

Relative size was determined by species-specific length categories from literature to determine if species present were less than fishable size, of fishable size, or of trophy potential, with 1, 2, or 4 points possible, respectively. The maximum size of a species captured in a survey determined size potential for each species. FWP biologists assigned relative abundance (rare, common, abundant) to each species' distribution and scores of 1, 2, or 4 points were assigned to each abundance, respectively.

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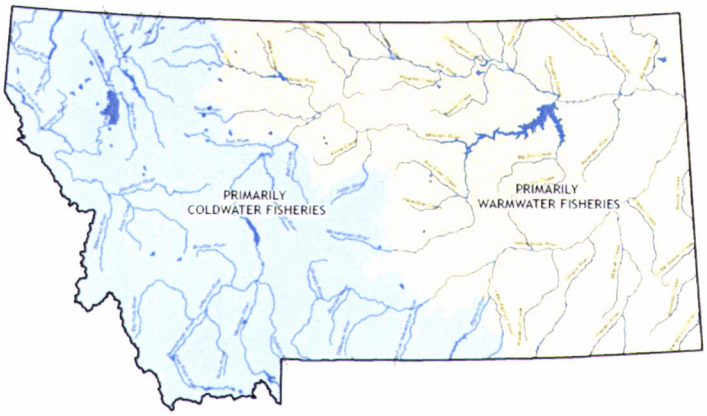
A score for each species was created by multiplying **Tier** x **Size** x **Abundance**, for a maximum score of 64 points possible per species. Species scores were then summed for each reach or waterbody. Additional points were given for: presence of unique species (10 points), exceptional numbers (>2500/mi) of a single species (32pts), and presence of a trophy fishery (20pts), based on FWP expert knowledge.

FINAL CATEGORIZATION: Four categories, representing a gradient of sport fish quality from high to low, were created based on breaks at the 97th, 90th, and 75th percentiles within each type of fishery, either cold or warmwater. Cold or warmwater designation was based on generalized species presence and composition at the 6th Code HUC scale. The final breaks used to classify fisheries from highest to lowest quality were reviewed with area biologists.



General distribution of cold and warmwater fisheries in Montana

CLASS	RANGE OF VALUES	RIVER MILES*		# LAKES*	
		Cold	Warm	Cold	Warm
1	~ Top 3% of Waterbodies With Sport Fish	866 (4%)	259 (3%)	26 (2%)	11 (3%)
2	~ Next 7% of Waterbodies With Sport Fish	1084 (5%)	591 (7%)	130 (8%)	28 (7%)
3	~Next 15% of Waterbodies With Sport Fish	2399 (11%)	1361 (15%)	215 (14%)	50 (13%)
4	~ Bottom 75% of Waterbodies With Sport Fish	16764 (79%)	6601 (75%)	1186 (76%)	293 (77%)
NOT RATED	Waterbodies w/o Sport Fish	28739	39740	1501	845

*Percentages associated with rated waterbodies only.

CONTACT: Bill Daigle – Data Services Section; 406.444.3737 bdaigle@mt.gov

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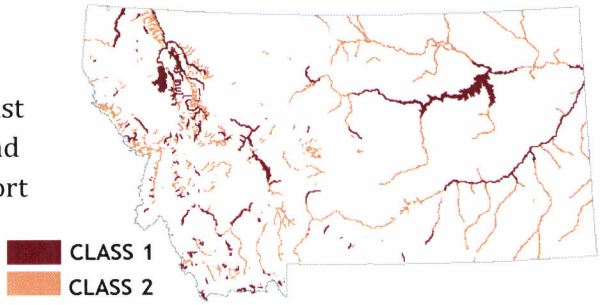
(exceptions: redband trout and burbot demoted to Tier 2 when not indicated as fishable in regulations)

**(exceptions:black & white crappie, yellow perch, and kokanee promoted to Tier 1 based on expert knowledge of desirability).*

Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

GAME FISH LIFE HISTORY



SUMMARY: This layer depicts habitats that support at least one of 43 recognized game fish species during essential and important life history stages, including habitats that support spawning, rearing, and are a source of thermal refuge during seasonal periods of stress.

MEASUREMENT UNIT: River segments for flowing water and entire waterbody for lakes/reservoirs. River segments are uniquely identified by river mile and latitude/longitude.

DATA SOURCE(S) / QUALITY: Montana, Fish, Wildlife & Parks (FWP) biologists' expert knowledge, supported by survey data from the Montana Fisheries Information System (MFISH) (http://fwp.mt.gov/fishing/mFish/) and telemetry, tagging, redd count, and creel data. Fisheries surveys conducted by Montana Fish, Wildlife & Parks and collector permit holders from state and federal agencies and non-governmental 0rganizations, 1998 - present.

DATA SOURCES
- ✓ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED
- None
- Modeling of habitat-species associations (deductive)
- Statistical modeling (inductive)
- ✓ Extrapolation to habitat unit (e.g. stream section)
- ✓ Extrapolation based on expert opinion

METHODS: Habitats or locations where fish congregate to complete important, often limiting, life history strategies such as spawning, rearing, or seeking thermal refuge are considered life history support areas. These life history support areas can be classified by their level of importance to the associated sport fish population as either essential or important. We asked local FWP biologists to delineate and designate life history support Areas by interpreting a combination of survey, telemetry, tagging, redd count, or creel data. We defined **essential habitat** as spawning, rearing, and thermal refuge habitats for migratory sport fish species that, if lost, would severely impact the associated sport fishery for that species. **Important habitats** are defined as spawning, rearing, and thermal refuge areas for migratory sport fish that cumulatively benefit the associated sport fishery. Impacts to these habitats would result in declines in abundance or distribution of the associated sport fishery for that species, however, the declines would not be as severe as losses to essential habitats.

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FINAL CATEGORIZATION: We categorized life history support areas for maintaining an associated sport fishery as either one of two categories: essential or important. Essential habitats were chosen as the most important category of life history support areas. These areas, as defined above, often limit the production and maintenance of many sport fisheries and, if lost, would severely impact an associated sport fishery for many species. Important habitats, as defined above, are shown as highly important, however, they are somewhat less important than essential habitats in that losses to one of these habitats may not result in severe population level declines. Cumulatively, however, these areas are highly beneficial to the overall maintenance of sport fisheries across the State.

