CHAPTER 2: ANALYSIS OF THE DRIFTLESS AREA.

A. INTRODUCTION AND DEFINING THE OVERALL PLANNING AREA

"The health of our waters is the principal measure
of how we live on the land."

-Luna Leopold

Although a sentiment that applies universally, in likely no part of the state is this passage truer than the Driftless Area.[1] With its steep topography and deep deposits of wind-blown loess soil, land use activities in the region have a direct and dramatic influence on the quality and quantity of the water in streams and rivers.

The large-scale changes to vegetation that began with Euro-American settlement beginning in the early 1800s brought major transformations to the streams and rivers of western and southwestern Wisconsin. As ridge tops and hills were plowed and cows grazed the steep hillsides, more and more topsoil washed down slope. In some drainages, over ten feet of soil covered valley floors. Rivers and streams that had meandered around rocks and boulders on gravel and sand beds were converted into sediment-laden waters incised in narrow, dirt-lined, deep channels. Where once healthy populations of brook trout and other native species dependent on cool, clean water thrived, only green sunfish, mudminnow, golden shiner, and common carp were common.

This condition began to improve in the 1930s as the impacts that poor farm management practices had on environmental health were increasingly recognized. Coon Valley in Vernon County became the nation's first watershed conservation project – a landscape-scale, multi-disciplinary approach to improving both the productivity of farms and quality of rivers and streams. As the new farming methods spread throughout the Driftless Area, farmland and ecosystem health improved. Flooding and its effects were dramatically reduced, farm economics were improved, and wildlife became more abundant. More rainfall seeped into the soil replenishing groundwater aquifers which in turn reinvigorated the countless springs that supplied cold, clean water to headwater creeks.

With the introduction of the Conservation Reserve Program (CRP) in 1985, the pace of improvements continued. Under CRP, farmers had the option of receiving annual payments from the USDA for 10 or 15 years in return for restoring highly erodible cropland to permanent vegetation. At peak enrollment in 1996, over 450,000 acres in the 22 counties making up Wisconsin's portion of the Driftless Area were in the program[2], with most planted to grasslands. This conversion of lands to permanent vegetation led to further improvements in aquatic conditions in many streams and rivers in the Driftless Area.[3]

As environmental conditions have continued to improve, the Department and many partner conservation groups have taken on the task of restoring in-stream habitats and their adjacent riparian corridors throughout the Driftless Area. In particular, Trout Unlimited and its locally-based chapters have invested substantial time, effort, and money in restoring in-stream conditions from the Kinnickinnic River to Gordon Creek.

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[1] For more information about the attributes and characteristics of the Driftless Area, see the bibliography in Appendix 2.

[2] See https://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=rns-css.

[3] Marshall, D.W., A.H. Fayram, J.C. Panuska, J. Baumann, and J. Hennessey.2008. Positive effects of agricultural land use changes on coldwater fish communities in southwest Wisconsin streams. *North American Journal of Fisheries Management* 28:944-953.

Although many former stream beds are still buried under tons of silt and soil, efforts to re-create stream structure and dynamics, combined with vastly improved water quality, have led to the successful reestablishment of healthy brook trout and smallmouth bass populations and naturalized populations of brown and rainbow trout in many waters. Today, people with a long history of fish management in the region say that the current condition of the fisheries in the Driftless Area is the best they have seen.

Given the complex interactions between land and water, many environmental, land use, social, and economic factors will determine the long-term health of the fisheries of the Driftless Area. Going forward, two factors are of foremost concern. First, crop prices (particularly for corn and soybeans) have risen dramatically over the last five years as a result of a number of factors. This has led to a recent conversion of many acres out of the Conservation Reserve Program and back into row crops. Exposing erodible land to annual cropping is likely to result in increased sedimentation in streams. Second, being very thermally sensitive, trout (and brook trout in particular) are likely to feel the effects of climate change more intensely and extensively than most species. Both of these issues are likely to significantly influence the health and distribution of the fisheries in the Driftless Area. As such, the DNR's approach to and strategies for how it manages lands associated with trout and smallmouth bass will need to incorporate these issues and they are further addressed later in the chapter.

The Wisconsin Glaciation, which lasted from about 100,000 to 10,000 years ago, was the most recent of the major advances of the Laurentide Ice Sheet. Lobes of the great glacier reached down into the northern and eastern portions of the state depositing countless tons of soil, sand, gravel, and boulders (referred to as glacial drift) across the landscape (Figure 2.1). The southern and western sides of the state were not covered with this most recent deposit of glacial material (hence the name "driftless" area), although portions were influenced during earlier glacial periods. The Driftless Area also occurs in southeastern Minnesota, northeastern Iowa and the very northwestern tip of Illinois.[4]

Figure 2.1: Advancement of lobes of the Wisconsin Glaciation

The boundaries of the Driftless Area are generally easy to discern in much of Wisconsin, in particular the eastern boundary along the border of the former Glacial Lake Wisconsin where the flat, sandy former lake bed sits in stark contrast to the hilly topography of the Driftless Area. The boundary along the northern and southern parts of the Driftless Area are somewhat blurred due in part to the impact that previous periods of glaciation had in these areas.

The boundary encompassing this planning process was established by selecting the basins as described by the USGS system of Hydrologic Unit Codes (HUCs) that most closely matched the generally recognized Driftless Area. For most of the planning boundary, Level 8 and Level 10 HUCs were used. In one instance a HUC-12 boundary was used to include an important trout stream in the plan.[5]

[4] Although they share many of the physical and environmental characteristics of the Driftless Area in Wisconsin, most of the "Driftless" portions of Minnesota, Iowa, and Illinois are believed to have been covered by earlier glaciers.
[5] For more information on Hydrologic Unit Codes see http://water.usgs.gov/GIS/huc.html

B. BIOLOGICAL RESOURCES AND ECOLOGICAL CAPABILITY OF THE DRIFTLESS AREA

1. OVERVIEW OF TERRESTRIAL RESOURCES OF THE DRIFTLESS AREA

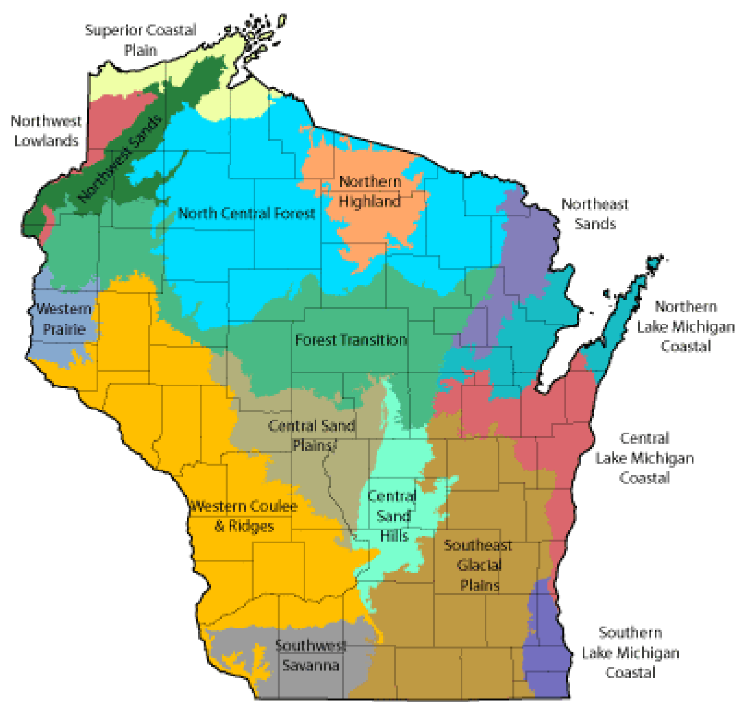
The Department of Natural Resources adopted a classification system (based on the system developed by the U.S. Forest Service and many collaborators) to consistently organize its land-based ecological planning, management, and monitoring activities. This system divides the state into 16 ecologically similar regions (referred to as "Ecological Landscapes" – Figure 2.2), based on soils, existing and pre-settlement vegetation, topography, and types of aquatic features present.[6] The planning boundary for the Driftless Area Stream Project closely approximates the boundaries for the Western Prairie, Western Coulee & Ridges, and the Southwest Savanna Ecological Landscapes. As such, the description of the terrestrial resources of the region will be based on these three ecological landscapes.

a) Western Prairie Ecological Landscape

This ecological landscape is located on the far western edge of the state just below the "tension zone" and contains the only true representative prairie potholes in Wisconsin. This is the easternmost extent of the vast prairie pothole region that stretches across Minnesota, North and South Dakota, Montana, and south central Canada. The area is characterized by generally open, gently to moderately rolling hills with pothole lakes, ponds, and wet depressions. A ribbon of forest occurs along the St. Croix River. Soils consist of a mosaic of silty, shallow and stony alluvial sands and peats, with red clay subsoil.

Pre-settlement vegetation was comprised of dry to mesic prairies in the broad rolling areas and wet prairies in the wide depressions. Open oak savannas were found on the hilly topography with small inclusions of sugar maple-basswood forest in the steeper sites protected from fire. Prairie pothole-type wetlands were most prominent in St. Croix County. Barrens were found along the river terraces of the St. Croix River. Floodplain forests, marshes, and wet prairies occurred within the floodplain of the St. Croix.

Figure 2.2: Ecological Landscapes of Wisconsin



Almost one-half of this landscape is now in agriculture with another one-third in grasslands. Forest pockets are mostly comprised of maple-basswood and oak-hickory, with smaller amounts of lowland hardwoods and conifers. Although dairy farming and row crops remain the predominant agricultural uses, this area is experiencing rapid urbanization along its western fringe due to its proximity to the Twin Cities.

[6] See the Ecological Landscapes Handbook at http://dnr.wi.gov and search for "ecological landscapes."

b) Western Coulee & Ridges Ecological Landscape

This ecological landscape is characterized by highly eroded topography. Soils are typically silt loams (loess) and sandy loams in the uplands and alluvial or terrace deposits in the valley floors. Large, meandering rivers with broad floodplains are also characteristic of this landscape and include the Mississippi, Wisconsin, Chippewa, Black, La Crosse, and Kickapoo.

Historical vegetation consisted of southern hardwood forests, oak savanna, scattered prairies, and floodplain forests and marshes along the major rivers. With Euro-American settlement, most of the land on ridgetops and valley bottoms was cleared of oak savanna, prairie, and level forest for agriculture. The steep slopes between valley bottom and ridgetop, unsuitable for raising crops, grew into oak-dominated forests after the ubiquitous presettlement wildfires were suppressed. Today, steep-sided valleys are heavily forested and often managed for hardwood production. Agricultural activities, primarily dairy and beef farming, are typically confined to valley floors and ridge tops. The floodplain forests associated with these riverine systems are among the largest in the Upper Midwest.

This landscape provides opportunities to protect some of Wisconsin's most significant natural features. The rugged hills that typify the area harbor the world's largest concentration of hillside prairies, which often support numerous species of rare plants, insects and reptiles. In addition, many of these sites provide excellent opportunities to restore and expand remnant oak openings, a globally rare natural community. This landscape also offers opportunities to pursue landscape scale management for several forest types, most notably southern dry forest dominated by white and black oak, southern dry-mesic forest with red oak as a principal component, and southern mesic forest consisting primarily of sugar maple and basswood.

Wisconsin's best remaining examples of pine and hemlock relicts are found within this landscape, typically in association with three river systems—the Kickapoo, Pine and Blue. They are of conservation interest due to their relative rarity, unique assemblage of "northern" plant species, and the overall biological diversity they contribute to this region of the state. Extensive tracts of floodplain forest, thousands of acres in size, are found along large river systems, including the Chippewa, Black, Wisconsin, and Mississippi Rivers. The vegetation of these forests is characterized by an abundance of silver maple, cottonwood, green ash, hackberry and river birch. While their size alone is significant, they take on added conservation value due to the rich assemblage of reptiles and amphibians they support and the habitat value they provide for resident and migratory birds. Determining the impact of fluctuating water levels and timber harvest practices on forest regeneration are among the most pressing conservation needs.

This landscape also offers conservation opportunities for a number of natural communities that, while smaller in geographic extent and more widely scattered than those previously described, are no less biologically significant. Included among these are algific talus slopes, dry sand prairies, cedar glades, dry cliffs and moist cliffs.

c) Southwest Savanna Ecological Landscape

This ecological landscape is characterized by deeply dissected topography with broad open hilltops, flat fertile river valleys, and steep wooded slopes. Soils on hilltops are silty loams, sometimes of shallow depth over exposed bedrock and stony red clay subsoil. Some valley soils are alluvial sands, loams, and peats. Some hilltops are almost treeless due to the thin soil while others have a deep silt loam cap. Historic vegetation consisted of tall prairie grasses and forbs with oak savannas and some wooded slopes of oak.

Occupying the south-facing slope of the Military Ridge, prairies and savannas were the dominant habitat types in this area prior to Euro-American settlement. Dry prairies covered the hilltops and graded into more mesic prairies, oak savannas and oak woodlands down slope. The river valleys were often a mix of hardwoods including oak, maple and elm. The dominant land use now is agriculture, although farms typically contain a combination of row crops, hay fields, and small woodlots.

From both a statewide and national perspective, a pressing conservation concern has been the dramatic decline over the past several decades of many grassland birds such as Henslow's sparrow, loggerhead shrike, greater prairie chicken, and Bell's vireo. Although data showing population trends for grassland mammals, reptiles, amphibians, insects and other species groups are lacking, it is believed that the full range of grassland species has plummeted. The primary cause of this decline has been the loss and fragmentation of prairies and oak savannas.

Some high quality prairie remnants remain on the rocky hilltops and slopes that are not suitable for farming. Although nearly all of the oak savannas have been converted to production agriculture or have transitioned to oak forests, a small number of remnants remain or are being restored in this ecological landscape. Prairie pastures are scattered through the area. Together, these remaining lands comprise critical habitat for many rare grassland birds, invertebrates, mammals, and reptiles. Because of its soil, existing land use, and topography, the Southwest Savanna ecological landscape offers one of Wisconsin's best opportunities for the large-scale restoration of functioning dry prairies, dry-mesic prairies, and oak savanna, three of the state's rarest natural communities. Maintaining viable farming operations in the area would be a critical component in any overall protection strategy to restore functioning grassland ecosystems here.

2. OVERVIEW OF AQUATIC RESOURCES OF THE DRIFTLESS AREA

The waters of the Driftless Area are predominantly small to mid-sized streams and rivers. The headwaters typically emerge from cold, spring fed areas or a series of ephemeral streams. As stream threads move down the valley in a dendritic pattern, more and more tributaries contribute increasing amounts of water. Depending upon the substrate, flow, nutrient load, gradient, and many other factors, these streams and rivers host a variety of ecological conditions and aquatic species.

In this section of the RPA a wide variety of attributes, features, and characteristics about aquatic resources are described. The focus of the discussion is on trout and smallmouth bass because the primary purpose of the properties included in this master plan is to provide angling access and habitat for these three species. To bring consistency to the presentation and organization of this wide array of information and data, a spatially nested system is used.

The United States Geological Survey created a hierarchical system of hydrologic units which are watershed boundaries organized in a nested hierarchy by size. Each unit is assigned a unique **Hydrologic Unit Code** (HUC). The aquatic resources data for this analysis are organized in this spatially nested hierarchical framework (Figure 2.3), which is similar to that described and proposed for the National Fish Habitat Monitoring Program.[7]

Figure 2.3: Spatial Framework for Aquatic Analysis

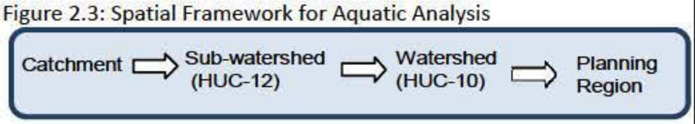


Table 2.1: Spatial Framework of the 8 Planning Regions.

Planning Region	Number of Catchments	Number of HUC-12	Number of HUC-10
Baraboo River Region	**1134**	**34**	**5**
Black River Region	**3158**	**62**	**12**
Chippewa River Region	**2635**	**80**	**16**
Kickapoo River Region	**3034**	**74**	**15**
Kinnikinnic River Region	**720**	**21**	**6**
Lower Wis River Region	**2848**	**76**	**17**
Pecatonica River Region	**1871**	**54**	**14**
Platte River Region	**1490**	**40**	**9**
Total	**16,890**	**441**	**94**

There are 16,890 catchments in the planning area for this Driftless Area Master Plan. A "catchment" is the area that drains a segment or reach of a stream. A "stream reach" is the length between two points, typically where one stream enters another. Catchments are grouped into 441 sub-watersheds (HUC-12s), which in turn are grouped into 94 watersheds (HUC-10s) (Table 2.1).

Figure 2.4: Nested Spatial Structure of the Black Earth Creek Watershed

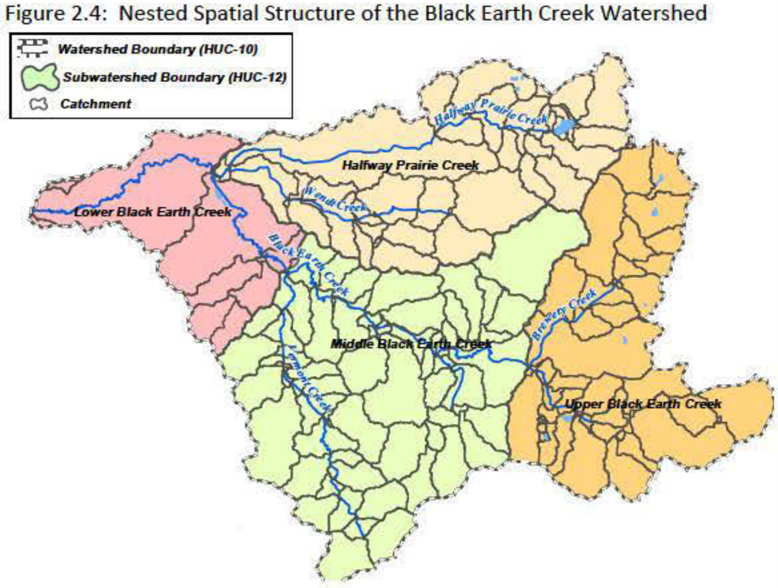


Figure 2.4 provides an example of the nested spatial structure for the Black Earth Creek Watershed (HUC-10), showing its four sub-watersheds and associated catchments. Most maps in the planning region chapters are depicted at the sub-watershed level (HUC-12). Many of the data summaries, each planning region report card, and associated figures are depicted at the watershed level (HUC-10).

7 Lizhu Wang, D. Infante, P. Esselman, A. Cooper, D. Wu, W. Taylor, D. Beard, G. Whelan, and A. Ostroff (2011): A Hierarchical Spatial Framework and Database for the National River Fish Habitat Condition Assessment, *Fisheries*, 36:9, 436-449

In determining the distribution and health of species' populations, the Department and others gather a wide range of data on stream and water characteristics and fish and invertebrate populations every year. Of course, not every stream or stream segment can be assessed, so a sampling of locations are selected and evaluated on a rotating basis. Of particular interest is the status of the brook and brown trout populations and, secondarily, smallmouth bass; the Department focuses a large percentage of its aquatic data collection efforts on these species.

The following section describes a range of habitat and population factors related to trout and smallmouth bass distribution and abundance in the Driftless Area. These include:

- The factors that provide good natural habitat and that cause habitat stress for all three species.
- Existing thermal conditions of trout streams and their resilience to climate change.
- Trout stream restoration work completed.
- The distribution and abundance of trout and smallmouth bass, based on electro-shocking survey work.
- Projected resilience of trout and expansion of smallmouth bass resulting from climate change.
- The amount and distribution of public access for angling.
- The potential demand for angling.

This information was used to create the planning region "report cards" that are presented in Chapters 3 through 10.

a) Identifying the factors most influential in determining the presence or absence of trout and smallmouth bass in waters of the Driftless Area

Using data from the DNR as well as counterparts in Minnesota, Iowa, and Illinois, the Midwest Fish Habitat Partnership's Driftless Area Restoration Effort (DARE)[8] modeled the probability five species occurring in catchments throughout the Driftless Area.[9] The five species are: brook trout, brown trout, smallmouth bass, longnose dace, and cottus (sculpin).

The modeling effort assessed the relative influence that different factors have in determining the likelihood that each of the species will be present or absent in a given catchment. The model evaluated both the quality of each catchment's natural habitat potential as well as the degree of human-induced stressors.

Natural habitat potential variables are those that human uses of land do not directly influence, such as air temperature, precipitation, the size of the network drainage area ("networks" are defined as the local catchment and all upstream catchments), and slope. Land use stressors, which include the factors that are a function of how people use land, include the amount of land in forests, grasslands, and impervious surfaces within a catchment or network, the density of cattle, and the local density of road crossings.

The **top five variables**, as determined by DARE's modeling work, **for natural habitat potential and land use stress for brook and brown trout and smallmouth bass are listed in Figures 2.5 to 2.10**.

