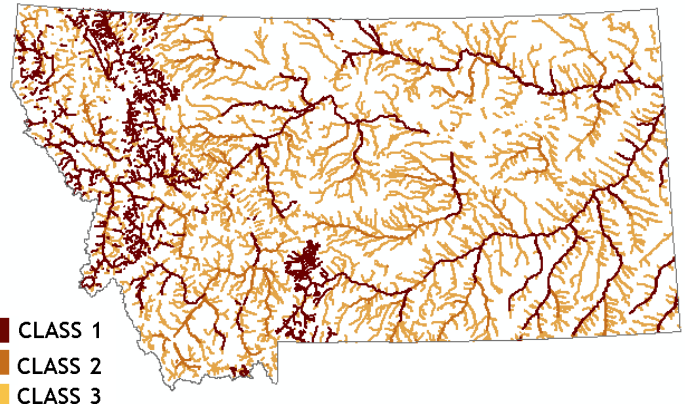




AQUATIC CONNECTIVITY

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 its 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	
<input checked="" type="checkbox"/>	Survey data – counts or estimates
<input checked="" type="checkbox"/>	Survey data – categorical (e.g. presence/absence)
<input checked="" type="checkbox"/>	Expert opinion based on observation
DATA EXTRAPOLATION TECHNIQUE USED	
<input type="checkbox"/>	None
<input type="checkbox"/>	Modeling of habitat-species associations (deductive)
<input checked="" type="checkbox"/>	Statistical modeling (inductive)
<input checked="" type="checkbox"/>	Extrapolation to habitat unit (e.g. stream section)
<input checked="" type="checkbox"/>	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 &

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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%)

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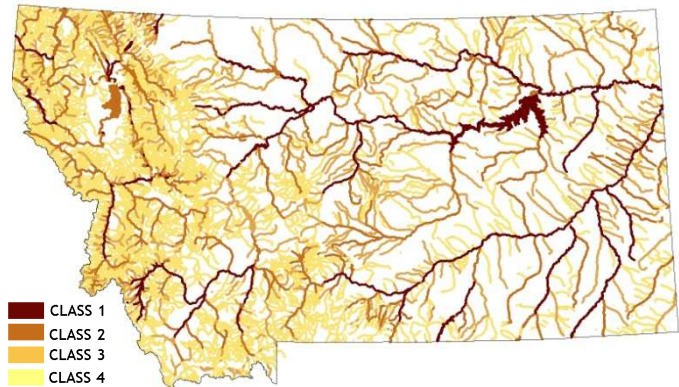


Montana Fish, Wildlife & Parks Crucial Areas Assessment



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)

DATA SOURCES	
<input checked="" type="checkbox"/>	Survey data – counts or estimates
<input checked="" type="checkbox"/>	Survey data – categorical (e.g. presence/absence)
<input checked="" type="checkbox"/>	Expert opinion based on observation
DATA EXTRAPOLATION TECHNIQUE USED	
<input type="checkbox"/>	None
<input type="checkbox"/>	Modeling of habitat-species associations (deductive)
<input type="checkbox"/>	Statistical modeling (inductive)
<input checked="" type="checkbox"/>	Extrapolation to habitat unit (e.g. stream section)
<input checked="" type="checkbox"/>	Extrapolation based on expert opinion

(<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.

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 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.