CLASS	CATEGORY	RIVER MILES*	# LAKES*
1	Essential Habitat	2213 (24%)	11 (58%)
2	Important Habitat	7007 (76%)	8 (42%)

***Percentages associated with rated streams only.**

CONTACT: Bill Daigle – Data Services Section; 406.444.3737 bdaigle@mt.gov

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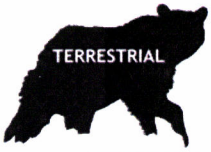

Montana Fish, Wildlife & Parks

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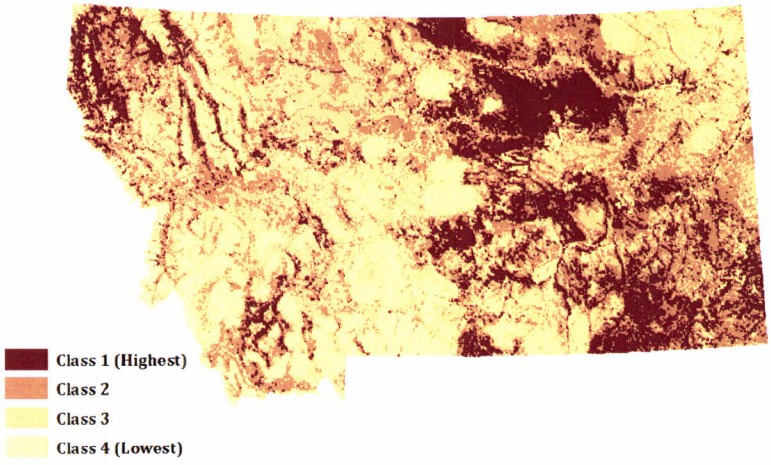
TERRESTRIAL CONSERVATION SPECIES



SUMMARY: This layer represents the cumulative expected occurrence of 85 of Montana's vertebrate species. Species inclusion was based on the State Species of Concern (SOC) list. The SOC list includes federally **listed Threatened or Endangered species**, those species listed Species of Greatest Conservation Need as part of the Montana Comprehensive, Fish and Wildlife Conservation Strategy, as well as other species deemed in need of conservation by the Montana Natural Heritage Program and cooperating biologists. Several data sources were used to represent species habitat suitability: predictive models based on observation data, deductive models generated as part of the GAP effort, as well as expert opinion informed distributions. Species with greater combined state and global conservation status were given more weight in the cumulative score. **THIS ASSESSMENT DOES NOT INCLUDE INVERTEBRATES OR PLANTS.**

MEASUREMENT UNIT AND MAPPING CONSIDERATIONS: Scores were calculated for each one-mile section in Montana. Species occurrence is based on modeling efforts informed by observations for most species. Individual species occurrences were modeled as 90-meter pixels and summarized to one-mile sections. Approximately 43,000 points observations were used to inform the modeling process; the number of points used per species ranged from 16 to over 4000. Observations were extracted from the shared FWP/NHP Point Observation Database. Only locations with less than 400 meters of uncertainty were used for modeling (with the exception of bird observations from the Breeding Bird Survey). Observations were not limited to recent observations.

DATA SOURCES

- ○ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED

- ○ None
- ○ Modeling of habitat-species associations (deductive)
- ✓ Statistical modeling (inductive)
- ○ Extrapolation to habitat unit (e.g. stream section)
- ✓ Extrapolation based on expert opinion

DATA SOURCE(S) / QUALITY: Species habitat suitability was predicted based on species observations and a variety of environmental features such as land cover, elevation, distance to stream, and precipitation. The models were created using MaxEnt software (Phillips et al. 2004; Phillips et al. 2006) and driven by point

Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

observations from the shared Montana Natural Heritage Program (MTNHP) and Montana Fish Wildlife and Parks (FWP) Point Observation Database (POD). Species with few (generally < 20) observations, as well as species for which predictive modeling clearly was not suitable (e.g., waterbirds) were represented using the original GAP models (insert citation) or expert-informed maps (Table 1). Grizzly bear distribution was represented by a layer depicting a 10-mile buffer around recovery areas. Lynx distribution was represented by boundary determined through expert review.

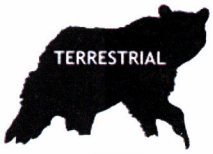
METHODS: All SOC were ranked using a formula that considered the Species of Concern (http://mtnhp.org/SpeciesOfConcern) state rank and the Natureserve global rank as determined by MTNHP and NatureServe, respectively. A model was created for each species that represented presence or absence. All model outputs were clipped to the known range of the species and then all species with the same rank were added together. Each rank group total was subjected to a multiplier (Table 1) and then the group scores were added to arrive at a final score. Scores were initially represented by 90-meter pixels.

FINAL CATEGORIZATION: All 90-meter pixels in a section were averaged to arrive at the final section score. Section values were broken into four classes using the natural breaks algorithm in ArcGIS; this algorithm finds gaps in the data corresponding to the number of categories desired.

CLASS	RANGE OF VALUES (points)	PERCENT OF STATE
1 (Highest)	8.0 to 13.75	18 %
2	6.25 to 8.0	33 %
3	4.25 to 6.25	34 %
4 (Lowest)	1 to 4.25	15 %

Table 1. Conservation species used in this layer (see model representation and footnotes for details).

Species	SRank	GRank	CLIP Rank[1]	# Of Obs.[2]	Data Quality Rating[3]	Model Representation[4]
Coeur d'Alene Salamander	2	4	3	142	Moderate	MaxEnt
Idaho Giant Salamander	2	3	2	52	Low	MaxEnt
Western Toad	2	4	3	1735	High	MaxEnt
Great Plains Toad	2	5	3	296	Moderate	MaxEnt
Plains Spadefoot	3	5	4	459	Moderate	MaxEnt
Northern Leopard Frog	1	5	2	1290	High	MaxEnt
Common Loon	3	5	4	536	High	MaxEnt
Horned Grebe	3	5	4		Limited Validation	GAP
Clark's Grebe	3	5	4		Limited Validation	GAP
American White Pelican	3	4	4		Limited Validation	GAP
American Bittern	3	4	4		Limited Validation	GAP
Great Blue Heron	3	5	4	2403	High	GAP
Black-crowned Night-Heron	3	5	4		Limited Validation	GAP
White-faced Ibis	3	5	4		Limited Validation	GAP