Figure 2.5: Top 5 natural habitat potential variables on **brook trout** distribution and their relative influence.

Variable description	Relative influence
Mean annual air temperature	13.12
Mean annual precipitation	8.46
Network drainage area	5.33
Network mean baseflow index	4.54
Slope of catchment flowline	3.55

Figure 2.6: Top 5 natural habitat potential variables on **brown trout** distribution and their relative influence.

Variable description	Relative influence
Network drainage area	15.70
Network carbonate bedrock cover	7.86
Mean annual air temperature	7.45
Mean annual precipitation	6.77
Network mean baseflow index	3.44

Figure 2.7: Top 5 natural habitat potential variables on **smallmouth bass** distribution and their relative influence.

Variable description	Relative influence
Network drainage area	50.4
Mean annual air temperature	6.24
Mean annual precipitation	4.73
Minimum catchment elevation	3.07
Network sandstone bedrock cover	2.34

Figure 2.11 shows the natural habitat quality, the level of anthropogenic stress, and probability of occurrence for brook trout. The maps show the relative grades for the sub-watersheds that contain classified trout waters (for brook and brown trout) and waters managed for smallmouth bass. Grades were established using the DARE modeling results using a similar method for all three species (brook trout, brown trout, and smallmouth bass). For brook and brown trout, only natural habitat potential and land use stress values from the catchments located adjacent to classified trout streams were selected. Likewise, for smallmouth bass, only natural habitat potential and land use stress values from catchments located adjacent to managed smallmouth bass streams were selected.

[10] See Downstream Strategies. 2012. *Driftless Area Restoration Effort Model Summaries.* Morgantown, WV.
[11] The DARE modeling effort used a slightly different boundary in WI than used in this master planning effort.

In general, the northern part of the Driftless Area contains higher habitat potential for brook trout, due to the high relative influence of air temperature and precipitation. The Kinnickinnic River, Chippewa River, Black River, and portions of the Kickapoo River regions represent the heart of Driftless Area brook trout country (Figure 2.11). In comparison, the Kickapoo River region has lower brook trout habitat potential, but land use stress is also lower (high local and network forested land cover). This results in high probability of brook trout occurrence throughout much of the Kickapoo River region as well. Pockets of high habitat potential also exist in the Lower Wisconsin River region, notably the northeast portion and the Devil's Lake area.

Figure 2.8: Top 5 land-use stress variables on brook trout distribution and their relative influence.

Variable description	Relative influence
Network forested land cover	9.04
Network density of cattle	5.71
Network impervious surface cover	4.04
Local forested land cover	3.55
Network surface water use	2.72

Figure 2.9: Top 5 land-use stress variables on brown trout distribution and their relative influence.

Variable description	Relative influence
Network grassland land cover	5.60
Local forested land cover	4.97
Network rowcrop land cover	2.60
Local rowcrop land cover	2.12
Network surface water use	1.53

Figure 2.10: Top 4 land-use stress variables on smallmouth bass distribution and their relative influence.

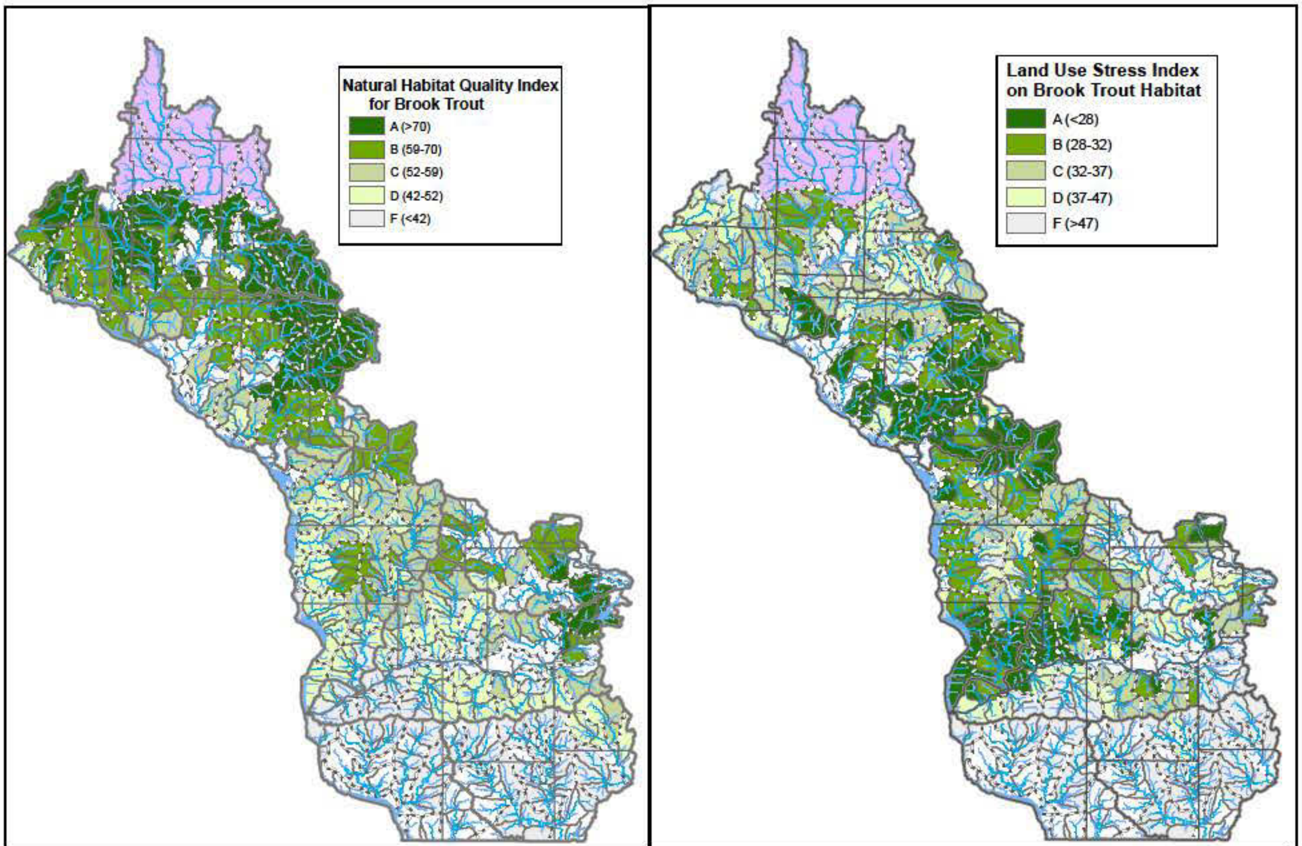
Variable description	Relative influence
Network density of cattle	3.90
Network grassland land cover	2.78
Local wetland land cover	1.45
Local rowcrop land cover	1.32

METHODS: Calculating grades for natural habitat potential and land use stress.

The natural habitat potential values range from 0 – 100, where higher values indicate better habitat potential and good grades (A), whereas lower values indicate poor habitat potential and poor grades (F). The land use stress values range from 0 – 100, where lower values indicate **less** land use impacts and good grades (A), whereas higher values indicate greater negative land use impacts with poor grades (F). Natural habitat potential values of all pertinent catchments in each sub-watershed were then averaged to create a mean value for each sub-watershed (HUC-12). Natural habitat potential sub-watershed values (potentially 441) were then distributed into their respective quintiles and grades were assigned where: F = 0-20th % quintile, D = 20-40th % quintile, C = 40-60th % quintile, B = 60-80th % quartile, and A = 80-100th % quartile. These sub-watershed grades were then mapped. The same procedure was applied to the land use stress values.

Next, at the broader watershed level (HUC-10), natural habitat potential values were calculated by estimating the mean from all of their "offspring" sub-watershed (HUC-12) values. Natural habitat watershed values (potentially 94) were then distributed into their respective quintiles and grades were assigned where: F = 0-20th % quintile, D = 20-40th % quintile, C = 40-60th % quintile, B = 60-80th % quartile, and A = 80-100th % quartile. These watershed values and grades are shown in figures and tabular form in the subsequent chapters of the 8 planning regions. The same procedure was applied to the land use stress values.

Figure 2.11: Sub-watershed maps showing natural habitat potential, land use stress index, and probability of occurrence for Brook Trout.



Habitat potential for brook trout in the Pecatonica and Platte River Regions is extremely low and, coupled with high levels of land-use stress, creates unfavorable conditions for the occurrence of any brook trout. Model results show less than 10% levels of probability of brook trout occurrence through the Pecatonica and Platte River Regions (exceptions are portions of Blue Mounds, Black Earth Creek and the West Branch of the Sugar River where probability of occurrence ranges from 20% to 60%).

Noteworthy is the lower levels of land use stress for brook trout in the Black River, Kickapoo River, and northwest portion of the Lower Wisconsin River Region, mostly due to higher levels of network forested land cover and lower network densities of cattle. **The pink areas on the map depict sub-watersheds that are included in this plan but not included in the DARE habitat modeling work.**

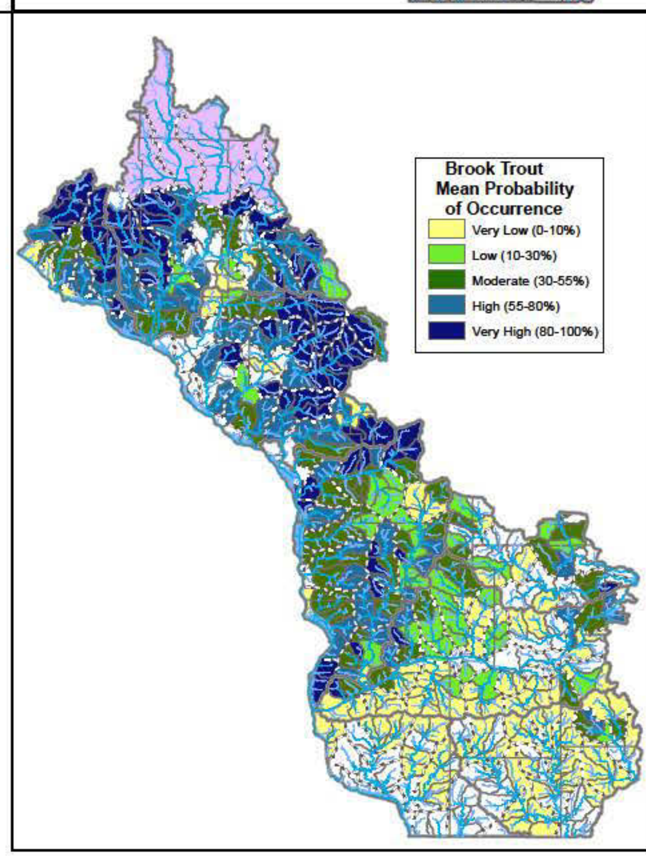
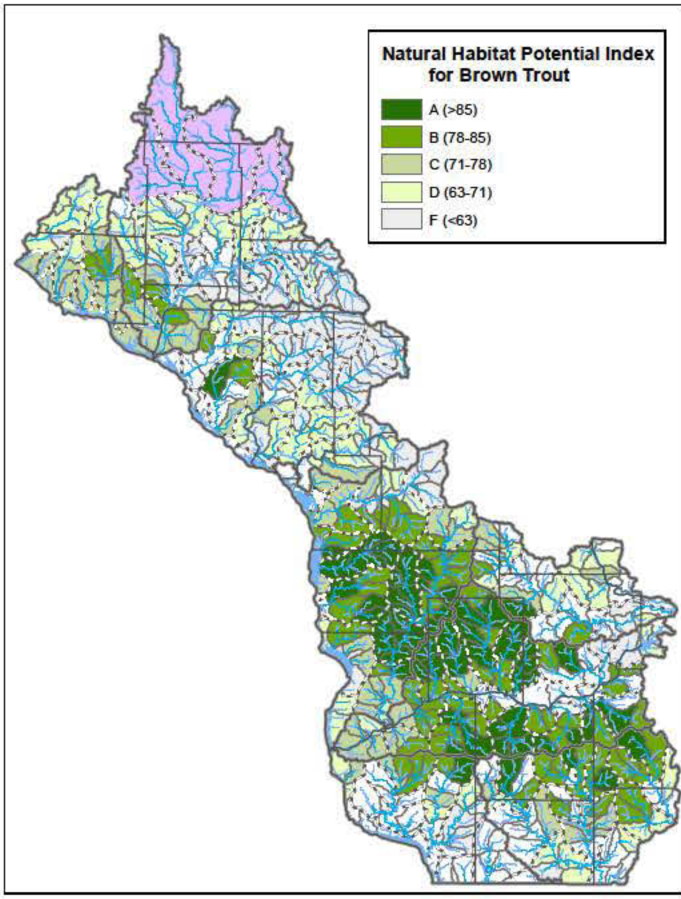
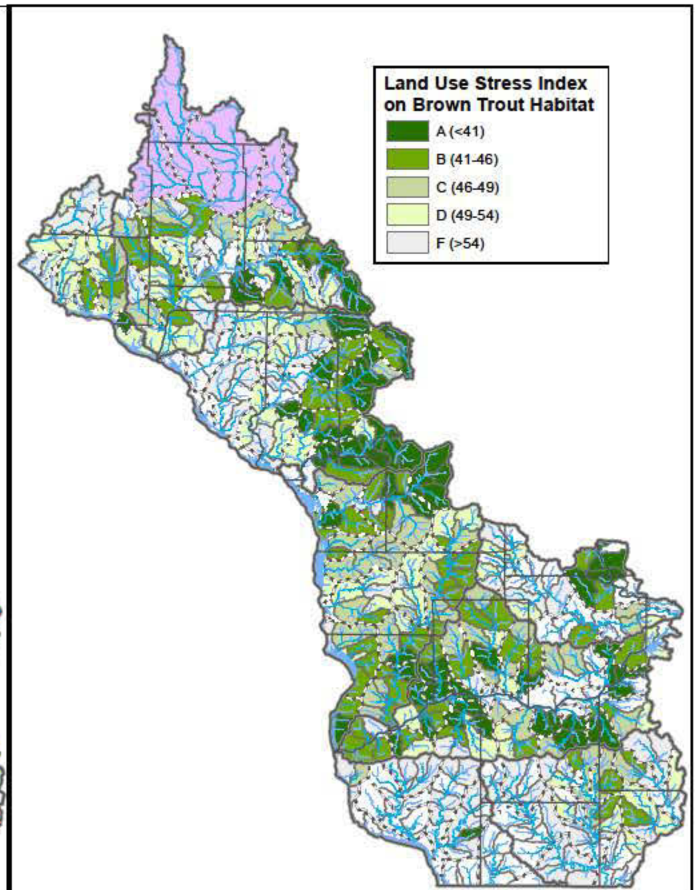


Figure 2.12: Sub-watershed maps showing natural habitat potential, land use stress and probability of occurrence for Brown Trout.





Brown trout habitat in the Driftless is found in two strongholds. First, the Kickapoo River region, Lower Wisconsin River region, the northerly half of the Pecatonica River region, and the north fringe of the Platte River region represent the heart of brown trout country. Second, westerly portions of the Chippewa River Region and the entire Kinnickinnic River region have excellent natural habitat potential. The Black River region is truly brook trout country, not brown trout. Most sub-watersheds in the Black River Region have brown trout natural habitat potential index values below 71 and are in the lower two quintiles (grades D and F). As a result, most sub-watersheds in the Black River Region have brown trout probabilities of occurrence under 10%.

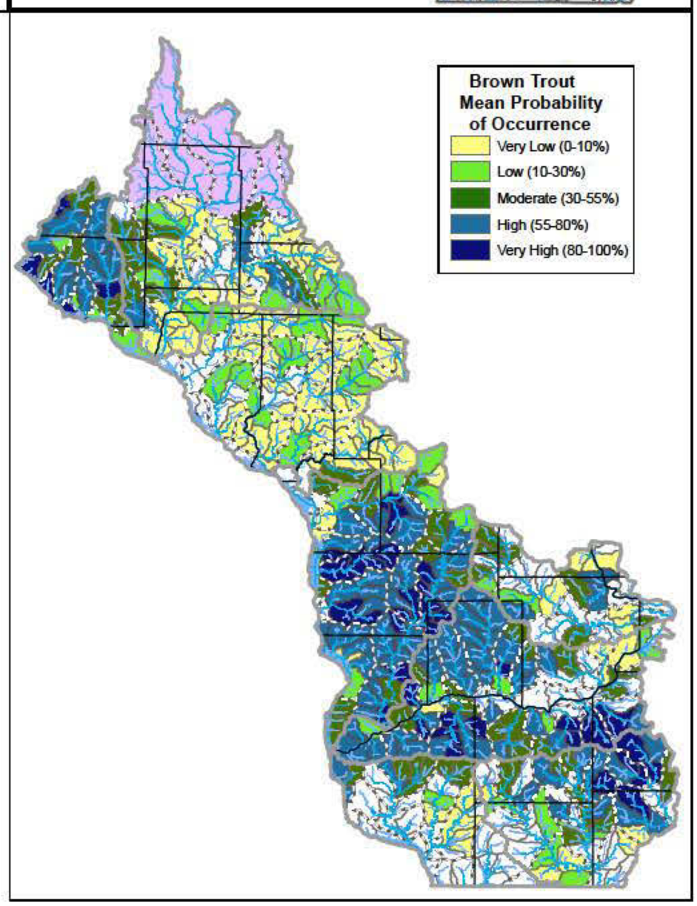
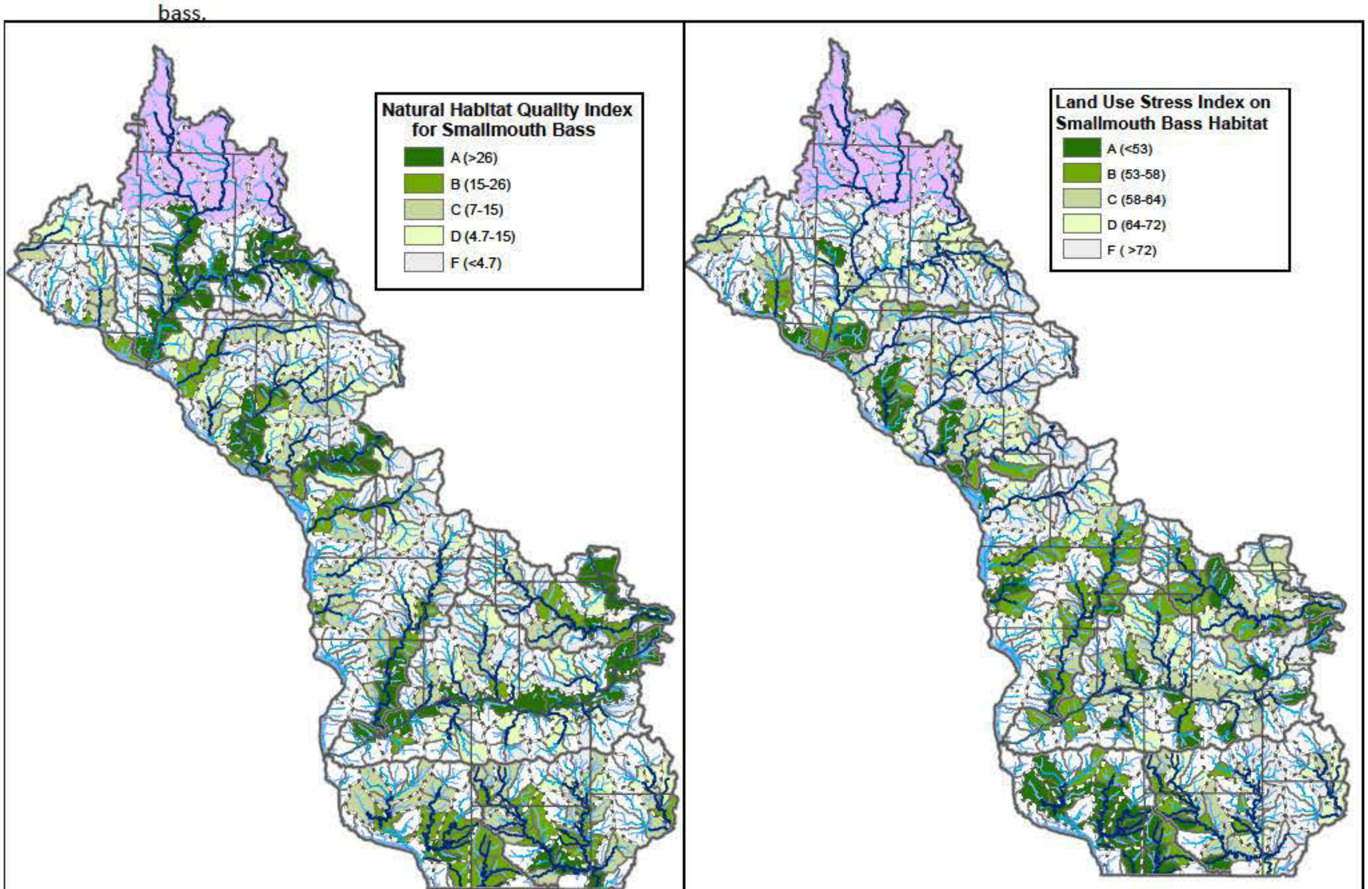
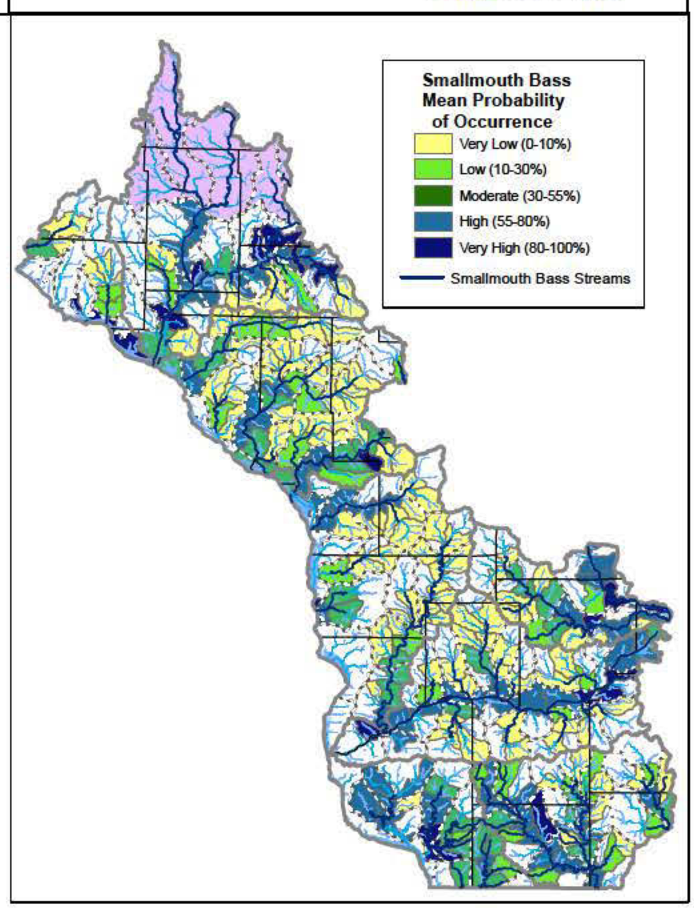


Figure 2.13: Sub-watershed maps showing the natural habitat potential, land use stress, and probability of occurrence for smallmouth bass.