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

DATE MODIFIED: March 22, 2010 – Version 1.0

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 an ecoregion	8863	80
4	<30 % of max species count within an ecoregion	22145	229



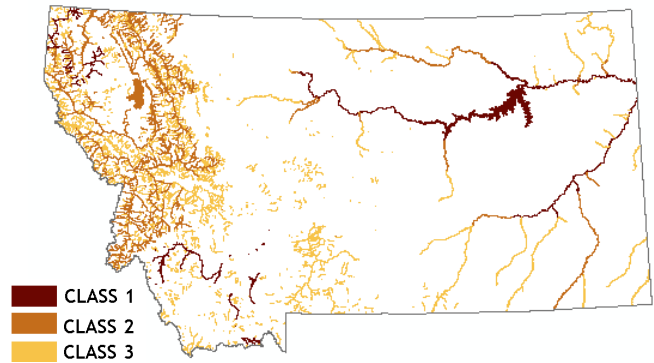
Montana Fish, Wildlife & Parks Crucial Areas Assessment



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)

DATA SOURCES	
<input checked="" type="checkbox"/>	Survey data – counts or estimates
<input checked="" type="checkbox"/>	Survey data – categorical (e.g. presence/absence)
<input checked="" type="checkbox"/>	Expert opinion based on observation
DATA EXTRAPOLATION TECHNIQUE USED	
<input type="checkbox"/>	None
<input type="checkbox"/>	Modeling of habitat-species associations (deductive)
<input type="checkbox"/>	Statistical modeling (inductive)
<input checked="" type="checkbox"/>	Extrapolation to habitat unit (e.g. stream section)
<input checked="" type="checkbox"/>	Extrapolation based on expert opinion

(<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.

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 Columbia Basin Redband Trout, Westslope cutthroat, 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.

Montana Fish, Wildlife & Parks



Crucial Areas Assessment

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 SOC species present	82,256	4154

*Percentages associated with rated waterbodies only.

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DATE MODIFIED: April 9, 2010 - Version 1.0



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	
<input checked="" type="checkbox"/>	Survey data – counts or estimates
<input checked="" type="checkbox"/>	Survey data – categorical (e.g. presence/absence)
<input checked="" type="checkbox"/>	Expert opinion based on observation
DATA EXTRAPOLATION TECHNIQUE USED	
<input type="checkbox"/>	None
<input type="checkbox"/>	Modeling of habitat-species associations (deductive)
<input type="checkbox"/>	Statistical modeling (inductive)
<input checked="" type="checkbox"/>	Extrapolation to habitat unit (e.g. stream section)
<input checked="" type="checkbox"/>	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.

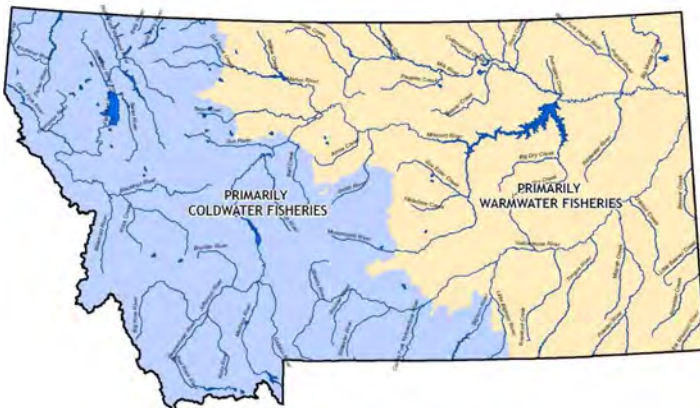
Montana Fish, Wildlife & Parks

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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

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DATE MODIFIED: March 22, 2010 – Version 1.0

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.

**(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).*

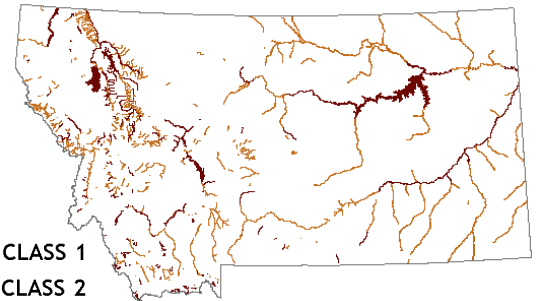


Montana Fish, Wildlife & Parks Crucial Areas Assessment



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 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: 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.

Montana Fish, Wildlife & Parks



Crucial Areas Assessment

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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