Montana Fish, Wildlife & Parks
Crucial Areas Assessment

Species	SRank	GRank	CLIP Rank[1]	# Of Obs.[2]	Data Quality Rating[3]	Model Representation[4]
Trumpeter Swan	3	4	4	29	Low	MaxEnt
Harlequin Duck	2	4	3	425	Moderate	MaxEnt
Bald Eagle	3	5	4	342	Moderate	MaxEnt
Northern Goshawk	3	5	4	375	Moderate	MaxEnt
Ferruginous Hawk	3	4	4	921	High	MaxEnt
Golden Eagle	3	5	4	4309	High	MaxEnt
Peregrine Falcon	3	4	4	360	Moderate	MaxEnt
White-tailed Ptarmigan	3	5	4		Limited Validation	OldGap
Greater Sage-Grouse	2	4	3			Handled elsewhere[5]
Sharp-tailed Grouse	1	4	2			Handled elsewhere[5]
Yellow Rail	3	4	4		Limited Validation	GAP
Whooping Crane	1	1	1			Only migratory in state
Piping Plover	2	3	2	736	Limited Validation	GAP
Mountain Plover	2	3	2	1784	High	MaxEnt
Black-necked Stilt	3	5	4		Limited Validation	GAP
Long-billed Curlew	3	5	4	1378	High	MaxEnt
Franklin's Gull	3	4	4		Limited Validation	GAP
Caspian Tern	2	5	3		Limited Validation	GAP
Common Tern	3	5	4		Limited Validation	GAP
Forster's Tern	3	5	4		Limited Validation	GAP
Least Tern	1	4	2	221	Moderate	MaxEnt
Black Tern	3	4	4		Limited Validation	GAP
Black-billed Cuckoo	3	5	4			Limited data[6]
Yellow-billed Cuckoo	3	5	4			Limited data[6]
Flammulated Owl	3	4	4	414	Moderate	MaxEnt
Burrowing Owl	3	4	4	442	Moderate	MaxEnt
Great Gray Owl	3	5	4	16	Low	MaxEnt
Black Swift	1	4	2	5	Limited Validation	GAP
Lewis's Woodpecker	2	4	3	15	Limited Validation	GAP
Red-headed Woodpecker	3	5	4			Limited data[6]
Black-backed Woodpecker	3	5	4			Limited data[6]
Pileated Woodpecker	3	5	4	23	Low	MaxEnt
Alder Flycatcher	3	5	4		Limited Validation	GAP
Pinyon Jay	3	5	4	173	Moderate	MaxEnt
Clark's Nutcracker	3	5	4	3987	High	MaxEnt
Boreal Chickadee	3	5	4	30	Low	MaxEnt
Brown Creeper	3	5	4	839	High	MaxEnt
Winter Wren	3	5	4	2681	High	MaxEnt
Sedge Wren	3	5	4			Limited data[6]
Blue-gray Gnatcatcher	2	5	3		Limited Validation	GAP

Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

Montana Fish, Wildlife & Parks

Crucial Areas Assessment

Species	SRank	GRank	CLIP Rank[1]	# Of Obs.[2]	Data Quality Rating[3]	Model Representation[4]
Veery	3	5	4	458	Moderate	MaxEnt
Sage Thrasher	3	5	4	294	Moderate	MaxEnt
Sprague's Pipit	3	4	4	1877	High	MaxEnt
Loggerhead Shrike	3	4	4	554	High	MaxEnt
Brewer's Sparrow	3	5	4	2504	High	MaxEnt
Sage Sparrow	3	5	4			Limited data[6]
Baird's Sparrow	3	4	4	1644	High	MaxEnt
Grasshopper Sparrow	3	5	4	2169	High	MaxEnt
Le Conte's Sparrow	3	4	4			GAP
Nelson's Sparrow	3	5	4	88	Low	MaxEnt
McCown's Longspur	3	4	4	984	High	MaxEnt
Chestnut-collared Longspur	2	5	3	3382	High	MaxEnt
Bobolink	3	5	4	486	Moderate	MaxEnt
Black Rosy-Finch	2	4	3		Limited Validation	GAP
Gray-crowned Rosy-Finch	2	5	3		Limited Validation	GAP
Cassin's Finch	3	5	4	2111	High	MaxEnt
Preble's Shrew	3	4	4			Limited data[6]
Dwarf Shrew	2	4	3		Limited Validation	GAP
Arctic Shrew	1	5	2			Limited data[6]
Merriam's Shrew	3	5	4		Limited Validation	GAP
Northern Short-tailed Shrew	1	5	2			Limited data[6]
Fringed Myotis	3	4	4			Limited data[6]
Northern Myotis	2	4	3			Limited data[6]
Eastern Red Bat	2	5	3			Limited data[6]
Hoary Bat	3	5	4	254	Moderate	MaxEnt
Spotted Bat	2	4	3			Limited data[6]
Townsend's Big-eared Bat	2	4	3	129	Moderate	MaxEnt
Pallid Bat	2	5	3	31	Low	MaxEnt
Black-tailed Jack Rabbit	2	5	3	17	Low	MaxEnt
Pygmy Rabbit	3	4	4	1196	High	MaxEnt
Uinta Chipmunk	3	5	4			Limited data[6]
Black-tailed Prairie Dog	3	4	4	1411	High	MaxEnt
White-tailed Prairie Dog	1	4	2		Limited Validation	GAP
Idaho Pocket Gopher	2-4	4	3			Limited data[6]
Great Basin Pocket Mouse	2-3	5	3		Limited Validation	GAP
Hispid Pocket Mouse	1-3	5	2		Limited Validation	GAP
Northern Bog Lemming	2	4	3			Limited data[6]
Meadow Jumping Mouse	2	5	3	29	Low	MaxEnt
Gray Wolf	3	4	4			Connectivity[7]
Swift Fox	3	3	3	514	High	MaxEnt
Grizzly Bear	2	4	3		High	Expert Knowledge

Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

Species	SRank	GRank	CLIP Rank[1]	# Of Obs.[2]	Data Quality Rating[3]	Model Representation[4]
Fisher	3	5	4			Handled elsewhere[8]
Black-footed Ferret	1	1	1			Reintroductions[9]
Wolverine	3	4	4			Handled elsewhere[8]
Western Spotted Skunk	1-3	5	2		Limited Validation	GAP
Canada Lynx	3	5	4		High	Expert Knowledge
Bison	2	4	3			Few wild populations[10]
Snapping Turtle	3	5	4	60	Low	MaxEnt
Spiny Softshell	3	5	4	155	Moderate	MaxEnt
Northern Alligator Lizard	3	5	4	48	Low	MaxEnt
Greater Short-horned Lizard	3	5	4	193	Moderate	MaxEnt
Common Sagebrush Lizard	3	5	4	266	Moderate	MaxEnt
Western Skink	3	5	4	54	Low	MaxEnt
Western Hog-nosed Snake	2	5	3	79	Low	MaxEnt
Milksnake	2	5	3	51	Low	MaxEnt
Smooth Greensnake	2	5	3	43	Low	MaxEnt

[1] Clip Rank was formed by combining SRank and GRank values, lower scores in these two categories led to lower Clip Ranks (greater conservation need).

[2]Number of observations indicates observations used for inductive (MaxEnt) modeling.

[3]Data Quality Ratings of Low, Moderate and High apply to inductive models.

[4]Model representation codes: MaxEnt = inductive modeling with Maximum Entropy, GAP = deductive models from GAP efforts at Montana Spatial Analysis Lab.

5These species were included in the Prairie Grouse Layer, a portion of the Terrestrial Game Layer.

[6]These species did not have enough observations with sufficient accuracy for modeling nor did they have GAP models. Data for these species is lacking.

[7]This species will be handled under a future connectivity analysis.

[8]These species were included in the Furbearer Layers, a portion of the Terrestrial Game Layer.

[9]This species currently only exists in Montana where experimental reintroductions have occurred.

[10]Populations of this species only occurred in small pockets of Montana currently.

REFERENCES:

Steven J. Phillips, Miroslav Dudík, Robert E. Schapire. A maximum entropy approach to species distribution modeling. In *Proceedings of the Twenty-First International Conference on Machine Learning*, pages 655-662, 2004.