Across the Driftless Area, smallmouth bass are a "big water" fish and can be found in larger warmwater streams and rivers like the Baraboo, Wisconsin, Pine, Black, Chippewa, Red Cedar, La Crosse, Pecatonica, and Platte. Of all the planning regions, the Platte River Region is smallmouth bass country, owing to the fact that the most influential factors for smallmouth bass habitat potential index are: 1) network drainage area; 2) mean annual air temperature; 2) mean annual precipitation; 4) minimum catchment elevation; and 5) network sandstone bedrock geology. The Kinnickinnic River region is the only planning region without a significant smallmouth bass presence.

For each species, evaluating natural habitat quality potential and level of land use stress allows the identification of sub-watersheds on which to focus protection efforts (high natural quality potential and low human-induced stress) as well as areas that may be primed for restoration efforts (high quality, high stress) (Figures 2.14-2.16). Areas with low natural quality, and either low or high stress, likely do not warrant protection or restoration efforts given the limit of current resources.

Figure 2.14: Protection and restoration priorities for brook trout.

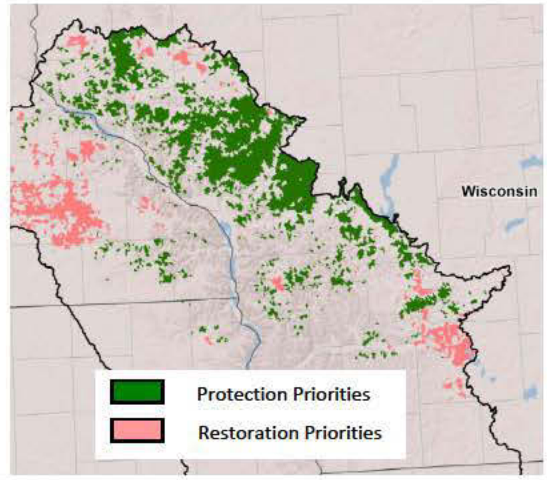


Figure 2.15: Protection and restoration priorities for brown trout.

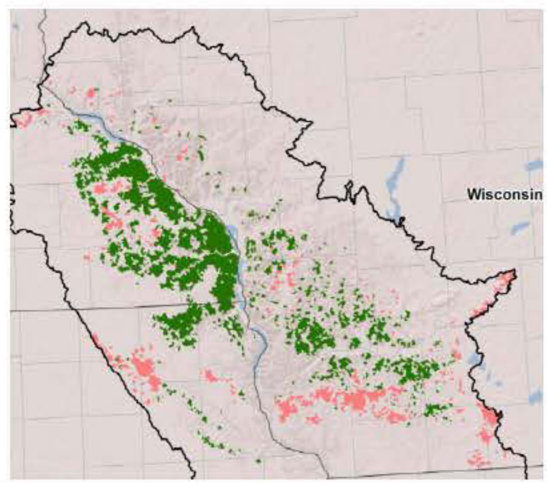
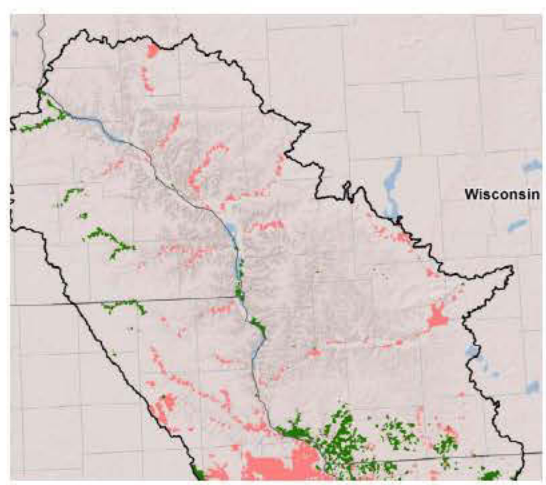


Figure 2.16: Protection and restoration priorities for smallmouth bass.



b) Thermal Habitat of Trout Streams in the Driftless Area

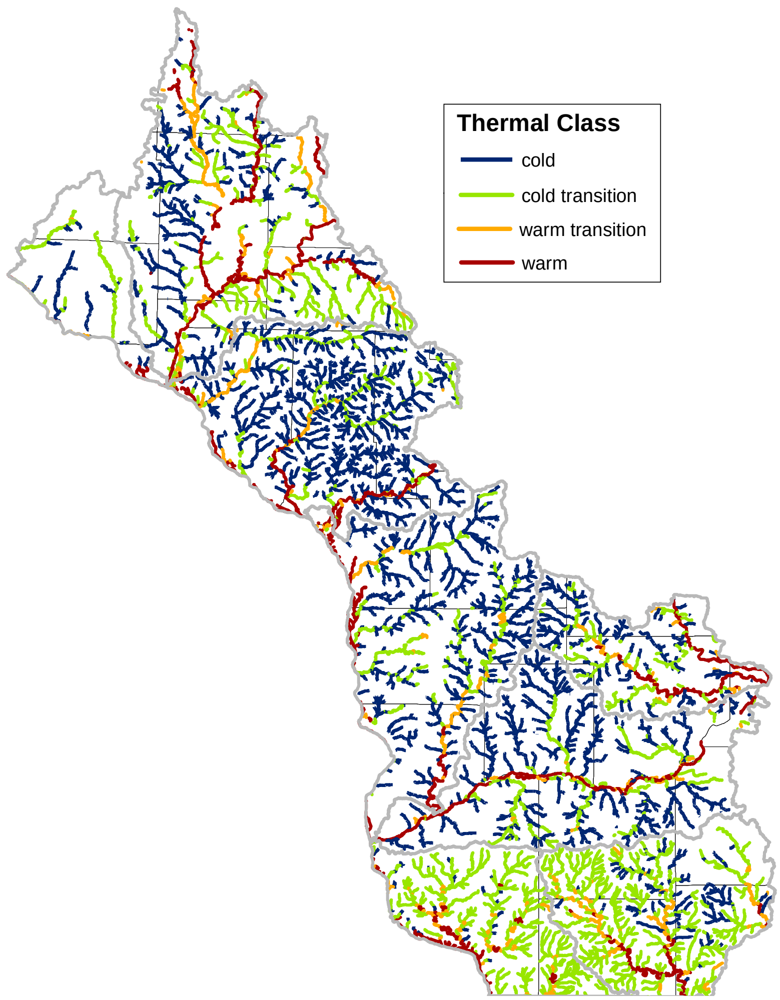
Waters are classified thermally based on the variation in their summer temperatures (in terms of both mean temperatures and temperature fluctuations) and the influence this has on the spectrum of species that can be supported within different temperature ranges.

Table 2.2 Thermal Classification Standards for Streams

Thermal Class and Subclass	July Mean °C	July Mean °F	Max daily mean °C	Max daily mean °F
Coldwater	<17.5	<63.5	<20.7	<69.3
Coolwater				
Cold transition	17.5-19.5	63.5-67.1	20.7-22.6	69.3-72.7
Warm transition	19.5-21.0	67.1-69.8	22.6-24.6	72.7-76.3
Warmwater	>21.0	>69.8	>24.6	>76.3

Lyons et al. (2009)[10] recently defined subclasses of coolwater stream as "cold transition" and "warm transition" and developed temperature ranges for each of the four classes of streams. This Regional and Property Assessment uses these themal class definition (Table 2.2) for the Driftless Area streams. Streams in the Driftless Area are categorized as: cold, cool-cold transition (sometimes referred to simply as cold transition), cool-warm transition (sometimes referred to as warm transition), and warm.

Figure 2.17: Thermal Class Map of Driftless Streams. Based on current July mean stream temperature



Broadly speaking, the thermal characteristics of streams in the Driftless Area can be divided into three main sections (Figure 2.17). The Platte and Pecatonica River regions are dominated by cool-cold transition waters and although there are pockets of cold water that support healthy populations of brook trout, brown trout and smallmouth bass are more common here. Brook Trout tend to be restricted to streams higher up in the watershed and are on the thermal edge of their distribution in these regions. Larger streams and rivers are typically cool-warm transition and support robust smallmouth bass populations. Nearly all the larger rivers in the broad valley floors are warm water.

[10] Lyons, J., T. Zorn, J. Stewart, P. Seelbach, K. Wehrly, and L. Wang. 2009. Defining and characterizing coolwater streams and their fish assemblages in Michigan and Wisconsin, USA. *North America Journal of Fisheries Management* 29:1130-1151.

In the second area, between Military Ridge[11] and the northern end of Buffalo, Trempealeau, and Jackson counties, streams are predominantly cold water and fed by countless springs and seeps. The landscape tends to be heavily dominated by forests which helps maintain cold stream temperatures in the summer. A few pockets of cool-cold transition water are found along the lands draining off the broad flat ridgetop surrounding Viroqua and in the Baraboo watershed. This portion is the heart of the Driftless Area trout water.

The third major area – north of Buffalo, Trempealeau, and Jackson counties – is a mix of cold and cool-cold transition waters. Some waters tend to be predominantly cool-cold transition systems (e.g., Rush River) while others, for example the Eau Galle and the upper Hay systems, are primarily cold water.

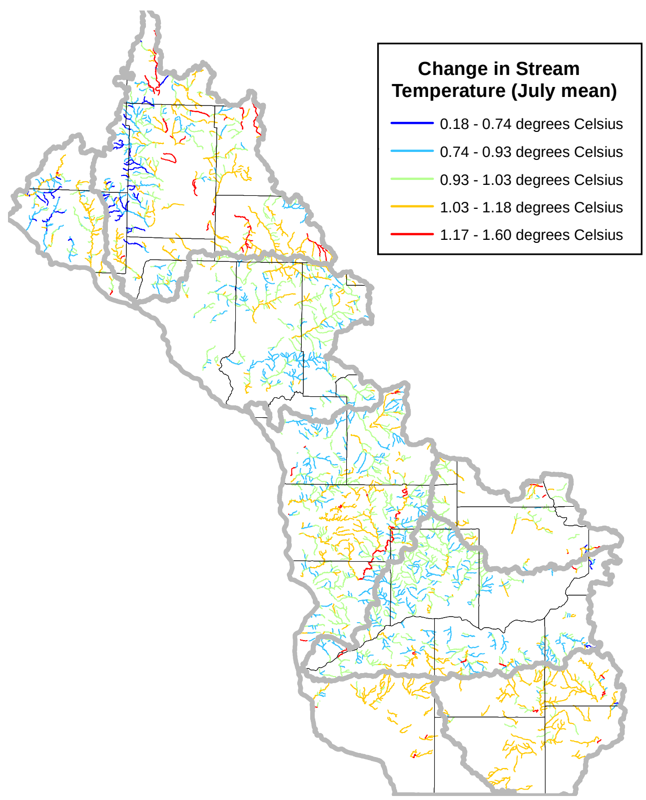
The large rivers throught the Driftless Area are all warmwater systems and support diverse very diverse assemblage of fish species including minnows, darters, suckers, sunfish, catfish, and smallmouth bass.

c) Thermal Resilience of Driftless Trout Streams to Climate Warming

Lyons et al. (2010)[12] and Stewart et al. (in prep.)[13] and have shown that the thermal characteristics of Driftless Area streams are projected to increase in varying amounts in the coming decades, as can be seen in Figure 2.18. By the mid-century, July mean temperature for trout streams throughout much of the Driftless Area are projected to increase 1.5^0F – 1.8^0 F, except for the Plate, Pecatonica, and Baraboo River regions, where nearly all streams will see increases of at least 1.8°F. The "highland" central portion of the Kickapoo River Region will also experience greater increases in stream temperature. The western portion of the Chippewa River region is most notable for the collection of streams that will retain much of their current thermal condition.

Among the northerly planning regions, the central "highland" portion of the Kickapoo River region, the eastern part of the Chippewa River region, and the northern part of the Kinnickinnic River region all represent areas of significantly less thermal resilience.

Figure 2.18: Projected trout stream temperature increases (current to the period 2046-2065).



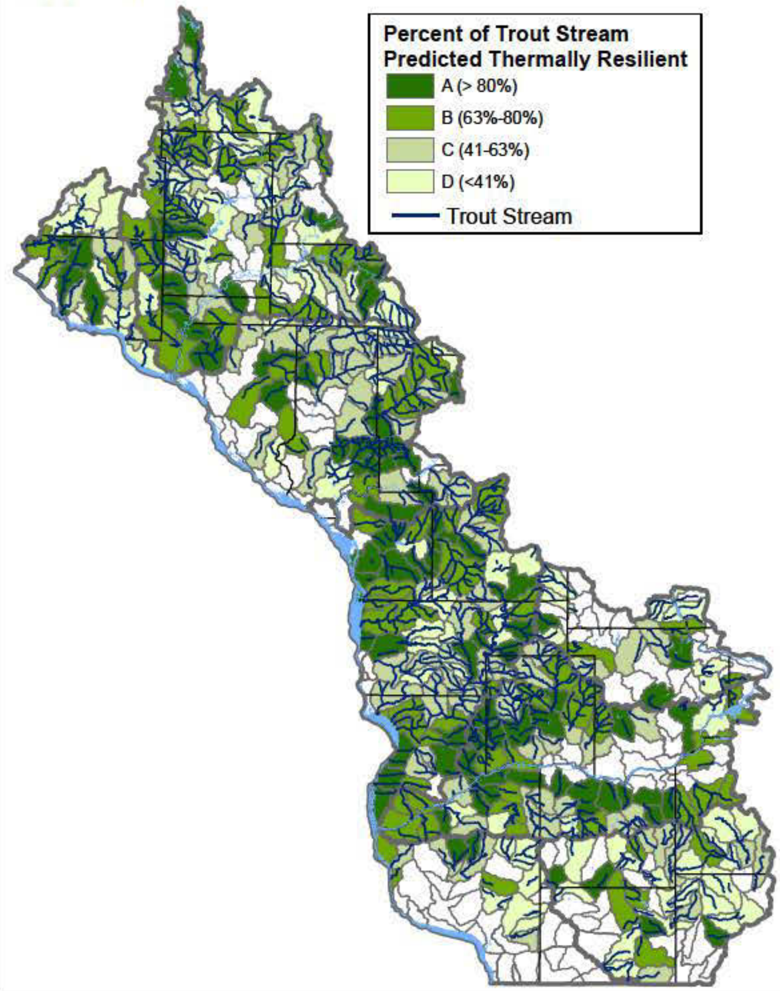
[11] Military Ridge is a well-known topographic feature in southwestern Wisconsin. It constitutes the divide between the north-flowing tributaries of the Wisconsin River and the south- flowing streams tributary to the Rock and Mississippi. Its crest was followed by the Military Road, built in 1835 from Green Bay to Prairie du Chien.

[12] J. Lyons, J. Stewart, and M. Mitro. 2010. Predicted effects of climate warming on the distribution of 50 stream fishes in Wisconsin, U.S.A. Journal of Fish Biology 77:1867–1898.

[13] J. Stewart, S. Westenbroek, and M. Mitro. (USGS Scientific Investigation Report; In Prep). A model for evaluating stream temperature response to climate change in Wisconsin.

Among the southerly planning regions, trout streams of the Platte and Pecatonica River regions are most vulnerable to shifts in thermal class due to climate warming. Here, most sub-watersheds had less than 40% of their trout stream miles thermally resilient to the mid-century.

Figure 2.19: Projected Thermal Resilience of Trout Streams to Climate Change (current to 2046-2057.



METHODS: Calculating grades for the thermal resilience of trout streams.

Thermal resilience was evaluated for all classified trout streams throughout the Driftless Area. A stream reach was defined to be **thermally resilient** when the Stream Climate Model projected that the thermal class (Table 2.2) would remain unchanged from current to the mid-century period. Each output thermal classification is based on a projected July mean stream temperature from the input of 10 downscaled climate models within the stream model. When projected future stream temperature increases of a stream reach "pushed" that stream reach into a warmer class, the change was invariably only one class level upward (i.e., stream reaches increased from cold to cold transition, or cold transition to warm transition, never from cold to warm transition).

Thermally-resilient stream reach segments were summed at the sub-watershed (HUC-12), and then expressed as the percent of the total trout stream miles. Frequency distributions of the percent thermally-resilient sub-watershed values (potentially 441) were then distributed into their respective quartiles and grades were assigned where: 1st quartile = D, 2nd Quartile = C, 3rd Quartile = B, and the 4th Quartile = A. There were no F's assigned for thermal stability metric. These thermal stability sub-watershed grades were then mapped (Figure 2.19). The same procedure was used at the watershed level (HUC-10) to calculate thermal resilience grades.

d) Trout Stream Restoration

Stream restoration needs vary across the Driftless Area. In some cases, relatively modest improvements are needed to address spawning, feeding or wintering habitat issues. In other cases, conditions have degraded to the extent that a reconstruction with significant re-shaping of the stream corridor, installation of in-stream structures, and other measures are warranted. The Department and partner groups restrict most stream restoration efforts to stretches along which there is public access. A more complete discussion of the goals and activities of the trout habitat program are provided later in this chapter.

From the 1970's to 2006, over 290 miles of trout streams have received some level of restoration work. The most restoration work was completed in the Kickapoo River Region, totaling over 121 miles of stream while only two miles of habitat work was completed in the Baraboo River Region (Figure 2.20). Habitat rehabilitation efforts are patchily distributed across the Driftless Area (Figure 2.21).

Figure 2.20: Miles of restored trout streams, by Planning Region.