Montana Fish, Wildlife & Parks

Crucial Areas Assessment

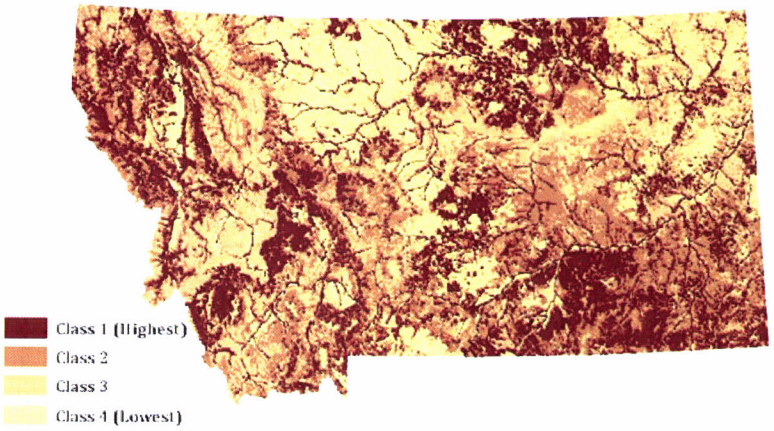
Steven J. Phillips, Robert P. Anderson, Robert E. Schapire. Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190:231-259, 2006.

CONTACT: Scott Story – Data Services Section; 406.444.3759 ; sstory@mt.gov

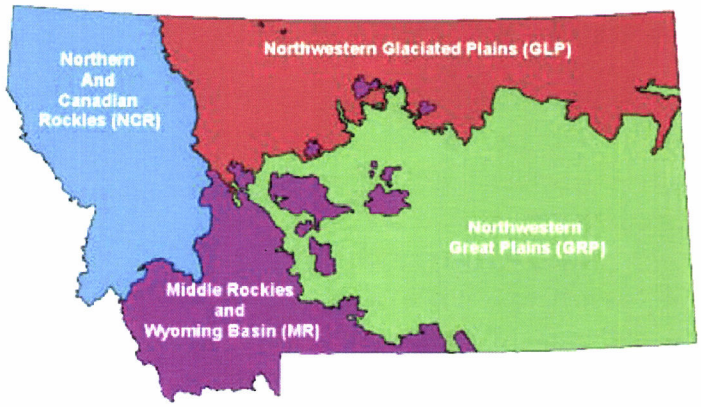
DATE MODIFIED: April 15, 2010 – Version 1.0

TERRESTRIAL SPECIES RICHNESS

SUMMARY: This layer represents species richness of all native land-based species in Montana, including amphibians, reptiles, birds, and mammals. Species included are found year round or breed in the state. The metric presented is the average number of species associated with all cover types (habitats) in each section. This data layer allows you to understand the overall number of species that is associated with each one mile section.



MEASUREMENT UNIT: One-mile section



DATA SOURCE(S) / QUALITY: A spatial dataset representing cover types (habitats), a species-habitat association database, and an ecoregion layer were used to create this layer. The Montana Land Cover, courtesy of Montana Natural Heritage Program (MTNHP) is a data layer created from satellite images that are categorized based on data collected from field measurements. There are 81 ecological classifications in Montana that represent communities such as sagebrush, coniferous forests and grasslands. The second source is a habitat association database created by MTNHP that associated all vertebrate species in Montana with Ecological Systems (habitats) according to the degree of association between the species and a given habitat: high, moderate, or low association. In an effort to compare ecologically different regions of Montana, four ecoregions based on Omernick Level 3 ecoregions (see Figure above), were created to summarize species richness . Area within each ecoregion was scored separately: 1)

DATA SOURCES

- ○ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED

- ○ None
- ✓ Modeling of habitat-species associations (deductive)
- ○ Statistical modeling (inductive)
- ○ Extrapolation to habitat unit (e.g. stream section)
- ○ Extrapolation based on expert opinion

Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

Northern and Canadian Rockies (NCR), 2) Middle Rockies, Idaho Batholith, & Wyoming Basin including island mountain ranges (MR), 3)Northern Glaciated Plains (GLP), and 4) Northwestern Great Plains (GRP).

METHODS: Habitats with "high" or "medium" suitability were used to create species-habitat associations for most vertebrate species in Montana. The resulting models were summed (taking into account the known range of each species) for each cell in the Ecological Systems layer. Scores for all cells in a given section were averaged to arrive at an average species richness score for each square-mile section. The highest scores (class 1) from both the wetland and riparian layers were "burned in" to this layer in the final step to account for high species richness that could not be represented using Montana Land Cover.

CLASS	(Number of species associations)				% OF STATE
	NCR	MR	GLP	GRP	
1 (Highest)	90-176	61-129	68-103	74-103	29 %
2	71-89	55-60	52-68	60-74	29 %
3	48-70	42-55	17-51	32-59	28 %
4 (Lowest)	0-47	0-41	0-16	0-31	14 %

FINAL CATEGORIZATION: Raw scores were divided into four classes for each ecoregion. Scores from all four ecoregions were merged together to form a single statewide layer.

Table 1. Ecological systems used in richness calculations.

Ecological System (Ctrl + click system name to go to Montana Field Guide)
Great Plains Badlands
Rocky Mountain Cliff, Canyon and Massive Bedrock
Alpine Ice Field
Rocky Mountain Alpine Bedrock and Scree
Shale Badland
Great Plains Cliff and Outcrop
Active and Stabilized Dune
Wyoming Basin Cliff and Canyon
Aspen Forest and Woodland
Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest
Rocky Mountain Subalpine Woodland and Parkland
Rocky Mountain Mesic Montane Mixed Conifer Forest
Rocky Mountain Foothill Limber Pine-Juniper Woodland
Rocky Mountain Lodgepole Pine Forest
Rocky Mountain Ponderosa Pine Woodland and Savanna
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
Rocky Mountain Montane Douglas-fir Forest and Woodland
Rocky Mountain Poor Site Lodgepole Pine Forest
Great Plains - Black Hills Ponderosa Pine Woodland and Savanna
Aspen-Mixed Conifer Forest and Woodland
Mountain Mahogany Woodland and Shrubland

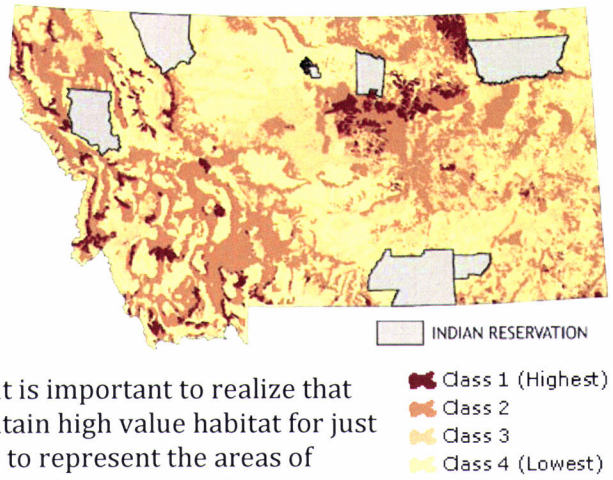
Montana Fish, Wildlife & Parks
Crucial Areas & Connectivity Assessment