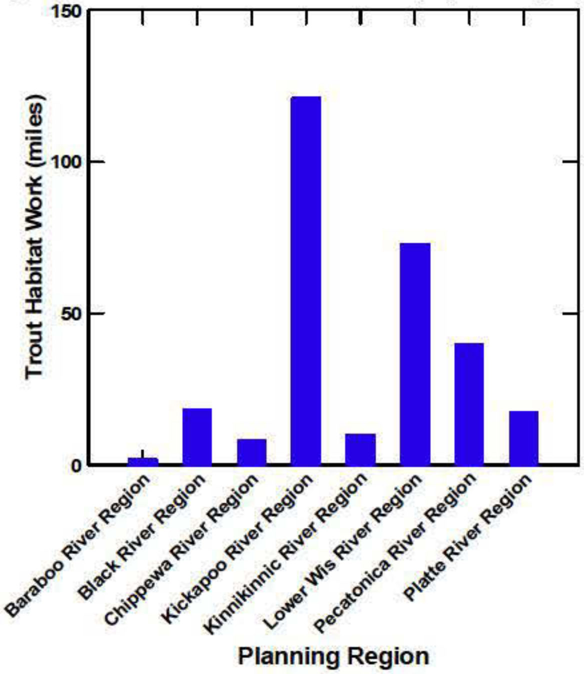
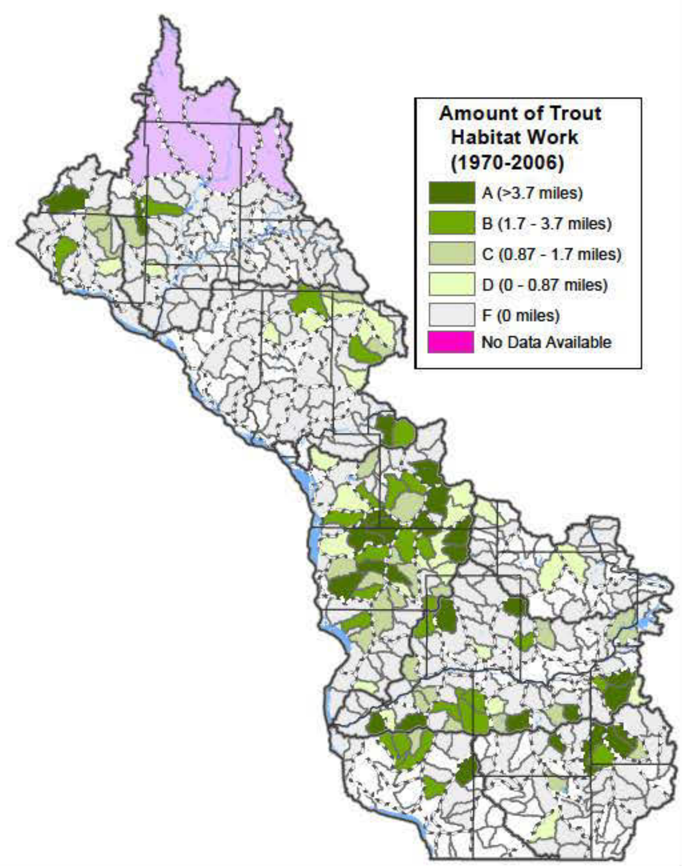


Figure 2.21: Sub-watershed map of the amount of trout habitat work completed from 1970-2006.



METHODS: Calculating grades for the amount of habitat work that has been completed.

The spatial data layer for trout habitat work shown here was initially developed by a TUDARE project led by Jeff Hastings, Laura Hewitt, and Tom Thrall. Their dataset roughly represents habitat efforts, ranging from brushing and fencing to more elaborate in-stream reconstruction, from the 1970's through 2006.

Habitat rehabilitation segments were summed at the sub-watershed, watershed, and planning region levels. A northern portion of the Chippewa Planning region is not represented in this data set. At the sub-watershed spatial scales, 0 miles of habitat work was assigned a grade of F. The remaining non-zero values were classified into quartiles where: 1st quartile=D, 2nd Quartile=C, 3rd Quartile=B, and the 4th Quartile= A. The same procedure was completed at the watershed level (HUC-10).

e) Sport Fishery Performance

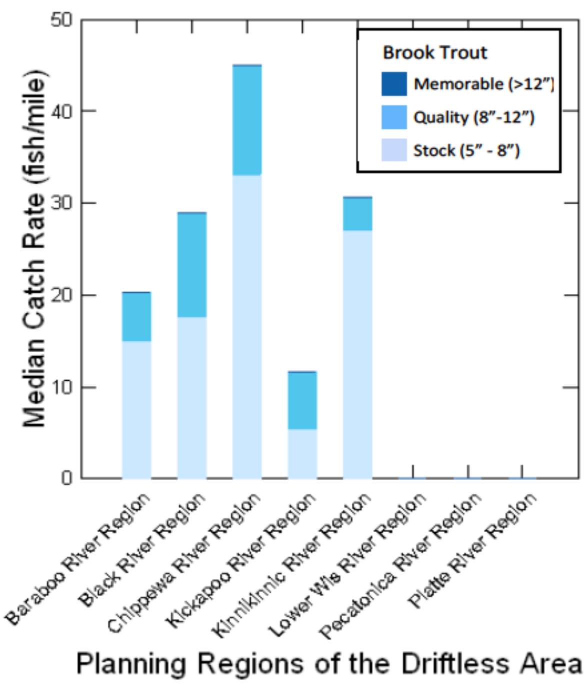
The Fisheries Management Program uses electrofishing catch per unit of effort (CPE) as an index of adult trout abundance in Wisconsin streams.[14] For the assessment of sport fishery performance for this RPA, stream and river survey data in the Driftless Area from 2001 through 2012 (except for the Mississippi River) were extracted from the **Fisheries Management Database (FMDB)**. Data on the number of trout and smallmouth bass caught per mile of stream were exported, without constraint by season or survey status.

Trout fisheries performance CPE estimates were based on 5,296 electrofishing surveys conducted on 1,494 different classified trout stream reaches. Likewise, smallmouth bass CPE estimates were based on 1,440 electrofishing surveys conducted on 318 different smallmouth bass-managed stream reaches. It was assumed that field staff always recorded any trout or smallmouth bass captured in electrofishing surveys in classified trout streams or smallmouth bass managed waters, respectively. Therefore, for all electrofishing surveys, a catch of zero was assumed when trout or smallmouth bass were not recorded in the database. When multiple survey events occurred at the same station location, a mean catch per mile was calculated for that station. When multiple stations occurred within a particular stream reach, a mean catch rate for the stream reach was calculated. This resulted in an estimate for each species/size-group per stream reach (catchment). Catch rates were tabulated by the following size-groups shown in Table 2.3.

Table 2.3: Size-groups for sport fisheries performance

Size	Brook Trout	Brown Trout	Smallmouth Bass
Stock	5" up to 8"	6" up to 10"	7" up to 14"
Quality	8" up to 12"	10" up to 15"	
Memorable	12" and larger	15" and larger	14" and larger

Figure 2.22: Brook trout abundance in the Driftless Area.

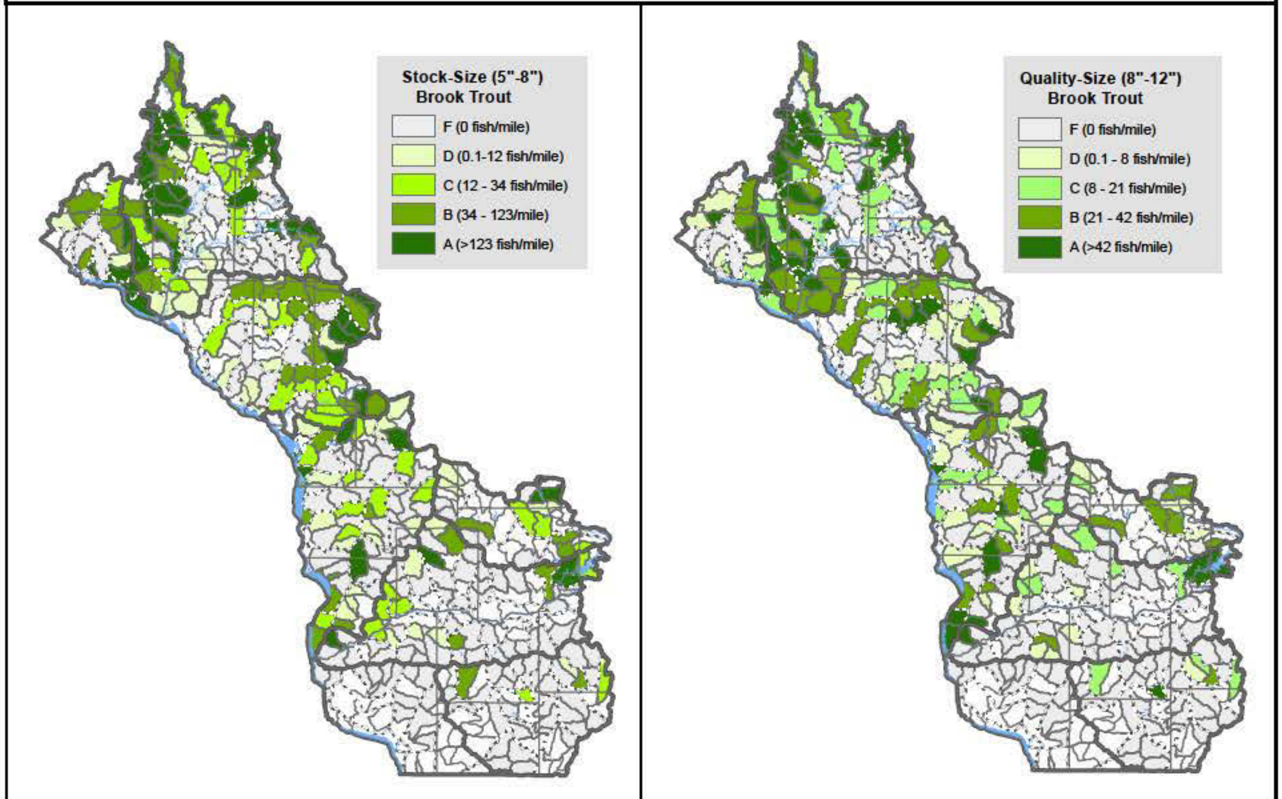


METHODS: Calculating grades for trout and bass abundance.

Fisheries electrofishing catch rate values were summarized at three hierarchical spatial scales: 1) sub-watershed (HUC-12), 2) the watershed (HUC-10), and 3) the planning region. At the sub-watershed and watershed spatial scale, all abundance estimates were classified to establish report card grades based on the following methods. For the sub-watershed (HUC-12), median catch rates were estimated using mean catch rates from all progeny stream reaches with surveys. At the broader watershed level (HUC-10), a new median catch rate was calculated from all progeny sub-watershed (HUC-12) values. Next, for both sub-watershed and watershed levels, median catch rates equal to zero were assigned an "F". Then, all non-zero values were distributed into their respective quartiles and grades of D (0-25th % quartile), C (26-50th % quartile), B (51-75th % quartile), or A (75-100th % quartile) were assigned. No grades were assigned at the planning region spatial scale.

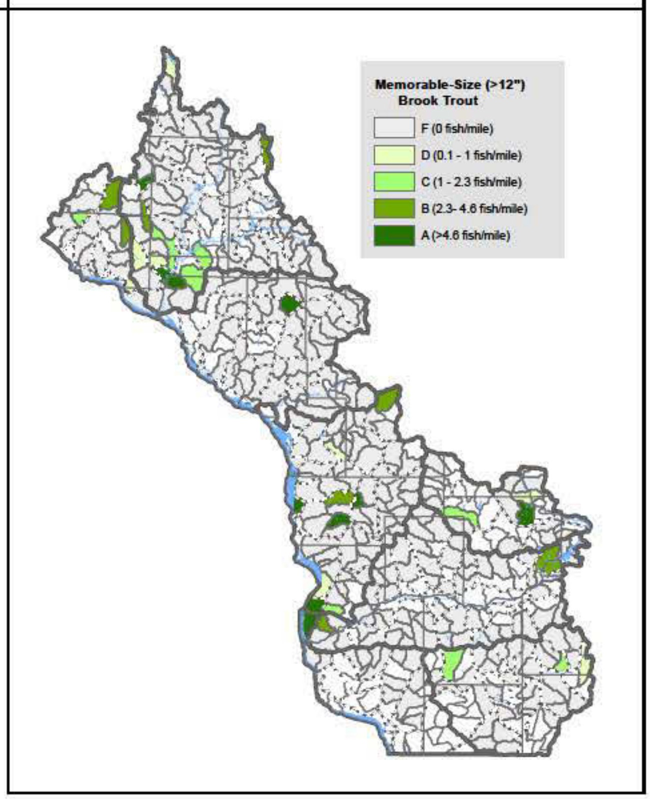
[14] P. Bergman, M. Hansen, and N. Nate. 2011. Relationship between Electrofishing Catch Rate and Adult Trout Abundance in Wisconsin Streams. *North American Journal of Fisheries Management* 31:952–961, 2011.

Figure 2.23: Brook trout abundance in sub-watersheds of the Driftless Area, by size class.



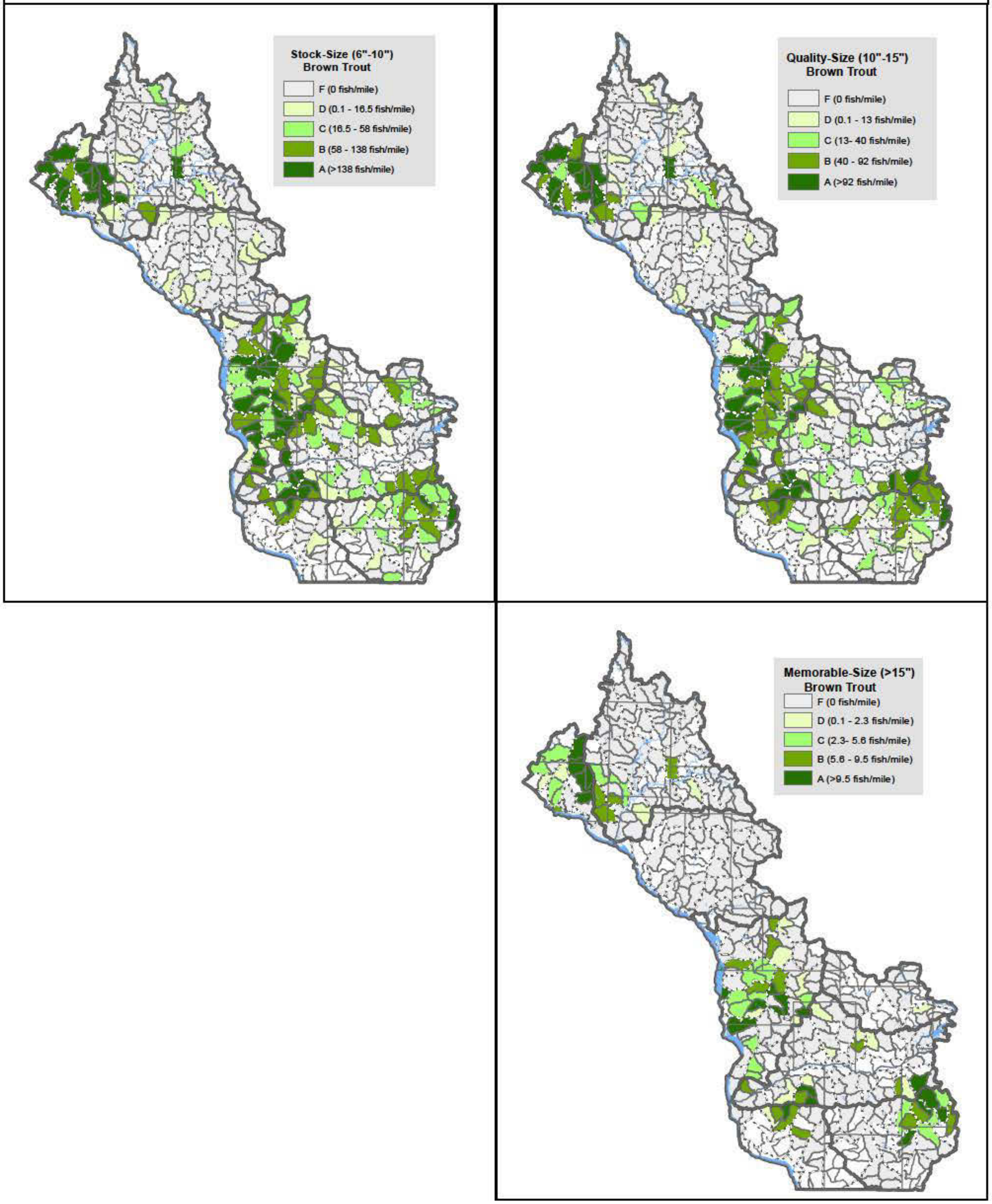
TROUT

As can be seen in Figures 2.22 and 2.23, brook trout are not uniformly distributed throughout the Driftless Area[15]. Some waters support impressively large fish, while others are dominated by very large numbers of smaller, younger fish. The better sub-watersheds for brook trout harbor median catch rates of stock-size (5-8") brook trout at more than 34 fish/mile, quality-size (8-12") at more than 21 fish/mile, and the rarer memorable-size (>12") at 2.3 fish/mile. The Lower Wisconsin, Pecatonica, and Platte River regions have very few streams where brook trout are present, and as a result have a "0" median catch rate at the planning region spatial scale. Similarly, although many streams harbor memorable-sized brook trout, the three regions' median catch rate is "0" because none had a majority of watersheds with that sized fish. Figure 2.23 maps the median number of brook trout in each sub-watershed where survey data have been collected. In addition to a range in the abundance of brook trout, there is also a range of sizes.



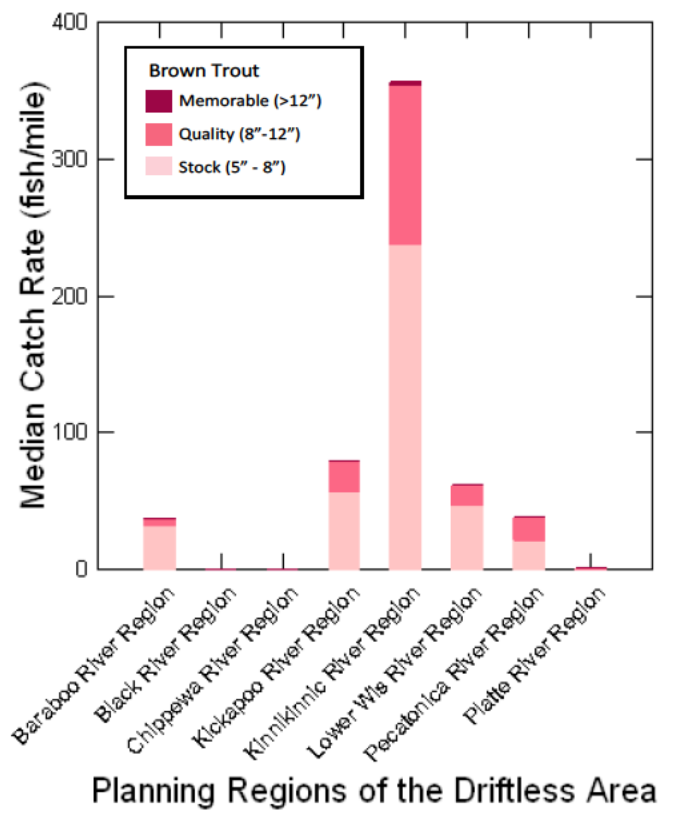
[15] Note: *Although using the median to summarize multiple data into a single number can result in "0" values when some of component numbers are positive, it provides a less distorted overall outcome than using* ***mean*** *catch rates (which yields even more skewed survey results due to very large catch rates in just short stretches of stream).*

Figure 2.24: Brown trout abundance in watersheds of the Driftless Area, by size class.



Brown Trout occur in significantly greater numbers than brook trout through much of the Driftless Area, but particularly in the Kinnickinnic River Region where they occur in staggeringly high densities due to the fact almost all of the sub-watersheds have high brown trout densities (Figure 2.24 and 2.25).

Figure 2.25: Brown trout abundance in the Driftless Area.



The sub-watershed map of median catch rates for stock-size (6-10") brown trout (Figure 2.24) mirrors the brown trout habitat potential map previously shown (Figure 2.17). Although brown trout are quite ubiquitous, the Driftless Area has two strongholds. First, the Kickapoo River region, Lower Wisconsin River region, the northerly half of the Pecatonica River region, and the north fringe of the Platte River region represent the heart of brown trout country. Second, the westerly fringe of the Chippewa River Region and the entire Kinnickinnic River region harbor a large, core population. The Black River Region and most of the Chippewa River Region harbor few brown trout.

The abundance of the different size-classes of brook and brown trout can also be influenced by other management actions such as **stocking** and **fishing regulations**. It is also affected by **competition between the two species**. These issues are discussed on the following pages.

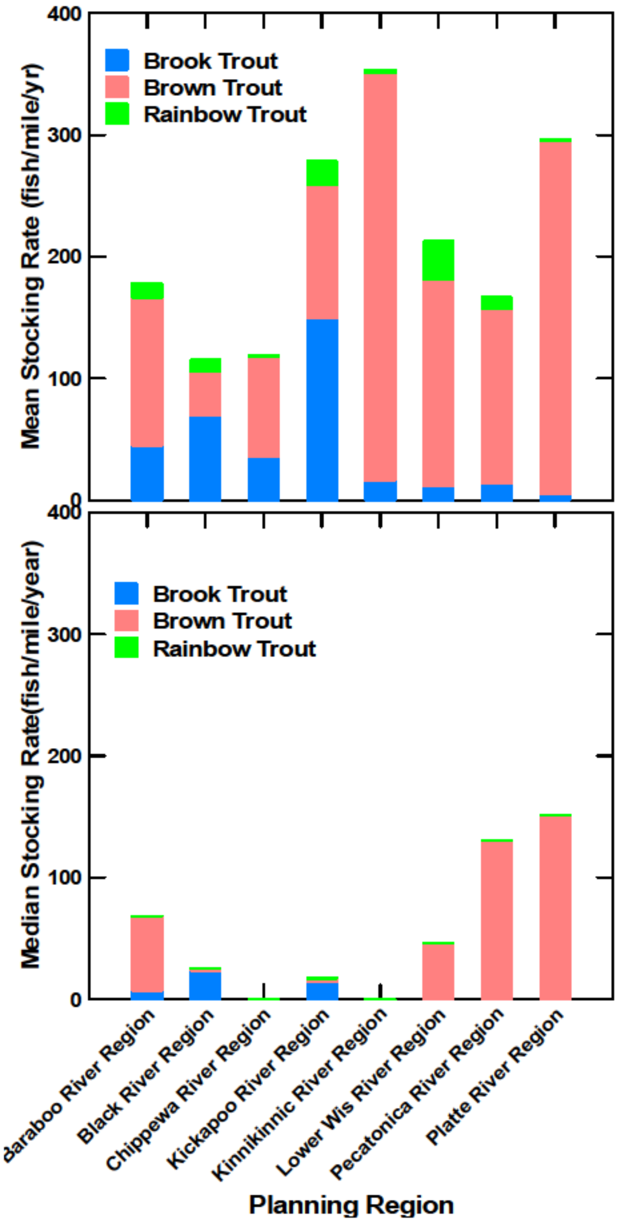
i) Trout Stocking

The Department uses stocking as a tool to help meet its management goals for the inland trout fishery program. That program seeks to protect, restore, and enhance habitat and water quality as well as emphasize wild, naturally-reproducing trout populations. Stocking serves a number of purposes, such as providing immediate fisheries, improving existing fisheries, and restoring fisheries in waters with improved habitat. The program has a long history and is well supported by the angling public. Waters stocked, species stocked, and numbers stocked are based on stocking guidelines in the Fish Management Handbook, results of surveys, results of historical stocking practices, and public input. In the Driftless Area, brook trout, brown trout, and rainbow trout have been stocked.

Stockings in the southern planning regions (Lower Wisconsin River, Pecatonica River, and Platte River) and the Kinnickinnic River Region are predominately brown trout (Figure 2.26 and 2.27). The differences observed between the upper and lower panels in Figure 2.26 are the result of different ways of identifying a set of data's "central tendency" (that is, mean as opposed to median). Estimates using means can be heavily influenced by a few sub-watersheds with high stocking rates, while the lower estimates of medians (lower panel) reflects a large number of sub-watersheds that do not receive any stocking. This is especially seen in the Chippewa and Kinnickinnic River Regions. Planning Regions with the largest discrepancies between median and mean estimates can be interpreted as stocking in fewer sub-watersheds, but where stocked they are stocked at much higher rates.

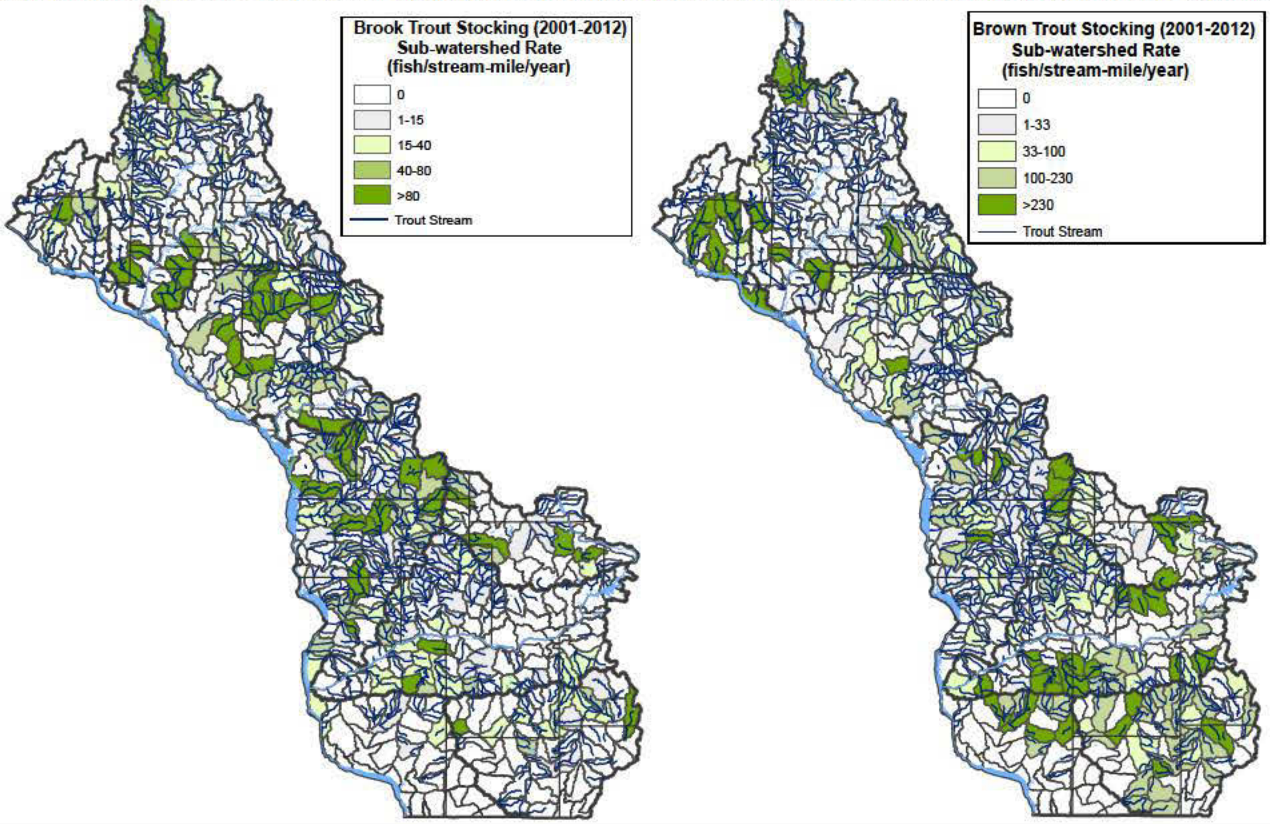
Stocking of brook trout occurs predominately in the Baraboo, Black, Chippewa, and Kickapoo River regions (Figure 2.26 and Figure 2.27).

Figure 2.26: Mean and Median Stocking Rates of Brook, Brown, and Rainbow Trout by Planning Region, 2001-2012.*



*Stocking totals for each species were summed at the sub-watershed and divided by miles trout stream and number of stocking years. Medians and mean stocking rates were then calculated by Planning Region.

Figure 2.27: Mean Stocking Rates of Brook Trout and Brown Trout stockings from 2001-2012. Stocking numbers were totaled for each sub-watershed expressed as a rate by dividing by the total trout stream miles in the sub-watershed and the number of years.



ii) Trout Regulations

Trout stream regulation categories based on a stream classification system have been used in Wisconsin since 1990. The stream classification system is intended to increase diversity of fishing opportunities in Wisconsin trout streams by matching regulations to stream potential based on stream characteristics. The classification assumes that trout growth, reproductive success, and natural and fishing mortality vary along a gradient of stream size and as such, regulations are tailored accordingly.

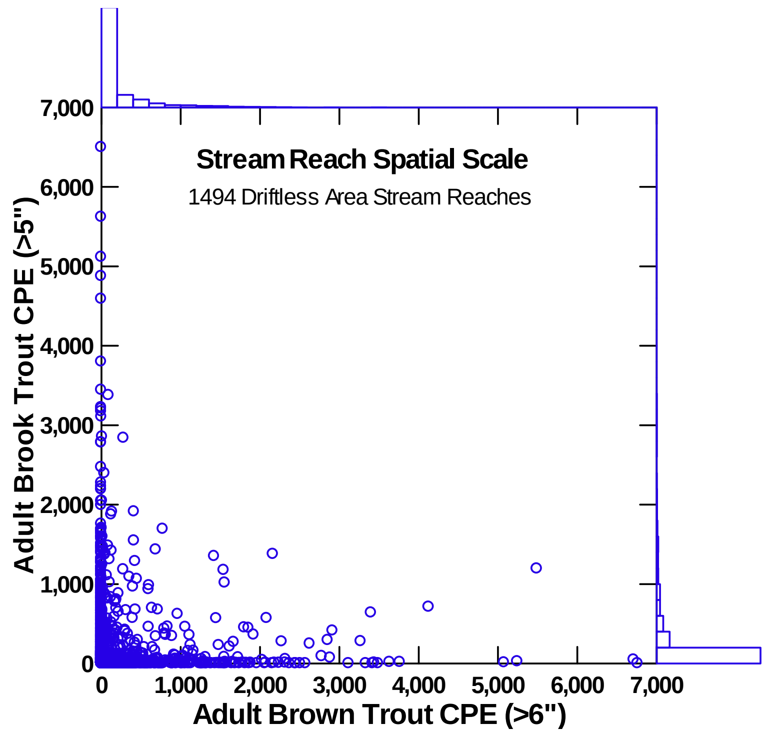
For example, small streams in headwaters typically have limited habitat for large fish, slow growth, poor size structure, high reproduction, low fishing pressure, and show little effect of fishing pressure. As a result, length limits typically are the least restrictive (i.e., smallest minimum length limit). In contrast, large streams located downstream typically have abundant habitat for large fish, fast growth, considerable potential for producing large fish (both stocked and self-sustaining populations), and high fishing pressure with increased potential for overharvest of larger fish. Length limits in these waters are often more restrictive.

Assignment of streams and stream segments to trout regulation classes is done by individual fishery managers based on their expertise and knowledge of specific streams. The effects of the trout regulations classification is most likely to be observed among the abundances of quality and memorable-sized classes and not as much among the abundances of stock-size trout.

iii) Competition between Brook Trout and Brown Trout

The only native salmonid to historically populate Driftless Area streams was the brook trout. Following the 19th century introduction of non-native brown trout to Wisconsin streams, the distribution of brown trout has increased and the distribution of brook trout has decreased. The native ranges of brook trout and brown trout do not overlap and these species do not naturally occur in sympatry. Plots of brown trout Catch per Unit Effort (CPE) versus brook trout CPE for adult trout surveyed in Wisconsin streams show that while sympatric populations of brook trout and brown trout now exist, rarely do these species occur at or near equal abundances in sympatry (Figure 2.28). Rather, streams tend to be dominated by one species or the other.

Figure 2.28: Degree of Allopatry between Brook and Brown Trout in Driftless Area Streams.



The mechanisms for this change in the abundance of these two trout are varied and, following the stocking of brown trout, may have included biotic interactions that favored the reproductive success or stage-specific survival of one trout species over another and net immigration or emigration.[16] Such interactions between individuals of the same or different species in which one or more individuals experience a net loss and none experience a net gain is termed competition. For salmonid species that are not naturally sympatric, there is a greater likelihood that interspecific competition will affect one of the species.[17] Stream habitat and environmental conditions also may affect the outcome of biotic interactions of brook and brown trout such that different trout species succeed in some streams and not in others.

The evidence for interspecific competition between brook and brown trout is varied. The segregation of brook and brown trout observed in streams may be selective or interactive, with interactive segregation a result of interference competition. Interference competition may be observed when sympatric species differ in resource use, in contrast to similar resource use when they are allopatric. Interference competition may occur when the behavior of one individual interferes with the ability of another to acquire a resource. Territorial behavior by trout in streams may result in interference competition in which the superior competitor occupies the most profitable stream habitat measured in terms of net energy gain (e.g., growth).

Observations of changes in the abundance of one species following the introduction of another also serve as evidence of interspecific competition. A limitation of such observations, however, is the potential confounding of other factors such as predation of one species on another. Controlled experiments have been used to separate such factors and have provided evidence to show that brown trout can be competitively superior to brook trout.

[16] Peterson, D. P., and K. D. Fausch. 2003. Testing population-level mechanisms of invasion by a mobile vertebrate: a simple conceptual framework for salmonids in streams. Biological Invasions 5:239-259.

[17] Hearn, W. E. 1987. Interspecific competition and habitat segregation among stream-dwelling trout and salmon: a review. *Fisheries* 12(5):24-31.

For example, Fausch and White (1981) conducted field experiments in a Michigan stream to show that introduced brown trout can aggressively exclude brook trout from preferred resting places. Following the release of competition from brown trout, brook trout shifted resting positions. Fausch and White (1981) also noted that declines in brook trout populations while brown trout populations expanded may have been attributable to the combined effects of interspecific competition, predation on juvenile brook trout by brown trout, and a differential response to environmental factors.[18] In laboratory studies of native brook trout and hatchery brown trout, DeWald and Wilzbach (1992) found that the presence of brown trout resulted in changes in brook trout behavior. Brook trout shifted location, initiated fewer aggressive interactions, lost weight, and were more susceptible to disease in the presence of brown trout. The authors suggested that if these changes in behavior and growth rates extended to sympatric populations in streams, they may help explain observed declines in native brook trout populations.[19]

Competition for spawning habitat in streams may also be an important factor in the displacement of brook trout by brown trout. Brook trout and brown trout spawning seasons consistently overlapped by 2-4 weeks in a small Minnesota stream during a three-year study in which Sorensen et al. (1995) observed attempts at hybridization and superimposition of spawning redds. About 10% of sexually active females were courted by males of both species. There was strong evidence of redd superimposition, particularly by later spawning and larger brown trout. The authors concluded that reproductive interactions may be partially responsible for the displacement of brook trout by brown trout because brook trout spawn earlier in the season, are smaller in size, and rarely survive long enough to spawn twice.[20] Grant et al. (2002) also showed that reproductive interactions between brook trout and brown trout may play a role in the displacement of native brook trout by introduced brown trout.[21]

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[18] Fausch, K. D., and R. J. White. 1981. Competition between brook trout (Salvelinus fontinalis) and brown trout (Salmo trutta) in a Michigan stream. *Canadian Journal of Fisheries and Aquatic Sciences* 38:1220-1227.

[19] DeWald, L., and M. A. Wilzbach. 1992. Interactions between native brook trout and hatchery brown trout: effects on habitat use, feeding, and growth. *Transactions of the American Fisheries Society* 121: 287-296.

[20] Sorensen, P. W., T. Essington, D. E. Weigel, and J. R. Cardwell. 1995. Reproductive interactions between sympatric brook and brown trout in a small Minnesota stream. *Canadian Journal of Fisheries and Aquatic Sciences* 52:1958-1965.

[21] Grant, G. C., B. Vondracek, and P. W. Sorensen. 2002. Spawning interactions between sympatric brown and brook trout may contribute to species replacement. *Transactions of the American Fisheries Society* 131:569-576.

SMALLMOUTH BASS

As can be seen in Figure 2.29, of note is the abundance of smallmouth bass in the Platte River Region, which is a function of the high quality habitat found in the larger, warmer rivers flowing south off of Military Ridge.[22] Other pockets of healthy populations of smallmouth bass are found in the river systems such as the Baraboo, Black, Chippewa, Hay, La Crosse, Pecatonica, Red Cedar, Sugar, Trempealeau, and the Wisconsin (Figure 2.30 and 2.31).

Note: The Lower Wisconsin River is not represented in this analysis because survey data extracted from the Fisheries Management Database does not include the Lower Wisconsin River.

Figure 2.29: Smallmouth bass abundance in the Driftless Area.

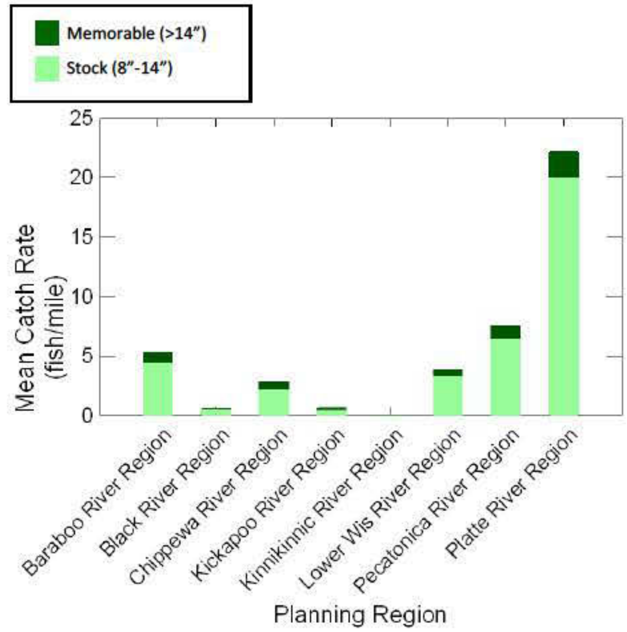


Figure 2.30: Abundance of stock–size smallmouth bass in sub-watersheds of the Driftless Area.

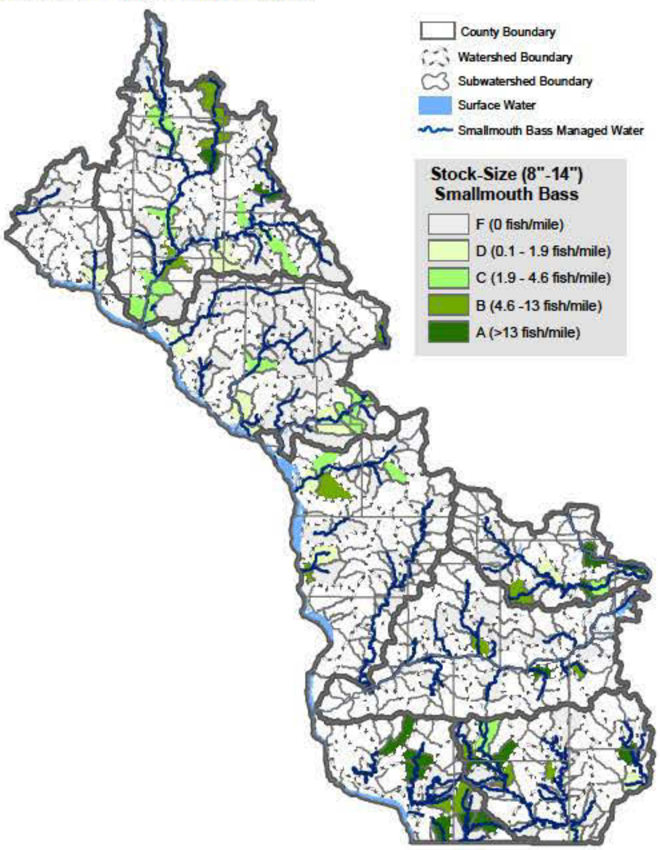
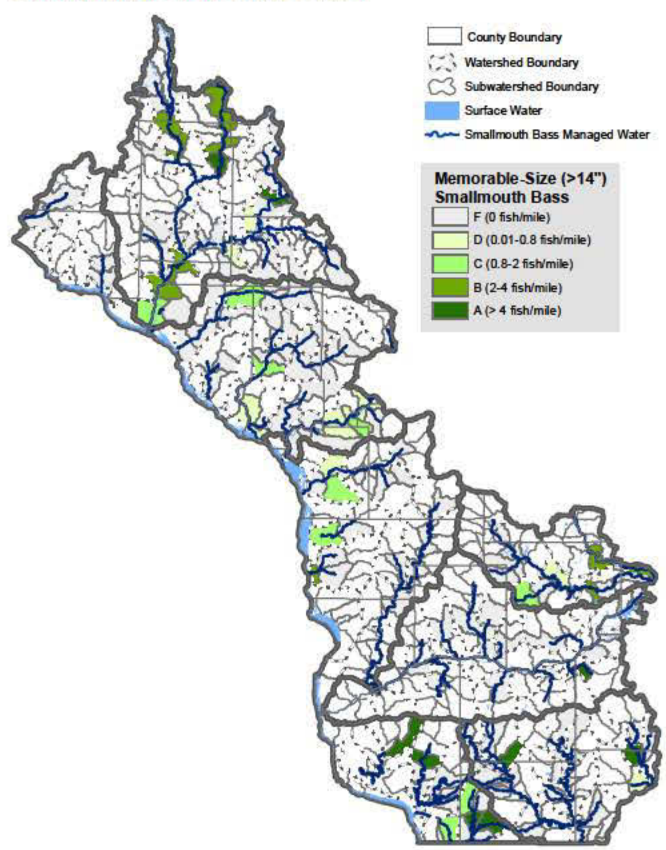


Figure 2.31: Abundance of memorable –size smallmouth bass in sub-watersheds of the Driftless Area.