Ecological System (Ctrl + click system name to go to Montana Field Guide)
Great Plains Wooded Draw and Ravine
Mat Saltbush Shrubland
Alpine Dwarf-Shrubland
Low Sagebrush Shrubland
Big Sagebrush Shrubland
Mixed Salt Desert Scrub
Great Plains Shrubland
Rocky Mountain Lower Montane-Foothill Shrubland
Rocky Mountain Montane-Foothill Deciduous Shrubland
Mountain Subalpine Deciduous Shrubland
Rocky Mountain Foothill Woodland Steppe Transition
Big Sagebrush Steppe
Montane Sagebrush Steppe
Rocky Mountain Lower Montane, Foothill and Valley Grassland
Rocky Mountain Subalpine-Upper Montane Grassland
Great Plains Mixedgrass Prairie
Alpine Fell-Field
Alpine Turf
Rocky Mountain Subalpine-Montane Mesic Meadow
Great Plains Sand Prairie
Greasewood Flat
Rocky Mountain Conifer Swamp
Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland
Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland
Great Plains Floodplain
Rocky Mountain Wooded Vernal Pool
Rocky Mountain Subalpine-Montane Riparian Woodland
Rocky Mountain Subalpine-Montane Riparian Shrubland
Great Plains Prairie Pothole
Alpine-Montane Wet Meadow
Great Plains Open Freshwater Depression Wetland
Emergent Marsh
Rocky Mountain Subalpine-Montane Fen
Great Plains Closed Depression Wetland
Great Plains Saline Depression Wetland
Great Plains Riparian

CONTACT: Scott Story – Data Services Section; 406.444.3759 ; sstory@mt.gov

DATE MODIFIED: April 15, 2010 – Version 1.0

TERRESTRIAL GAME QUALITY



SUMMARY: This layer depicts the relative value of areas based upon the specific habitat requirements of 12 native game species. These species were categorized into 4 functional groups: big game, bighorn sheep and mountain goat, prairie grouse, and forest carnivores. Area values were calculated by adding together the individual contribution of each species group, meaning that in areas of overlap values will generally be higher. However, it is important to realize that an area with a lower cumulative value can still contain high value habitat for just one species group. These 12 species were selected to represent the areas of highest value for native game in Montana, all other native game species are represented in the Terrestrial Species Richness layer.

MEASUREMENT UNIT: Public land survey sections - approximately one square mile.

MAPPING CONSIDERATIONS: Indian reservations were not evaluated due to lack of data. National park lands are not currently represented in big game distribution layers and therefore have lower than expected values in some areas.

DATA SOURCE(S) / QUALITY:

Big Game: *Metric evaluated*: winter range habitat value. *Species*: pronghorn antelope, elk, moose, mule deer and white-tailed deer. *Data layers*: big game distribution - publicly available for individual species, maintained by FWP. Layers are updated using expert knowledge, including known habitat associations and extrapolation from survey data. Resolution is based on 1 square mile public land survey sections; Montana Land Cover Classification –layer maintained by the Montana Natural Heritage Program (NHP) Spatial Analysis Lab, University of Montana. Classification based on remote sensing. Resolution is 30 meters. **Bighorn sheep and mountain goat**: M*etric evaluated*: general and winter distribution. *Data layer*: big game distribution – see previous. **Forest carnivores**: *Metric evaluated*: habitat suitability. *Species*: wolverine, fisher, marten. *Data layers*: furbearer harvest locations – maintained by FWP Mandatory Reporting System. Reporting at section level by trappers; Furbearer observation records – Maintained in NHP Point Observation Database. Accuracy verified by NHP staff; Wolverine primary habitat model – produced by the Wildlife Conservation Society; Fisher and marten habitat suitability model developed using known locations and reviewed by FWP biologists. Resolution is 90 meters.

DATA SOURCES

- ✓ Survey data – counts or estimates
- ✓ Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED

- ○ None
- ✓ Modeling of habitat-species associations (deductive)
- ✓ Statistical modeling (inductive)
- ○ Extrapolation to habitat unit (e.g. stream section)
- ✓ Extrapolation based on expert opinion

Prairie grouse: *Metric evaluated*: core habitat areas, lek areas, and habitat suitability. *Species*: sage-grouse, sharp-tail grouse. *Data layers*: sage-grouse and sharp-tail grouse lek locations and

observations collected via ground and aerial surveys by FWP and Bureau of Land Management biologists – maintained in FWP sage-grouse database; Sage-grouse core areas – developed and maintained by FWP with input from Bureau of Land Management. Publicly available layer based expert knowledge review of sage-grouse habitat suitability model using lek locations and limited to areas of highest male density. Sharp-tail grouse habitat suitability model developed using lek locations and reviewed by FWP biologists. Resolution is 90 meters.

METHODS: **Big game** values were determined based upon the presence winter range habitat. The score assigned to particular areas varied by FWP Region (R#). In the Western mountains, areas identified as winter use areas in the species distribution layers received one point. In the Northwest (R1) winter use of Elk or White-tail Deer was given an additional point. In the Southwest (R2-3), Elk or Mule Deer was given an additional point. For the rest of the state, areas identified as winter use areas in the species distribution layers, as well as areas containing >50% sagebrush grassland, received one point. Areas identified as winter use for more than one species, or containing >75% sagebrush grassland were given an additional point. **Bighorn sheep and mountain goat** received 1 point for overall distribution and 2 points for winter use. In areas of species overlap, values were not cumulative, the highest value was chosen. **Forest carnivore** habitat values were 2 points for wolverine habitat; 2 points to highly suitable marten or fisher habitat; and 1 point to moderately suitable marten or fisher habitat. In areas of species overlap, values were cumulative to a maximum value of 6 points. Values were only calculated in western forest habitats where forest carnivores were expected. **Prairie grouse** habitat was valued by assigning 3 points to sage-grouse core areas and outside of core areas, 2 points were assigned to sage-grouse lek areas. Two points were assigned to highly suitable sharp-tail grouse habitat and 1 point to moderately suitable sharp-tail grouse habitat. In areas of species overlap, values were cumulative to a maximum value of 5 points. Values were only calculated in prairie areas where prairie grouse were expected. **Overall:** Within each species group, values were rescaled by dividing by the maximum number of points to give each category a value ranging from 0 to 1. In this way each group received equal weight. Big game winter habitat was given twice the weight in the final calculation based upon its level of importance. The final summed value was again rescaled to 0 to 1, by dividing by the total possible score for that section. For example, in eastern prairie areas the total possible score did not include forest carnivores.

FINAL CATEGORIZATION: The resulting scores ranged from 0 to 1. The mean (0.37) and the standard deviation (0.23 SD) of the final scores were calculated. Final categories were determined by assessing the deviation from the mean value. The highest category had values > 1.5 SD from the mean. The high category was 0.5 to 1.5 SD from the mean value. The moderate category ranged from -0.5 SD below the mean to 0.5 SD above the mean. The low category was < -0.5 SD from the mean. Actual values and percentage of land area are shown in the table.