[22] In Figure 2.29, mean (rather than the median) catch rate was used for smallmouth bass to account for the significantly fewer survey data points available for bass than are available for trout.

f) Resilience of Trout to Climate Change

Wisconsin's native brook trout are an integral part of our natural legacy, our culture, and our identity, particularly in the Driftless Area. Brook trout are also very sensitive to changes in water temperature. Global climate models indicate that climate change will have significant impacts on mid-latitude regions such as the Upper Midwest. Dealing with climate change will require the best available science and meaningful participation of public and private stakeholders.

The Wisconsin Initiative on Climate Change Impacts (WICCI) was created to assess and anticipate climate change impacts on specific Wisconsin natural resources, ecosystems and regions. WICCI also develops and recommends adaptation strategies that can be implemented by resource managers and communities.[23] WICCI represents a partnership between the University of Wisconsin, the Department of Natural Resources, and other state agencies and institutions. Within WCCI, working groups conduct science-based assessments of potential climate change impacts on specific regions, ecosystems, communities and industries in Wisconsin and to make recommendations on adaptation strategies. Scientists, experts and practitioners work together in each group.

The work of one group, the Coldwater Fish and Fisheries working group, is extremely important to this Regional and Property Analysis. The working group developed two adaptation strategies to reduce the impact of climate warming on trout. One is to use a triage approach to identify and allocate management resources to only those coldwater species most likely to succeed. That could include managing for brown rather than brook trout. The second strategy is to develop activities focusing on land, shoreline, water management and in-stream restoration to offset the impacts of rising air and water temperatures and changes in precipitation.

Models assessing the impacts that projected climate changes may have on the future distribution of trout and smallmouth bass have been developed. These models incorporate different types of data and different types of interactions between variables to project the likelihood of different outcomes. The US Geologic Service has been working with scientists in the Midwest to develop a **Regional Decision Support Tool for Identifying Vulnerabilities of Riverine Habitat and Fishes to Climate Change.** This stream model utilizes the methods developed by Lyons,[24] however the stream temperature model components have recently been refined by the work of Stewart.[25]

The Regional and Property Analysis utilizes these newest USGS model outputs to evaluate impacts of global warming on future distributions of brook and brown trout and smallmouth bass. This fish distribution model assembles ten different downscaled climate models to project distribution of a range of fish species (including brook and brown trout and smallmouth bass) in the period from 2046 to 2065. For each trout species, the RPA examines future distributions by classifying each stream reach into three categories: stable, at risk, and lost (Figures 2.27 and 2.29).

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[23] The WCCI report and summary of the working group's findings can be found at the WICCI website (www.wicci.wisc.edu).

[24] Lyons, J., J. Stewart, and M. Mitro. 2010. Predicted effects of climate warming on the distribution of 50 stream fishes in Wisconsin, U.S.A. *Journal of Fish Biology* 77:1867–1898

[25] J. Stewart, S. Westenbroek, and M. Mitro. (USGS Scientific Investigation Report; In Prep). A model for evaluating stream temperature response to climate change in Wisconsin.

All of the model outputs project a decline in brook and brown trout populations (Figures 2.32 and 2.34). Losses of native brook trout distribution by the mid-century are much greater than brown trout. For brook trout, all eight planning regions have over 60% of their current stream miles classified as lost by the mid-century. Brook trout losses will vary in degree and location, with the species persisting more effectively in some watersheds than in others.

By most measures brook trout are projected to be largely extirpated in the Platte and Pecatonica River Regions, and its status is tenuous in the Kinnickinnic River Region. The most resilient brook trout sub-watersheds can be found in: western Chippewa River Region, throughout much of the Black River Region, northeastern portions of the Kickapoo River Region, the Devil's Lake area of the Baraboo River Region and pockets of the Lower Wisconsin

Figure 2.32: Climate effects on brook trout distribution (2046 – 2065).

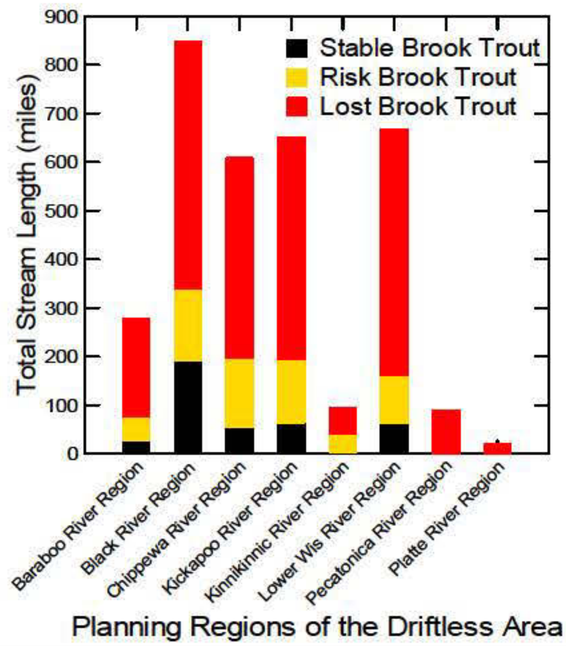
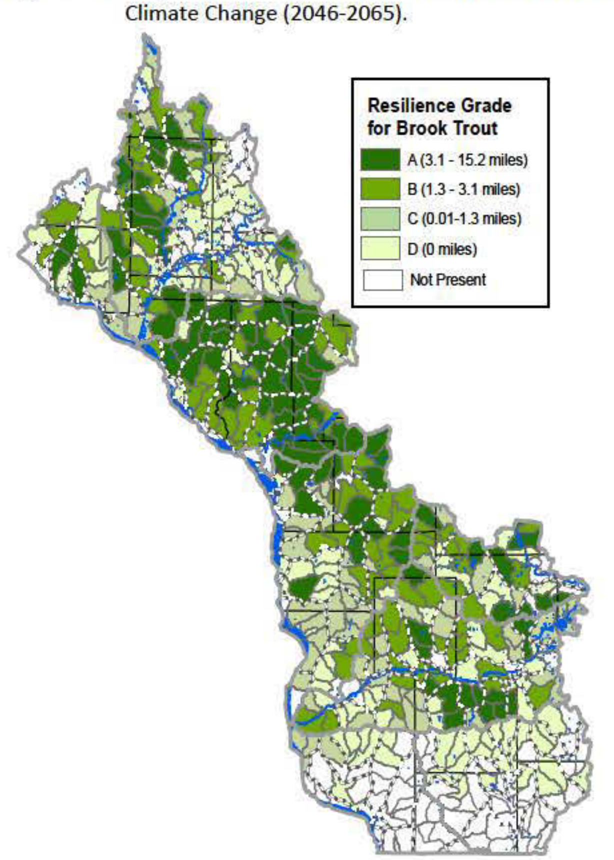


Figure 2.33: Projected Resilience of Brook Trout Distribution to Climate Change (2046-2065).



METHODS: Calculating grades for projected resilience of trout to climate change.

If zero, one or two of the ten climate models driving the stream model project that brook or brown trout will be lost a particular stream reach, then the species' likelihood of future presence was classified as "**stable.**" If three to seven of the ten models project that a particular stream reach will no longer support brook or brown trout, then their likelihood of future presence was classified as "**at risk.**" The "at risk" category represents conditions where the models differ in their projected response. If eight, nine or all ten of the models project that a sub-watershed will no longer support brook or brown trout, then their likelihood of future presence was classified as "**lost.**"

Model outputs were "clipped" to only keep perennial flowing streams in this analysis (artificial ditches and intermittent streams were dropped). At the sub-watershed spatial scale and the watershed spatial scale the distances of individual stream reaches were then summed by each class (stable, at risk, and lost). For each trout species, **resilience** was defined as follows:

> total miles of **stable** stream + ½ the total miles of **at risk** stream

At the sub-watershed and watershed levels resilience values (miles of stream) were then distributed into their respective quartiles and grades of D (0-25th % quartile), C (26-50th % quartile), B (51-75th % quartile), or A (75-100th % quartile) were assigned. There were no F grades for the species resilience metric, and no grades were assigned at the planning region spatial scale. The resilience values mapped in Figures 2.33 and 2.35 represent an estimate of the total amount stream miles in each sub-watershed that the particular species is likely to occupy during the mid-century.

River Region. None of the models projected that there would be a gain in the distribution of brook trout.

In comparison, brown trout distribution is much less affected by climate warming by the mid-century (Figure 2.34). For brown trout, five of the eight planning regions have over 80% of their stream miles classified as stable. Brown trout distribution loss is mostly confined to the Chippewa River, Pecatonica River and Platte River Regions, with sub-watersheds in other regions showing high levels of resilience (Figure 2.35). However, it is noteworthy that numerous sub-watersheds in the northern portion of the Platte River and eastern portion of Pecatonica River hold high resilience values (>12.8 stream miles/sub-watershed) for brown trout. Some models project a minimal increase in the distribution of brown trout, but relative to brown trout's existing distribution, the increase is insignificant. In this situation, only 40 reaches were classified as **gain** reaches among the 3,102 reaches possible (gain is defined where eight or more of the models agree brown trout will expand into a reach where it is currently not present).

Figure 2.34: Climate effects on brown trout distribution (2046 – 2065).

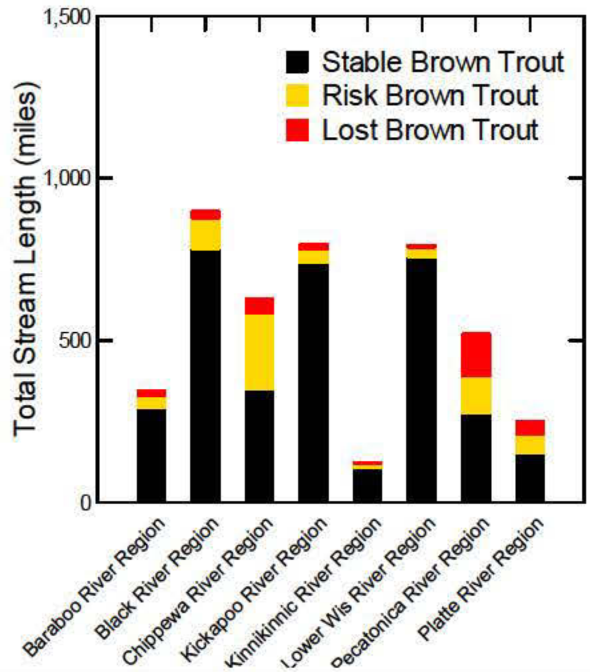
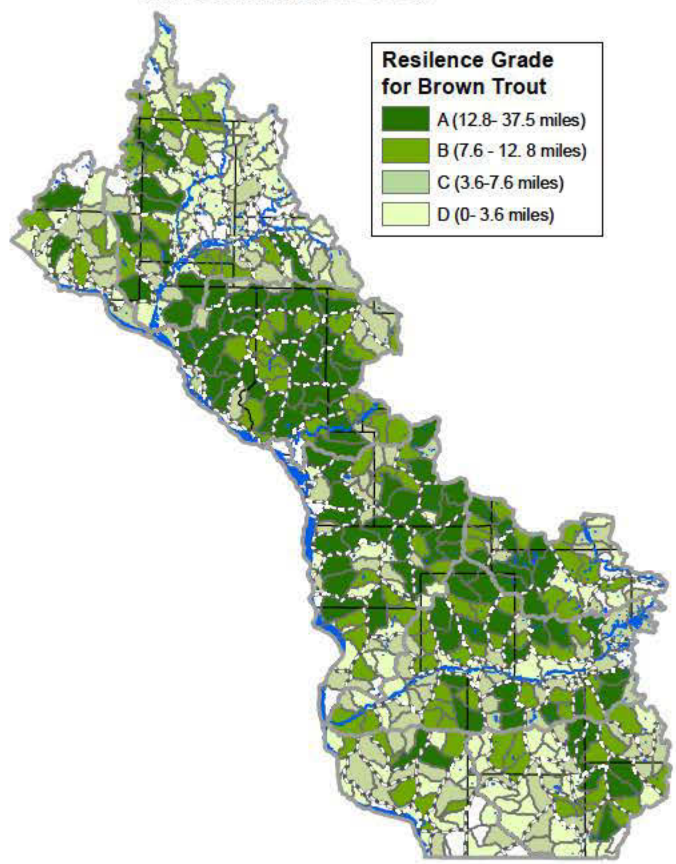


Figure 2.35: Projected Resilience of Brown Trout Distribution to Climate Warming (2046-2065)

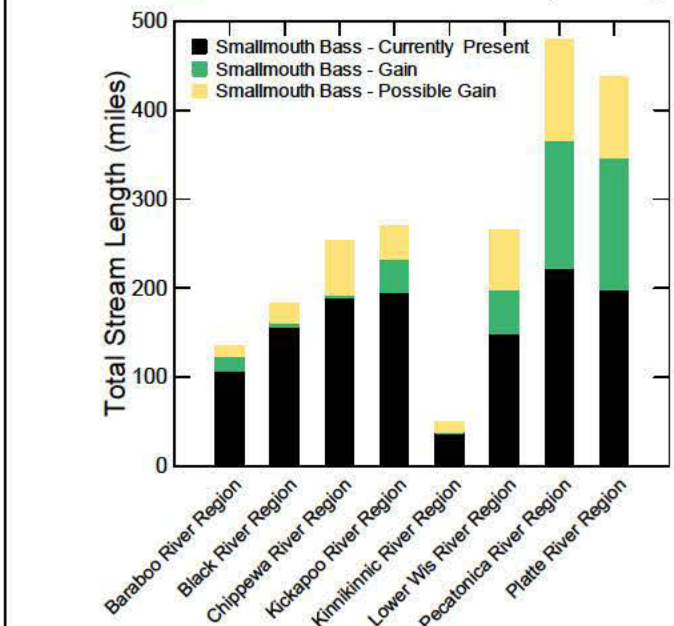


g) Expansion of Smallmouth Bass as a result of Climate Change

Unlike the projected declines in trout, the effects of climate change will expand the future distribution of smallmouth bass by the mid-century. The smallmouth bass analysis was designed to be similar to resilience analysis for trout, but in the opposite direction.

Several of the larger waters where brown trout currently occur will likely become smallmouth bass streams (Figure 2.37) in the future. None of the models project that smallmouth bass will be lost from waters where they currently exist. Because bass require larger water, they are projected to expand into only a subset of the waters where trout will be lost. Moreover, the waters they expand into are likely to be nursery-habitat streams, too small to support significant adult fishable populations. In addition, since they occupy a higher trophic level, the number of smallmouth bass in these streams and rivers will be considerably fewer than the number of trout that had existed.

Figure 2.36: Climate effects on smallmouth bass distribution (2046 – 2065).



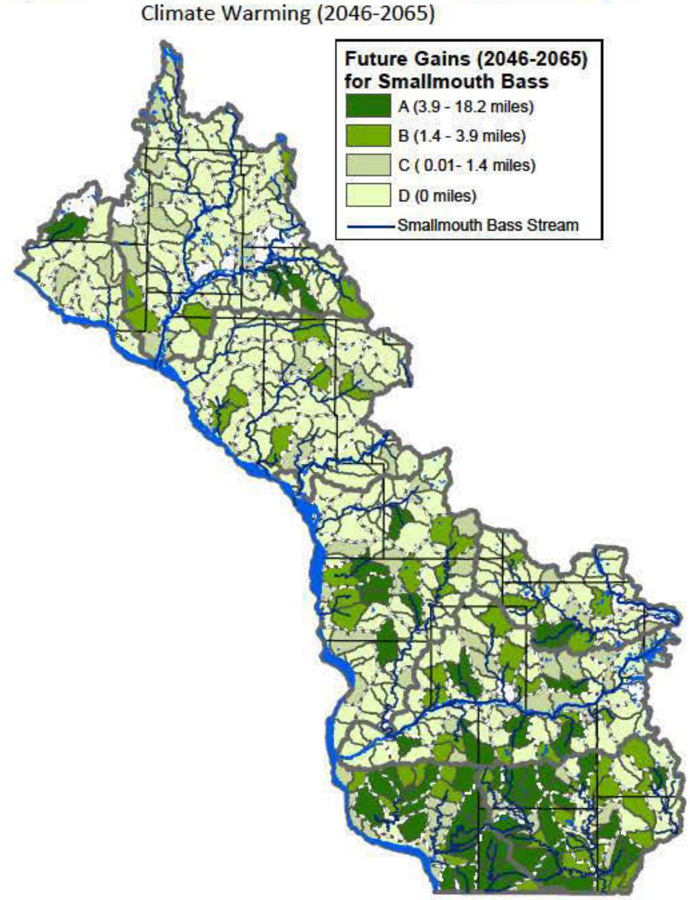
METHODS: Calculating grades for projected expansion of smallmouth bass as a result of climate change.

In this analysis, if only zero, one or two of the climate models driving the stream model projected that a stream reach (where bass do not currently occur) would have smallmouth bass, then their likelihood of future presence was classified as "**no gain**". If three to seven of the ten models projected that a stream reach would support smallmouth bass, then their likelihood of future presence was classified as "**possible gain**." If eight or more *the* models projected that a stream reach would support smallmouth bass, then their likelihood of future presence was classified as **"gain."** At the sub-watershed spatial scale and the watershed spatial scale the distances of individual stream reaches were then summed by each class (**gain** and **possible gain**). For smallmouth bass, **future gain** was defined as follows:

total miles of **gain** + ½ the total miles **possible gain**

At the sub-watershed and watershed levels **future gain** values (miles of stream) were then distributed into their respective quartiles and grades of D (0-25th % quartile), C (26-50th % quartile), B (51-75th % quartile), or A (75-100th % quartile) were assigned. There were no F grades for the smallmouth bass future gains metric, and no grades were assigned at the planning region spatial scale. The future gains values mapped in Figure 2.37, which represents an estimate of the total amount of stream miles in each sub-watershed in which smallmouth bass are projected to expand by the mid-century.

Figure 2.37: Projected Gains for Smallmouth Bass Distribution to Climate Warming (2046-2065)



h) Angling access

TROUT

There are more than 4,445 miles of classified trout streams that are spread through the Driftless Area; indeed the vast majority of watersheds have at least some trout waters. Although the public has access to all of these streams if they enter at road crossings or other public access sites and "keep one foot wet," many anglers prefer fishing along streams where they have access to the adjacent shoreline. Over the years the Department and partner groups have worked to acquire public access (in both fee and easement) along over 694 miles of trout streams in the Driftless Area. The distribution of these access opportunities is influenced by many factors including the quality of the fishery, available funding, recreation demand, and landowners' willingness to sell land or easements.

From the perspective of the entire Driftless Area, of the **325 sub-watersheds that have trout streams, 67% have some public access**. As shown in Figure 2.38, the distribution of public access varies from a high of 22% in the Kickapoo River Region to lowest of 11% in the Chippewa River Region. As seen in Figure 2.39, the distribution of public access for trout angling is patchily distributed. There are 19 sub-watersheds that have over 50% of their trout streams in public access, while there are **108 sub-watersheds without any public access along trout streams.**

Figure 2.38: Trout Stream miles adjacent to public land and private land, by planning region.

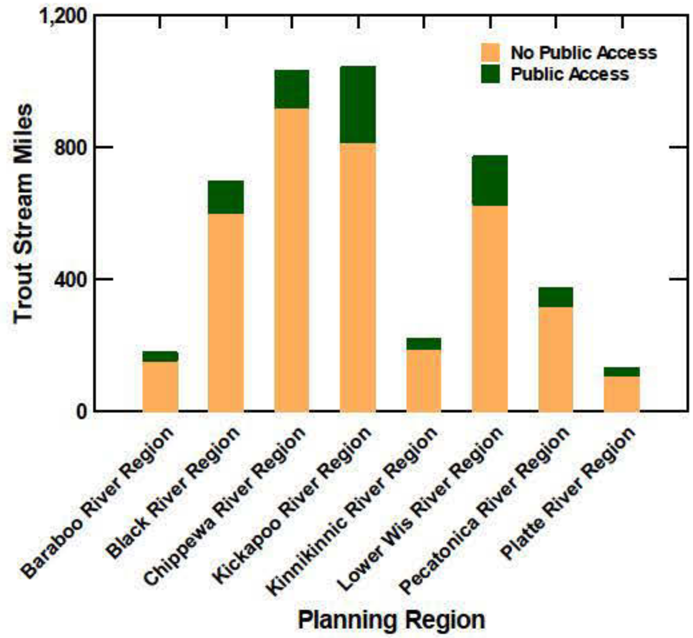
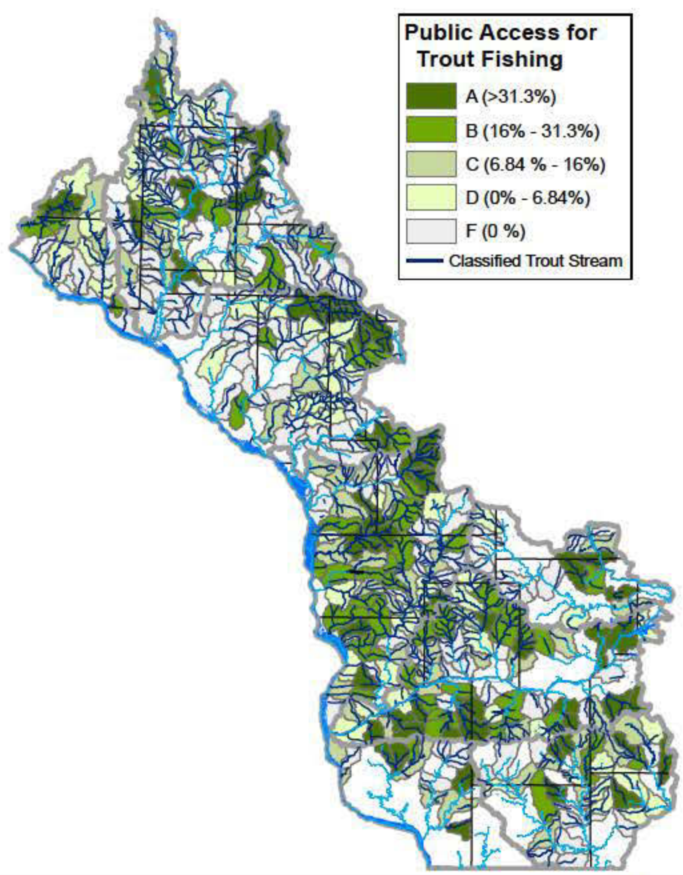


Figure 2.39: Percent of classified trout stream miles that are adjacent to public land (publicly-accessible)



SMALLMOUTH BASS

Across the Driftless Area, smallmouth bass are a "big water" fish and can be found in larger warmwater rivers like the Baraboo, Wisconsin, Pine, Black, Chippewa, Red Cedar, La Crosse, Pecatonica, and Platte. Other than the fore-mentioned big rivers, the Platte River Region is smallmouth bass country. The Kinnickinnic River region is the only planning region without any significant smallmouth bass managed streams (Figure 2.40). Because of extensive land acquisition, the Lower Wisconsin River and Lower Chippewa have ample public access opportunities; whereas, the Red Cedar, Hay and Pecatonica Rivers are lacking for public access.

Some sub-watersheds show excellent public access for smallmouth bass angling where adult-fishable populations are minimal to non-existent (Figure 2.41). Typically, these are classified as both trout and bass waters with their bass habitat being limited to nursery habitat and as such they may not harbor fishable adult populations (e.g., Coon Creek, Vernon County).

Figure 2.40: Smallmouth Bass Stream miles adjacent to public land and private land, by planning region.

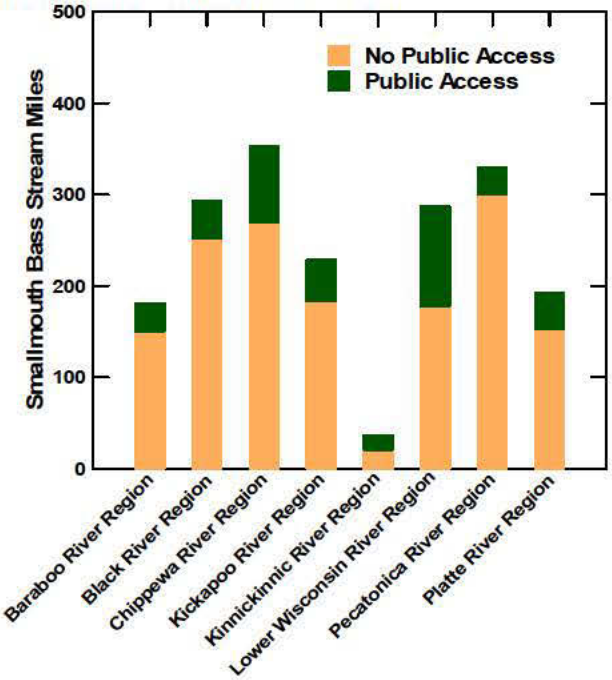
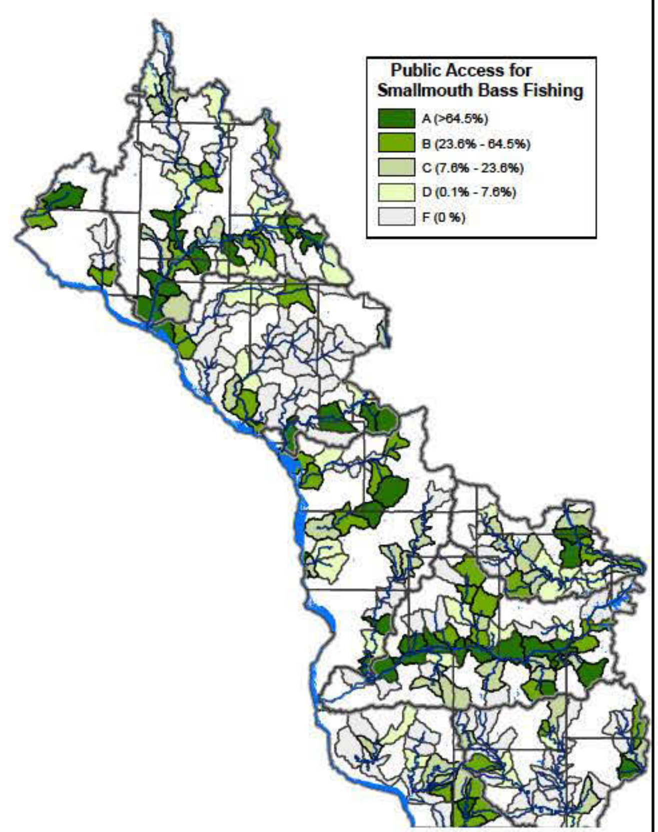


Figure 2.41: Percent of smallmouth bass stream miles that are adjacent to public land (publicly-accessible.

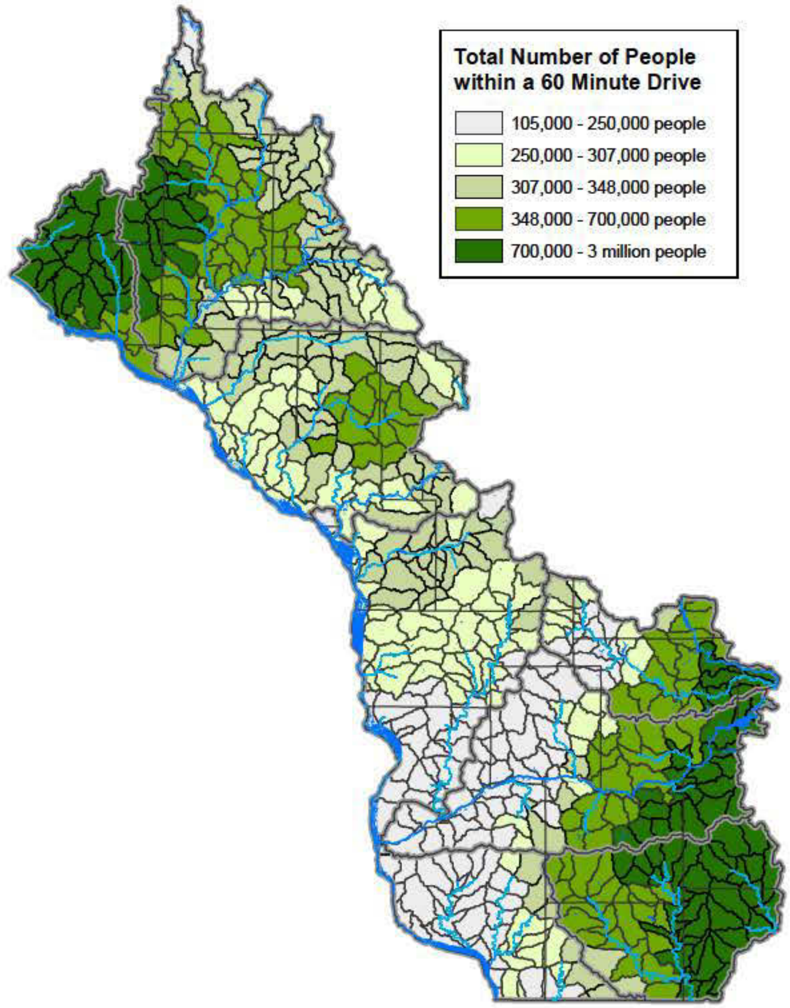


i) Angling Demand and Supply

Although high quality streams with lots of big fish will always draw anglers from afar, many anglers looking for easily accessible fishing opportunities to visit after work or on a weekend morning are limited to streams near where they live. Providing angling opportunities in close proximity to population centers is a priority for the Department[26] and several partner groups. Figure 2.42 shows the portions of the Driftless Area that are in closest proximity to the largest number of people.

A 60 minute drive time was selected because it is believed to capture most anglers' preference when seeking opportunities when their time is limited. The influence of the Twin Cities and Madison is clearly seen in Figure 2.42, as is the presence of the higher speed roads (e.g., I-94 and USH 151).

Figure 2.42: Population within a 60 minute drive.



METHODS: Calculating the population within a 60-minute drive time.

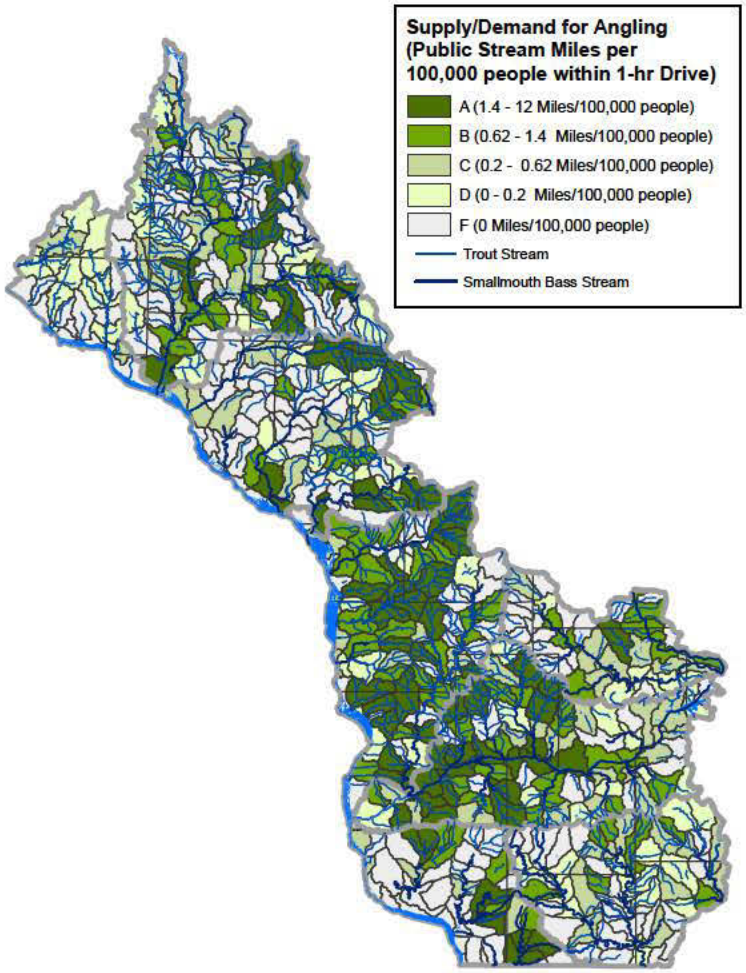
The data used in this analysis contains custom summarized 2010 population census information. To start, the number of people (residents of Wisconsin and surrounding states) that could reach the center of each township within a 60 minute drive was calculated. This analysis was completed using custom python scripts that used ESRI Network Analyst to create polygons for 60 minutes (cost) drive time outward from township polygon centroids. These cost polygons were intersected with 2010 census blocks. The census blocks were attributed with cost polygon information and summarized for total population within each cost polygon. Finally, township polygons were attributed with cost polygon summarized populations for use in mapping and population use analysis. The cost polygons that were created used a road network that crossed state lines and the census information included surrounding states. The results are therefore inclusive of the entire population within a 60 minute drive time and not exclusive to Wisconsin residents.

Population drive time data were then transferred from townships to sub-watersheds by a centroid-intersect procedure. Sub-watershed estimates for population size with a one hour drive time were distributed and quintiles mapped in Figure 2.42.

[26] Administrative Code NR 1.40 addresses the DNR's acquisition of recreational land. In the establishment of new acquisition projects, one of the priority criteria listed is land within 40 miles of the 12 largest cities in Wisconsin.

Not surprisingly, trout streams with high densities, lots of public access and in close proximity to large numbers of people receive exceptionally high fishing pressure. The Kinnickinnic River, Black Earth Creek, and Mt. Vernon Creek have these qualities and all receive heavy use throughout the trout season. To many anglers, these waters are over-crowded on weekends. Providing additional angling opportunities on other nearby trout waters would help to alleviate crowding issues.

Figure 2.43: Sub-watershed map of angling opportunity/angling demand



The distribution of the demand for angling, as roughly represented in Figure 2.42, can be combined with the distribution of existing public angling opportunities to identify where fishing pressure is well served and where crowding issues are likely most severe. To be sure, some of the state's "blue ribbon waters" – great quality water, lots of big fish, lots of public access, all set within scenic valleys – will always attract numerous anglers willing to travel for hours to have a special day on the water. Figure 2.43 depicts the number of publicly-accessible stream miles for each 100,000 people that can drive to each sub-watershed within 60 minutes. It is a representation of the interaction between angling supply and demand and shows that, despite the large public ownerships near the Twin Cities and Madison, these areas are relatively underserved to meet the needs of anglers looking for opportunities in close proximity to where they live.

METHODS: Calculating the interface between angling supply and demand.

Spatial data layers for public access for smallmouth bass angling and public access for trout were combined to represent general angling opportunities. At the sub-watershed spatial scale a ratio estimator was developed to incorporate both angling opportunity and demand into one metric. This **supply/demand** metric was created by dividing the total public stream miles by the number of people within a one hour drive. The number of people was divided by 100,000 to bring the values into a range of 0 to 12.

Grades for the 441 sub-watersheds were assigned as follows. First, where supply/demand metric = 0 (i.e., no public access exists) a grade of "F" was aassigned. Next, all non-zero values were distributed into their respective quartiles and grades of D (0-25th % quartile), C (26-50th % quartile), B (51-75th % quartile), or A (75-100th % quartile) were assigned and mapped (Figure 2.43). No grades were assigned at the planning region spatial scale.

The Kickapoo and Lower Wisconsin River Regions hold the bulk of the sub-watersheds with high access relative to the number of people within a one hour drive time (Figure 2.43). Due to the high population associated with Dane County and the St. Paul Metro area, the Pecatonica and Kinnickinnic River regions have lower relative availability of public access per person.

3. RARE SPECIES AND HIGH QUALITY NATURAL COMMUNITIES IN THE DRIFTLESS AREA

In 2011 the Bureau of Endangered Resources conducted an ecological assessment of 94 of the Bureau of Fisheries Management's properties in the Driftless Area. Their report, *Rapid Ecological Assessment for Driftless Area Streams* (REA), (Appendix 2), summarizes the rare species and natural communities known to occur in the Driftless Area as well information on many of the DNR-owned properties included in this master plan. The report also highlights several opportunities for protecting critical sites. The following information supplements the REA.

a) Species of Greatest Conservation Need

As part of a nationwide effort coordinated by the US Fish & Wildlife Service, the Department recently completed an assessment of animal species in the greatest need of conservation and protection in the state. These species (known as Species of Greatest Conservation Need, or SCGN) and their associated conservation strategies are described in the Wisconsin Wildlife Action Plan (at http://dnr.wi.gov/org and search for "Wildlife Action Plan"). Species of Greatest Conservation Need include both species already listed by either the federal or state government as endangered or threatened, as well as species that are at significant risk but not yet on the state or federal endangered or threatened species lists.

The vertebrate SGCN that occur in the Driftless Area and are associated with stream and riverine habitats include:

- Louisiana waterthrush
- Redside dace
- Blanding's turtle
- Four-toed salamander
- Northern Cricket Frog
- Pickerel frog
- Wood turtle
- Northern long-eared bat

Information about the life history needs of these species, as well as a list of terrestrial SGCN associated with one or more of the three ecological landscapes comprising the Driftless Area, can be found at the DNR's website.

In addition to these vertebrate species, many invertebrates (e.g., mussels, insects, arthropods, and crustaceans) in the Driftless Region are also of conservation concern. Unfortunately, many aspects of their basic biology remain poorly understood and limited information on their distribution and population exists. As a result it is difficult to develop meaningful habitat management recommendations for the rare aquatic invertebrates known to occur in the Driftless Region.

b) Natural Community Management Opportunities in the Driftless Region

An in-depth discussion of the most pressing management opportunities for high-quality natural communities in the Driftless Region can be found in the *Wildlife Action Plan* on the DNR's website. A short summary of some of the water and wetland-based priority opportunities related to this planning process is provided here:

- Protection of the Kinnickinnic River watershed and corridor, which contains many rare plants and significant geological features.
- Protection and maintenance of relict hemlock stands.
- Management of floodplain forests and large southern upland forest tracts.
- Restoration and protection of spring-fed cold water streams.
- Restoration and maintenance of red and white oak as a cover type.
- Preservation of cliff communities, along with cave and bat hibernacula.

4. AREAS OF PARTICULAR CONSERVATION INTEREST OR CONCERN IN THE DRIFTLESS AREA

a) State Natural Areas

State Natural Areas (SNAs) protect outstanding examples of Wisconsin's native landscape of natural communities, significant geological formations and archeological sites. Wisconsin's 653 State Natural Areas, encompassing over 358,000 acres, are valuable for research and educational use, the preservation of genetic and biological diversity, and for providing benchmarks for determining the impact of use on managed lands. They also provide some of the last refuges for rare plants and animals. In fact, more than 90% of the plants and 75% of the animals on Wisconsin's list of endangered and threatened species are protected on SNAs.

There are just over 100 SNAs in the Driftless Area, most of which are not associated with trout and smallmouth bass waters. Sixteen SNAs are included in this master plan.

b) Primary Sites identified in the Rapid Ecological Assessment (REA)

Among other purposes, the DNR completes Rapid Ecological Assessments to identify the most important opportunities for native community management, special conservation areas, or rare species habitat within a planning area. Given the quality and sensitivity of these lands, they warrant special consideration as plans for future management are drafted. Indeed, many of these sites, referred to as Primary Sites, typically are considered for designation as State Natural Areas in the development of a master plan. As such, during the development of the master plan, actions which would limit future management options at these sites are deferred until the document is completed and approved.

The *Rapid Ecological Assessment for Driftless Area Streams* (Appendix 2[27]) identified 17 Primary Sites (Appendix G of the REA), six of which are currently designated as State Natural Areas.

c) Conservation Opportunity Areas

As part of the Wildlife Action Plan,[28] the Department considered the issues and threats facing each of the vertebrate Species of Greatest Conservation Need (SGCN) and the natural communities they inhabit. The implementation effort of the plan focuses on identifying conservation actions and conservation opportunity areas critical to the state's long-term goal of conserving SGCN and their habitats. The intent is to focus management actions in conservation opportunity areas to achieve the most effective and efficient approach to conserve SGCN with limited resources.

Conservation Opportunity Areas (COAs) are identified places on the landscape that contain ecological features, natural communities or species habitat for which Wisconsin has a unique responsibility for protecting, or that contain habitat with dominant responsibility for conservation when viewed from the global, continental or in the upper Midwest perspectives. COAs typically cover large areas within which lie different opportunities to protect and restore critical habitats.

There are 37 Conservation Opportunity Areas within the Driftless Area.

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[27] Appendix 2, the Rapid Ecological Assessment, is a large document and is not attached to this RPA. It can be viewed or downloaded at the DNR's website.

[28] The Wisconsin Wildlife Action Plan (2005 to 2015) can be viewed and downloaded from the DNR's website – search for "WAP."

d) Impaired Streams of the Driftless Area

Under section 303(d) of the federal Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDL) for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards. The Clean Water Act is implemented by the Department of Natural Resources to ensure that all waters maintain healthy aquatic communities and provide citizens with opportunities for fishing and swimming.

Table 2.2 lists the individual streams on the “303(d) list,” their impairments, and the miles in each planning region of the Driftless Area. Figure 2.44 is a summation of the total miles of impaired streams in each planning region. Figure 2.44 is most influenced by the impairment of contaminated fish tissue, which is found in the large rivers of the Driftless Area: Wisconsin, Chippewa, Black, Red Cedar, and the Trempealeau. For more information regarding Wisconsin’s Impaired Waters, visit: http://dnr.wi.gov and search for “impaired waters.”

Figure 2.44: Total miles of 303(d)-classified impaired streams by Planning Region.