CLASS	RANGE OF VALUES	PERCENT OF STATE
1 (Highest)	> 0.71	4.3 %
2	0.48 – 0.71	33.0 %
3	0.26 – 0.48	29.7 %
4 (Lowest)	< 0.26	33.0 %

CONTACT: Adam Messer, FWP – Data Services Section; 406.444.0095; amesser@mt.gov

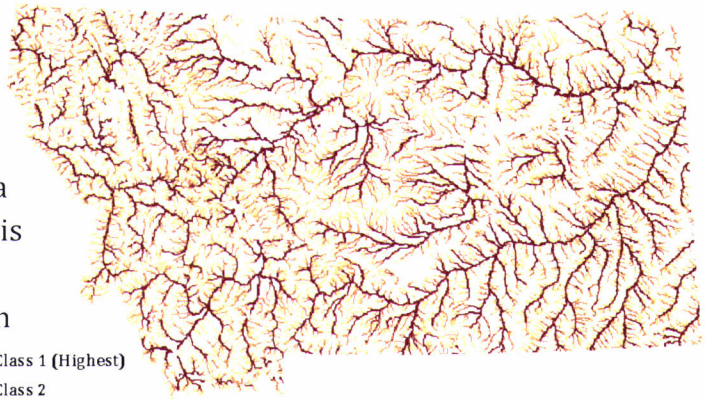
DATE MODIFIED: April 9, 2010 – V 1.0

TERRESTRIAL

Montana Fish, Wildlife & Parks

Crucial Areas & Connectivity Assessment

RIPARIAN AREAS



SUMMARY: The purpose of this layer is to represent total riparian area in Montana by square-mile section. This layer does not represent riparian condition or health, only area. Riparian areas serve as important sources of biodiversity and are not captured well in remotely-sensed data due to their size. We represented riparian corridors separately using this layer to capture the biodiversity that these unique habitats represent.

DATA SOURCES

- Survey data – counts or estimates
- Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED

- None
- Modeling of habitat-species associations (deductive)
- Statistical modeling (inductive)
- ✓ Extrapolation to habitat unit (e.g. stream section)
- Extrapolation based on expert opinion

DATA SOURCE(S) / QUALITY: FWP streams layer (based on National Hydrologic Dataset 1:100,000) and riparian mapping conducted by Montana Natural Heritage (MTNHP) program for submission to the National Wetlands Inventory (NWI).

METHODS: Streams with Strahler order > 1 were extracted from the FWP streams layer. A stratified random sample (order = stratum) of streams was examined relative to detailed riparian mapping from preliminary NWI data mapped by MTNHP. Using this sampling technique mean riparian buffer widths were determined for each Strahler stream order. Buffers were applied to all FWP streams in the hydrologic network to produce a layer of riparian corridors statewide. The riparian corridor layer was intersected with the Montana PLSS section layer to calculate total riparian area for each section in Montana. The metric presented is total riparian area per section. Riparian condition was not considered in this analysis.

CLASS	RANGE OF VALUES (acres)	PERCENT OF STATE
1 (Highest)	29 to 366	7 %
2	6.4 to 29	11 %
2	1.0 to 6.3	15 %
4 (Lowest)	0.1 to 0.9	3 %
No Class		63 %

FINAL CATEGORIZATION: Raw scores (total riparian area for section) were assigned into four categories by finding natural breaks in the data.

CONTACT: Scott Story – Data Services Section; 406.444.3759; sstory@mt.gov

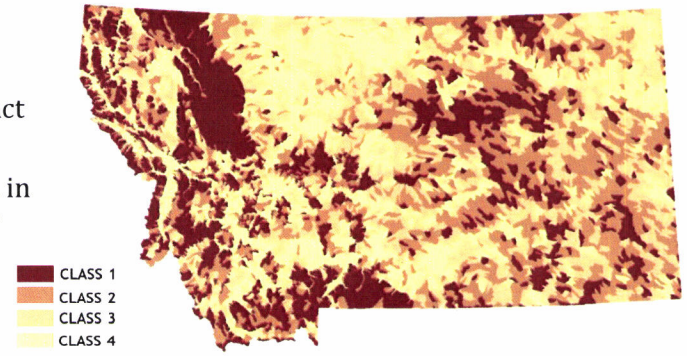
DATE MODIFIED: April 15, 2010 – Version 1.0

Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

AQUATIC

Montana Fish, Wildlife & Parks
Crucial Areas Assessment

WATERSHED INTEGRITY



SUMMARY: We characterized the level of human impact on streams and river basins by creating a score of watershed integrity for each river basin and sub-basin in Montana. Watershed Integrity (WI) is a summation of human impacts that contribute to the impairment of streams and watersheds. The 13 variables are supported by literature as best predictors of watershed health in Pacific Northwest and Rocky Mountain streams and include impacts that are likely to affect water quality, water quantity, watershed connectivity, stream function, and the overall health of stream systems. Variables include: 1) % urban, 2) % riparian buffer as urban, 3) % cultivated cropland, 4) % riparian buffer as cultivated cropland, 5) road density, 6) road density in riparian buffer, 7) # producing oil / gas wells, 8) # unique points of irrigation diversion, 9) # surface / placer mines, 10) # dams with storage >20 surface acres, 11) presence of large in-stream reservoirs, 12) presence of impaired streams (303d listed by Dept of Environmental Quality), 13) # of Wetland Modification Project Permits (Army Corps of Engineer 404 permits).

MEASUREMENT UNIT: Upper and lower portions of 6th Code HUCs (4,271 in State)

DATA SOURCE(S) / QUALITY: Montana Department of Natural Resources and Conservation: **water rights & points of diversion**; Montana Department of Environmental Quality: **303d list of impaired waterbodies**; Army Corps of Engineers: **404 Permits (Wetland Modification Project Permits);** US Census: **TGR Roads 2000**; Montana Natural Heritage Program: **land use**; Montana Natural Resource Information System: **mines, dams, oil and gas wells**. Montana Department of Revenue: **Farm Land Use-Type (FLU)**. All data sets used were current (within one year) at the time of publication and contained statewide coverage.

DATA SOURCES

- [x] Survey data – counts or estimates
- [x] Survey data – categorical (e.g. presence/absence)
- [ ] Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED

- [ ] None
- [ ] Modeling of habitat-species associations (deductive)
- [ ] Statistical modeling (inductive)
- [x] Extrapolation to habitat unit (e.g. stream section)
- [ ] Extrapolation based on expert opinion

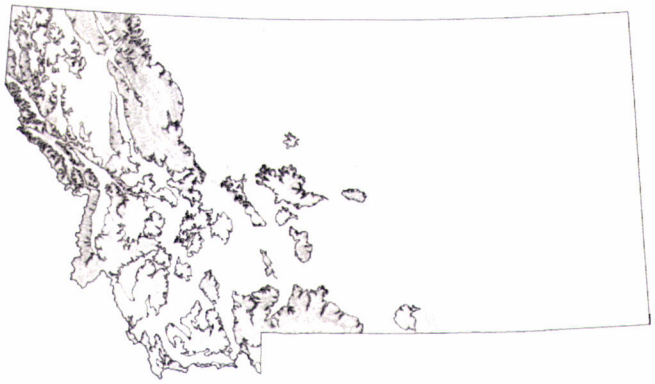
METHODS: Variables were summarized by 6th Code HUC and each HUC was given a score based on density, frequency or presence of each variable. In HUCs west of the lower Yellowstone and Missouri basins, HUCs were split into valley and mountain portions to account for differences in land use management and stream gradient. Valley segments of watersheds are generally lower in gradient, have a different suite of native species present, and have different ownership characteristics than mountainous stream reaches that are generally high gradient and publicly owned.

Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

AQUATIC

Montana Fish, Wildlife & Parks
Crucial Areas Assessment

Variables used to represent watershed integrity were selected from literature as best explaining the variability seen in watershed health throughout Pacific Northwest and high elevation prairie streams. Variables presence, density, or frequency were summarized by 6th Code HUCs in prairie systems (lower Missouri and Yellowstone), and by sub-basin (upper and lower) for streams west of the lower Missouri and Yellowstone ecoregions. The elevation contour that best explained the division between valley and mountain topography was selected as the division between upper and lower portions of most western HUCs.



Map showing elevation contours used to divide HUCs into mountain and valley sub-basins

HUC scores for each variable ranged from 0 to 30 with five categories possible for most variables. Scoring breaks for each variable were made using the Natural Breaks (Jenks) Method of categorization. Variables shown by literature as being highly correlated to watershed health (% cultivated cropland, road density, % urban) received more weight than others. Calculations for riparian buffers are based on increasing buffer widths for stream orders 2 – 8, with buffers 5 to 246 meters, respectively. Each 6 th Code HUC score was calculated by adding scores for each variable and dividing by possible points, such that: WI Score = HUC total / total possible.

FINAL CATEGORIZATION: Scores for watershed integrity were normally distributed. We created four categories of watershed integrity based on quartiles that represented a gradient of integrity from highest to low. Perfect score for a watershed was 1.00, whereas the lowest scoring HUC was 0.48

CLASS	RANGE OF VALUES	SQUARE MILES (% of State)
1	0.901 - 1.00	40,669 (24%)
2	0.831 – 0.90	49,476 (29%)
3	0.766 – 0.83	42 265 (25%)
4	0 - 0.765	35,754 (21%)

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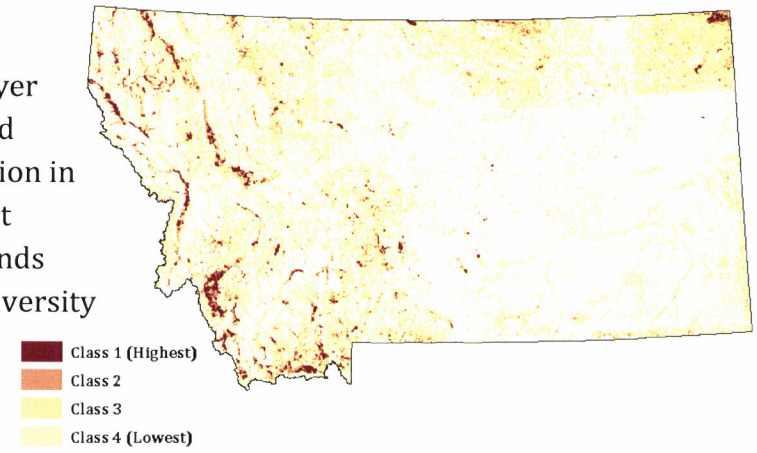
Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

WETLAND AREAS



SUMMARY: The purpose of this layer was to represent maximum wetland area or count in each one-mile section in Montana. This layer does not reflect wetland condition or health. Wetlands serve as important sources of biodiversity and are not captured well in remotely-sensed data due to their size. We represented wetlands separately using this layer to capture the biodiversity that these unique habitats represent. The metric presented is a score that represents the greater of two measures: 1) total wetland area per one-mile section divided into four classes, and 2) total count of wetlands per one-mile section divide into four classes. The metric also takes into account the amount of flooded irrigation in a one-mile section.

MEASUREMENT UNIT: One-mile section

DATA SOURCES

- ○ Survey data – counts or estimates
- ○ Survey data – categorical (e.g. presence/absence)
- ✓ Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED

- ✓ None
- ○ Modeling of habitat-species associations (deductive)
- ○ Statistical modeling (inductive)
- ○ Extrapolation to habitat unit (e.g. stream section)
- ○ Extrapolation based on expert opinion

DATA SOURCE(S) / QUALITY: National Hydrologic Dataset (NHD) 1:24,000 scale waterbodies, USFWS National Wetlands Inventory (NWI), Montana Land Cover (MLC), USDA/ERS Major Land Use (MLU), and Montana PLSS Sections. NHD waterbodies were digitized by 24K quad therefore results vary across Montana (both and amount and categorization of wetlands). USFWS National Wetlands Inventory was completed in the 1980's for much of the northern glaciated plains in Montana (north of Hwy-2 east of the Continental Divide), however completion of other parts of the state are subject to specific project funding. Coverage of Montana by the NWI is patchy but detailed where complete. Montana Landcover is based on satellite data and is comprehensive; however, small wetlands are not well represented by this layer. USDA MLU for Montana was digitized using aerial imagery and has complete statewide coverage.

METHODS: NHD waterbody features were available for Montana by hydrologic basin. NHD waterbody data for each basin was clipped to the extents of the Montana state boundary. All NHD basin waterbodies were merged to form a single layer. *Ice Mass* and *Reservoir* waterbody categories were removed from the NHD layer leaving *Lake/Pond*, Swamp/*Marsh*, and *Playa* wetland categories. To remove wetlands that are highly altered, we selected all wetlands from the NWI that included the word "impounded" in the wetland description. All wetlands in the NHD layer that intersected "impounded" NWI wetlands were removed. All wetland land cover classes from the Montana Landcover dataset were combined into a single wetland raster layer. Patches of wetland were identified from this layer and converted to simplified polygons. We overlaid the NHD wetlands described above with the Montana Landcover wetlands to arrive at unique wetland boundaries for all overlapping polygons.

	% OF SECTION IN WETLANDS		COUNT OF WETLANDS IN SECTION		
CLASS	MAXIMUM VALUE	MEAN VALUE	MAXIMUM VALUE	MEAN VALUE	PERCENT OF STATE
1 (Highest)	100	18.1	183	57	1%
2	58.7	8.1	164	28	2%
3	46.1	3.0	42	11	7%
4 (Lowest)	17.3	0.4	20	3	30 %
No Class					59 %

FINAL CATEGORIZATION: We calculated the total wetland area and total count of distinct wetland by one-mile section. We converted each of these two metrics to four classes by finding natural breaks in the data. One-mile sections with no wetlands were given a score of zero. To calculate a single wetland score for each one-mile section we took the highest score from the total wetland area and total wetland count scores. Finally, we penalized all one-mile sections by one class (unless a section was already a "zero" or was in the lowest wetland class) if the amount of flooded agriculture in the one-mile section exceeded twenty-five percent.

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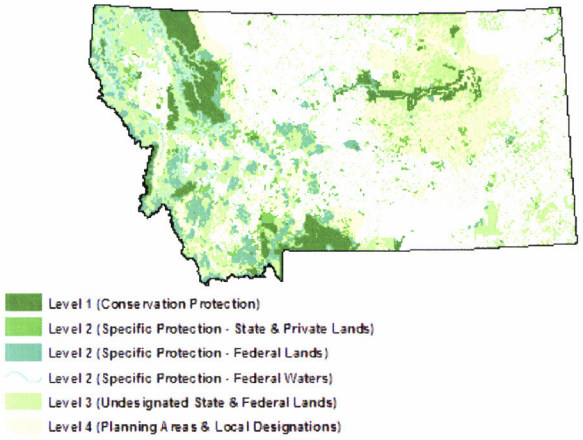
Montana Fish, Wildlife & Parks
Crucial Areas Assessment

DESIGNATED AREAS



SUMMARY: Designated areas depict lands and water bodies having biological, recreation, conservation and/or socioeconomic value based on a variety of conservation and management programs. This includes, but is not limited to federal, state and local designations; recreation areas, and conservation lands.

MEASUREMENT UNIT: This layer is comprised of polygons and lines of varying size. Source data were developed at scales of 1:24,000 and 1:100,000.

DATA SOURCE(S): Designated areas drew primarily from the stewardship layer managed by the Montana Natural Heritage Program (MTNHP). Other layers used include Montana Fish, Wildlife & Parks (FWP) lands, Bureau of Land Management (BLM) Areas of Critical Environmental Concern, U.S. Forest Service (USFS) Roadless Areas, Northwest Power Planning Council protected areas, and the national Protected Areas Database.

METHODS: Lands were categorized into seven value groups based on management practices, type of area (water body or land) and level of protection. These value groups are defined below.

- Level 1 (Conservation Protection): Public lands and privately owned preserves managed to retain a natural state and protected from conversion. These include national parks and federal wildlife refuges and wilderness areas.

- Level 2 (Specific Protection - State and Private Lands) : State Lands and privately owned conservation easements managed for specific purposes (waterfowl production, habitat preservation, recreation) and protected from some types of conversion. These include FWP wildlife management areas, state parks, conservation easements and fishing access sites and privately held conservation easements.

- Level 2 (Specific Protection Federal Lands)- Federal lands with preliminary designation for conservation protection from most types of conversion. These include USFS and BLM roadless areas.

- Level 2 (Specific Protection – Federal Waters) – Rivers and streams that have been protected from some types of conversion due to either a National Wild and Scenic Rivers System designation or the Northwest Power Planning Council Protected Areas Program

- Level 3 (Undesignated State and Federal Lands) -Public lands managed for natural resources including resource extraction (logging, grazing, mining) but protected from conversion to urban. These include all remaining USFS and BLM federal lands and State Lands.

Full documentation @ http://fwp.mt.gov/wildthings/conservationInAction/crucialAreas.html

- Level 4 (Planning Areas and Local Designations)- Lands that may not be managed or protected but are recognized as valuable from a biological or recreational standpoint. The protection status of many of these lands is unknown and some lands are privately owned with no protection. These include The Nature Conservancy Ecoregions, Audubon Bird Areas,

FINAL CATEGORIZATION: Lands were placed into value groups based on management practices and level of protection.

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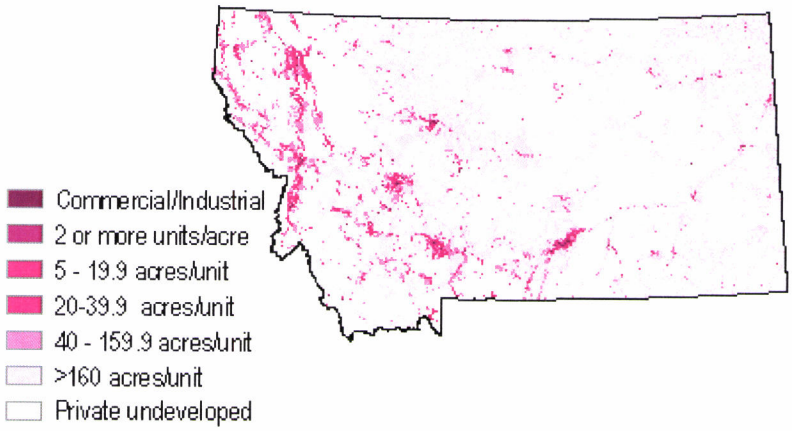
Montana Fish, Wildlife & Parks

Crucial Areas Assessment

HOUSING DENSITY BY DECADE



SUMMARY: This layer represents housing density projections for Montana. The projections reflect housing density by decade, from 2000 to 2040. This layer allows users to visualize areas of the state that are projected to grow faster than others. The housing density projection layers can be overlaid with aquatic and terrestrial data layers. The metric is divided into six housing densities and a seventh category depicting commercial/industrial development.

MEASUREMENT UNIT: Aggregation of data from Census blocks by computing the average within a one-mile section.

DATA SOURCE(S) / QUALITY: The data are based upon: (1) 2000 US Census datasets for housing units and "year housing built" by Census block, and housing unit per population ratio and population projections per county; (2) the public/protected lands data layer from Montana's Natural Resource Information System (September 18, 2008); (3) county-level population projections from a demographic-econometric model (US EPA Integrated Climate and Land Use projections) and (4) commercial/ industrial land in 2000 according to the 2001 National Land Cover Data (US EPA).

DATA SOURCES

- [x] Survey data – counts or estimates
- [ ] Survey data – categorical (e.g. presence/absence)
- [ ] Expert opinion based on observation

DATA EXTRAPOLATION TECHNIQUE USED

- [ ] None
- [ ] Modeling of habitat-species associations (deductive)
- [x] Statistical modeling (inductive)
- [ ] Extrapolation to habitat unit (e.g. stream section)
- [ ] Extrapolation based on expert opinion

METHODS: Housing density projections were generated by a spatially explicit regional growth model (SERGoM) developed by Dr. David Theobald, Colorado State University. SERGoM assumes that: (1) future growth patterns will be similar to those found in the past decade, and (2) areas of future growth are likely to be near current high growth areas. The model converted population growth projections to projected number of new housing units. Urban, suburban, exurban, and rural density classes were each assigned a location-specific average growth rate. New housing units were spatially allocated based on these locally determined growth rates. The distribution of new housing units was adjusted according to accessibility (travel time) to the nearest urban core area. The new housing density was added to the current housing density. Public lands, protected private lands, and water bodies were removed from the set of potential development locations.

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FINAL CATEGORIZATION: Twelve housing density categories were condensed into six. The commercial/industrial category was not adjusted.

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