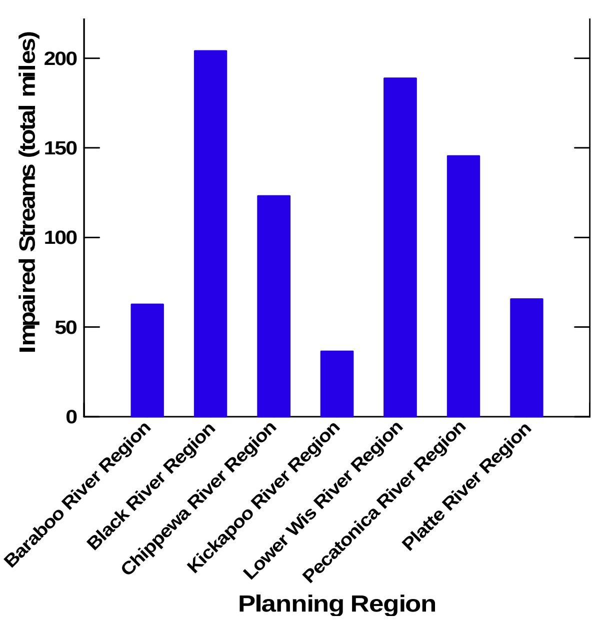


Table 2.2: List of Impaired Streams in the Driftless Area.

Planning Region	Stream Name	Impairment (miles)	Impairment
Baraboo River	Babb Creek	6.41	Degraded Habitat
Baraboo River	Crossman Creek	6.43	Degraded Habitat, Turbidity
Baraboo River	Silver Creek	4.40	Low DO, Degraded Habitat
Baraboo River	West Br Baraboo River	7.24	Low DO
Baraboo River	Wisconsin River	38.23	Contaminated Fish Tissue
Black River	Black River	45.21	Contaminated Fish Tissue
Black River	Buell Valley Creek	2.32	Degraded Habitat
Black River	Chippewa River	0.08	Contaminated Fish Tissue
Black River	Cochrane Ditch (Rose Valley Cr)	6.50	Degraded Habitat
Black River	Eagle Creek	8.47	Degraded Habitat
Black River	Fleming Creek	9.57	Elevated Water Temperature, Degraded Habitat
Black River	Hardies Creek	3.54	Degraded Habitat
Black River	Irish Valley Creek	7.89	Degraded Habitat
Black River	Irvin Creek	5.31	Degraded Habitat
Black River	Jahns Valley Creek	7.71	Degraded Habitat
Black River	Joos Valley Creek	7.44	Degraded Habitat
Black River	Mill Creek	2.96	Degraded Habitat
Black River	Newcomb Valley Creek	5.76	Degraded Habitat
Black River	North Creek	7.59	Degraded Habitat
Black River	Printz Creek	3.06	Degraded Habitat
Black River	Roaring Creek	5.34	Degraded Habitat
Black River	Swinns Valley Creek	8.49	Degraded Habitat
Black River	Tappen Coulee Creek	5.06	Elevated Water Temperature
Black River	Trempealeau River	31.28	Contaminated Fish Tissue
Black River	Trump Coulee Creek	7.71	Low DO, Degraded Habitat
Black River	Weiland Valley Creek	3.21	Elevated Water Temperature
Black River	Welch Coulee Creek	5.37	Elevated Water Temperature
Black River	White Creek	3.10	Degraded Habitat
Black River	Wolf Valley Creek	2.70	Degraded Habitat
Black River	Woodward Creek	4.00	Degraded Habitat
Black River	Yeager Valley Creek	4.43	Degraded Habitat
Chippewa River	Chetek River	0.05	Low DO, Eutrophication
Chippewa River	Chippewa R At Eau Claire	1.21	Contaminated Fish Tissue, Contaminated Sediment
Chippewa River	Chippewa R At L Wissota	0.00	Contaminated Fish Tissue
Chippewa River	Chippewa River	75.75	Contaminated Fish Tissue
Chippewa River	Coon Creek	3.35	Elevated Water Temperature, Degraded Habitat
Chippewa River	Eau Galle River	5.45	Elevated Water Temperature, Degraded Habitat
Chippewa River	Eau Galle River	1.24	Elevated pH
Chippewa River	Missouri Creek	9.28	Degraded Habitat
Chippewa River	Red Cedar River	12.19	Contaminated Fish Tissue
Chippewa River	Red Cedar River	6.61	Contaminated Fish Tissue, Eutrophication, Elevated
Chippewa River	Red Cedar River	6.22	Eutrophication, Elevated pH
Chippewa River	Rock Creek	1.84	Elevated Water Temperature, Degraded Habitat
Kickapoo River	Adams Valley Creek	2.57	Degraded Habitat
Kickapoo River	Creek 23-13b	0.90	Degraded Habitat
Kickapoo River	Gills Coulee Creek	4.86	Degraded Habitat
Kickapoo River	Halfway Creek	3.87	Degraded Habitat
Kickapoo River	Halls Branch	3.19	Degraded Habitat
Kickapoo River	Johnson Coulee Creek	2.26	Degraded Habitat
Kickapoo River	Jug Creek	4.65	Degraded Habitat
Kickapoo River	Kickapoo River	6.40	Contaminated Fish Tissue
Kickapoo River	Long Coulee Creek	5.29	Degraded Habitat
Kickapoo River	Stillwell Creek	2.46	Elevated Water Temperature
Lower Wisconsin River	Blue River	3.16	Degraded Habitat
Lower Wisconsin River	Fennimore Fork (Castle Rock)	4.87	Degraded Habitat
Lower Wisconsin River	Fennimore Fork (Castle Rock)	4.25	Water Quality Use Restrictions, Degraded Habitat
Lower Wisconsin River	Gunderson Valley Creek	5.40	Low DO, Degraded Habitat
Lower Wisconsin River	Halfway Prairie Creek	8.00	Degraded Habitat
Lower Wisconsin River	Little Bear Creek	6.77	Degraded Biological Community, Elevated Water Temp
Lower Wisconsin River	Little Willow Creek	7.73	Degraded Habitat
Lower Wisconsin River	Otter Creek	21.79	Degraded Habitat
Lower Wisconsin River	Rush Creek	6.02	Degraded Habitat
Lower Wisconsin River	Shannahan Valley Creek	1.29	Chronic Aquatic Toxicity, Low DO, Elevated Water T
Lower Wisconsin River	Vermont Creek	3.46	Elevated Water Temperature, Degraded Habitat
Lower Wisconsin River	Wendt Creek	8.25	Degraded Habitat
Lower Wisconsin River	Wisconsin River	107.89	Contaminated Fish Tissue
Pecatonica River	Apple Branch	2.77	Elevated Water Temperature
Pecatonica River	Argus School Branch	2.37	Elevated Water Temperature
Pecatonica River	Braezels Branch	4.06	Degraded Habitat
Pecatonica River	Brewery Creek	3.32	Chronic Aquatic Toxicity
Pecatonica River	Buckskin School Creek	6.71	Degraded Habitat
Pecatonica River	Burgy Creek	10.98	Elevated Water Temperature
Pecatonica River	Cherry Branch	7.11	Degraded Habitat
Pecatonica River	Cherry Branch	2.10	Degraded Habitat, Turbidity
Pecatonica River	Dodge Branch	22.76	Degraded Habitat
Pecatonica River	Dougherty Creek	2.62	Low DO, Degraded Biological Community
Pecatonica River	German Valley Branch	7.63	Degraded Habitat
Pecatonica River	Honey Creek	9.25	Degraded Habitat
Pecatonica River	Honey Creek	6.60	Water Quality Use Restrictions, Degraded Habitat
Pecatonica River	Jockey Hollow Creek	3.10	Degraded Habitat
Pecatonica River	Jordan Creek	6.00	Degraded Habitat
Pecatonica River	Legler School Branch	5.49	Degraded Habitat
Pecatonica River	Livingston Branch	11.61	Chronic Aquatic Toxicity, Low DO
Pecatonica River	Pioneer Valley Creek	4.15	Degraded Habitat
Pecatonica River	Pleasant Valley Branch	5.92	Degraded Habitat
Pecatonica River	Prairie Brook	3.11	Degraded Habitat
Pecatonica River	Silver School Branch	6.14	Degraded Habitat
Pecatonica River	Silver Spring Creek	5.90	Degraded Biological Community, Degraded Habitat
Pecatonica River	Trib To Brewery Creek	2.25	Contaminated Fish Tissue, Acute Aquatic Toxicity
Pecatonica River	Trib To Livingston Br	3.50	Low DO, Acute Aquatic Toxicity
Platte River	Bacon Branch	5.96	Degraded Habitat
Platte River	Big Patch Creek	5.00	Degraded Habitat
Platte River	Bull Branch	3.75	Chronic Aquatic Toxicity, Eutrophication, Degraded
Platte River	Chase Creek	1.15	Degraded Habitat
Platte River	Culver Br	2.34	Degraded Habitat
Platte River	Diggings Creek	5.43	Chronic Aquatic Toxicity, Degraded Habitat
Platte River	Louisburg Cr	5.26	Degraded Habitat
Platte River	Martin Branch	9.94	Degraded Habitat
Platte River	Martinville Cr	5.06	Degraded Habitat
Platte River	Rogers Branch	11.83	Low DO, Degraded Habitat
Platte River	Sandy Creek	5.64	Degraded Habitat
Platte River	Un Tr To Shullsburg Br	4.30	Chronic Aquatic Toxicity, Degraded Habitat

C. POPULATION, SOCIO-ECONOMIC AND LAND USE CHARACTERISTICS OF THE DRIFTLESS AREA

1. INTRODUCTION AND DEFINING THE PLANNING AREA

The properties of the Driftless Area Master Plan are located in the 23 counties of western and southwestern Wisconsin.[29] Since nearly all population, economic, and land use information that is currently available is organized and presented by county, the "region" for this part of the analysis will include all portions of these counties.

2. POPULATION[30]

Much of the total population of the 23 counties comprising the Driftless Area, an estimated 1.4 million, is located in rural areas or small cities and villages. The populations of the top ten largest urban areas within the planning boundary are:

Municipality Name	County	2010 Population
Eau Claire	Eau Claire	65,883
La Crosse	La Crosse	51,320
Onalaska	La Crosse	17,736
Menomonie	Dunn	16,264
River Falls	Pierce/St. Croix	15,000
Chippewa Falls	Chippewa	13,661
Baraboo	Sauk	12,048
Platteville	Grant	11,224
Verona	Dane	10,619
Sparta	Monroe	9,522

Nearly all of the rural areas of the region have experienced slow population growth rates of less than 1% per year over the last several decades. Although only partially within the planning boundary, both Dane and Saint Croix counties experienced explosive growth: Dane County's population increased by 33% (121,000 residents) from 1990 to 2010 while Saint Croix County's population increased 68% (34,000 residents) over the same time period. Counties within commuting distance of Madison and the Twin Cities typically have experienced annual growth rates ranging from 1-3%.

[29] The planning boundary encompasses only very small portions of two additional counties, Polk and Adams. Socio-economic and land use information about these counties is not included in this section.

[30] Population data come from the US Census Bureau. See Wisconsin Department of Administration's Demographic Services Center at http://www.doa.state.wi.us for a state summary of Census data.

3. LAND USE, COVER, AND OWNERSHIP

a) Land Use and Cover

The bulk of the lands within the planning boundary are used for farming operations with a high percentage involved with raising dairy or beef cattle. Given the steep topography, nearly all of the row crops, hay fields, and pasture lands are in the valley floors or ridge tops. Upland forests make up approximately 40% of the landscape and are part of most farming operations' land holdings. Most are actively managed to provide timber products to supplement farm income.

The exceptions to this land use pattern in the Driftless Area are the far northern portion (northern Pierce County and southern St. Croix County) and the portion south of Military Ridge. Here, row cropping and pasture/grasslands constitute over 75% of the landscape with forests comprising less than 20%. The landscape south of Military Ridge has a greater percentage of farmland than any other region in the state and the highest market value per acre of agricultural products sold.

Many of the farming practices that adversely impacted the water quality of streams in the Driftless Area decades ago (e.g., tilling croplands to the edge of streams, allowing uncontrolled cattle access along streambanks, and grazing woodlots) have been dramatically reduced over the last several decades. These changes have brought about a significant improvement in water quality in many streams and consequently an improved fishery.

b) Land Ownership

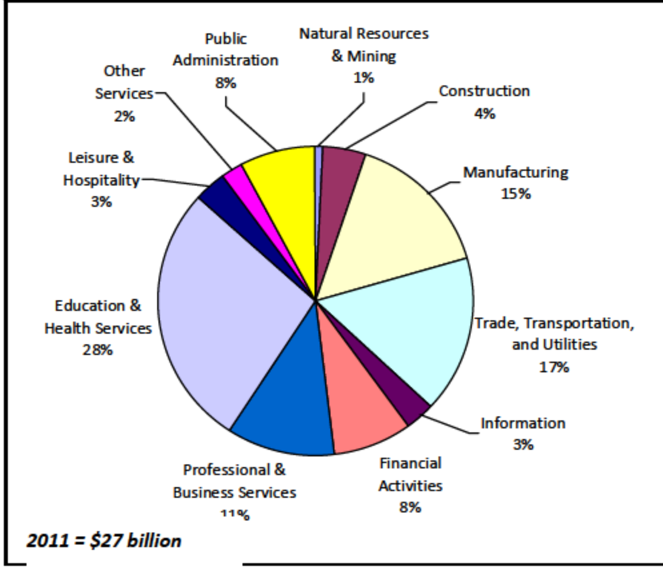
Much of the region is comprised of ownerships ranging in size from 40 to 200 acres. Although the Driftless Area lacks any large urban centers, land ownership patterns are directly influenced by the Twin Cities, Madison, and the Milwaukee/Chicago metropolitan areas. Over the last several decades an increasing number of parcels have been acquired by residents of these cities as second home and recreation properties.

Approximately 3% of the land base in the Driftless Area is in public ownership with much of it located along the Mississippi and Wisconsin Rivers. With the exception of the southeastern portion of the state (which is dominated by the Milwaukee-Racine-Kenosha urban corridor), the Driftless Area has the smallest percentage of public land in Wisconsin.

4. ECONOMIC ISSUES

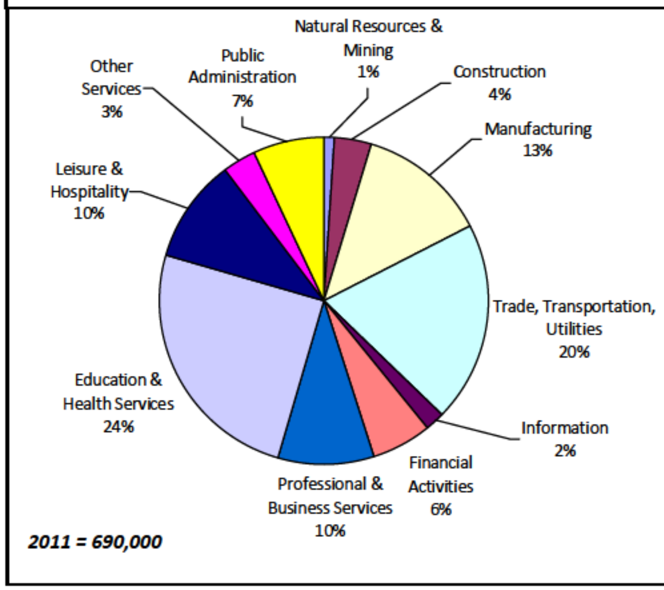
The largest industry sectors for employment in the region are similar to the rest of the state: education and health; trade, transportation, and utilities; manufacturing; and leisure and hospitality. The natural resource sector (which includes agriculture) provides jobs in the region at more than twice the statewide rate. Though it contributes relatively few direct farm-based jobs, agriculture's importance to the region is substantial and indirectly supports many manufacturing, professional services, and trade sectors. Wages, as well as the growth rate of income, are generally lower in the region than in the rest of the state. Similarly, poverty rates are higher here than many other regions of the state. However, in the recent economic downturn, the region's unemployment rate did not increase nearly as much as many other parts of the state.[31]

Figure 2.44: Total wages in the 23 counties comprising the Driftless Area.



In addition to data collected by the state and federal governments, Trout Unlimited contracted a private firm, NorthStar Economics, to assess the economic impact of trout fishing in the Driftless Area. Their 2008 report, *The Economic Impact of Recreational Trout Angling in the Driftless Area*, estimates that recreational trout angling generates $1.1 billion dollars annually in economic activity. Although the report did not break out this total economic impact by state, about one-half of the Driftless Area lies within Wisconsin and it is likely that a similar portion of the economic impact occurs here as well.

Figure 2.45: Employment in the 23 counties comprising the Driftless Area.



[31] See http://dwd.wisconsin.gov/oea/county_profiles/, the Ecological Landscapes Handbook, SCORP Regional Profiles http://dnr.wi.gov/planning/scorp/data.html

D. RECREATION RESOURCES, USE AND DEMAND IN THE DRIFTLESS AREA

1. INTRODUCTION AND DEFINING THE PLANNING AREA

The primary source of information on outdoor recreation in Wisconsin is the Statewide Comprehensive Outdoor Recreation Plan, or SCORP.[32] The Department revises the SCORP periodically to determine status, trends and needs for outdoor recreation in the State. The current plan covers the period from 2011 to 2016; former iterations (particularly the 2005 to 2010 version) contained more detailed information about recreation supply and demand and is the source of information presented here. Information for the SCORP is obtained through public surveys, listening sessions and interviews. For purposes of evaluation, the State is broken into 8 regions that share similar characteristics. The Driftless Area encompasses all of one and parts of three of the SCORP regions.

By analyzing the amount of supply and demand for different recreation activities in different regions of the state, the SCORP identifies the highest priority needs. For the Driftless Area, the SCORP identified the following nature-based recreational supply shortages:

- Boat launches – carry-in and trailerable
- Campgrounds – electrical and backcountry/walk-in
- Horseback riding and rentals
- Natural areas
- Nature centers
- Parks
- Public water access
- Trails – cross-country ski, hiking, horseback riding, water (paddling), and ATV

2. FISHING AND WATER-BASED ACTIVITIES

a) Trout Fishing

With public fishing access along over 500 miles of streams, trout fishing is very popular in the Driftless Area. Indeed, given the quality and quantity of angling experiences available, it is one of the recreation opportunities in Wisconsin that regularly draws visitors from Chicago, the Twin Cities, and increasingly from other areas of the Midwest. The differing fishing regulations in different streams within the Driftless Area enable a variety of trout fishing experiences. The regulations on some streams are "catch and release" to facilitate the growth of more, larger trout while others are designed to enable anglers to keep fish for consumption. There are 4,445 miles of Class I, II, III trout streams in the Driftless Area, of which public fishing access has been acquired along 694 miles (16%).[33]

The Department recently completed a survey of trout anglers to better understand their perspectives on the trout management program and how to better serve their needs. In addition, the survey gathered information about where, when and how many fish they caught and harvested and the factors most important to them. The results of the survey are expected to be published in the next year and will be applied during the development of the master plan.

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[32] Current and past SCORPs can be viewed at the DNR's web site (http://dnr.wi.gov and search for "SCORP.")

[33] Public access for both trout and smallmouth bass includes all shorelands that are in public conservation ownership or are otherwise publicly-accessible. It is not limited to just the DNR properties that are part of the master plan.

b) Smallmouth Bass Fishing

Although there are fewer opportunities for smallmouth fishing than trout, there is growing interest in smallmouth bass as both water quality and the quality of the fishery continues to improve. In particular are the cluster of streams in southern Grant and Lafayette Counties that support large and healthy fish populations and popular angling opportunities. Other opportunities are found in the larger and warmer waters of streams and rivers lower in watersheds. Popular waters for "smallie" fishing include: the East and West Branches of the Pecatonica, Platte, Wisconsin, Baraboo, Kickapoo, Black and Chippewa rivers.

c) Other Fishing

Many of the larger rivers, flowages, and natural lakes (of which there are very few) in the area support healthy populations of walleye, northern pike, catfish, perch, and panfish that are popular among anglers. Most notable are the opportunities to fish both the main channel and the numerous backwater sloughs along the Mississippi, Wisconsin, Chippewa, and Black rivers.

d) Other Water-based Activities

Boating is very popular during the summer months along the large rivers, particularly the Mississippi and Wisconsin rivers. Canoeing and kayaking are popular in many of the mid-sized streams and rivers from the Sugar, Fever, and Platte in the south to the Kinnickinnic, Red Cedar, and Chippewa in the north. The Kickapoo is one of the most popular paddling rivers in the Midwest.

3. HUNTING AND TRAPPING

Over 100,000 acres of DNR land are open for public hunting and trapping in the Driftless Area. Management of much of this land is aimed at establishing and maintaining the forest, grassland and wetland habitat to support healthy populations of ducks, wild turkey, deer, and small game including gray and fox squirrel, rabbit, grouse and a number of fur-bearer species. In addition, federal and local agencies also own thousands of acres open to hunting and trapping.

Although a considerable amount of the hunting and trapping on public lands occurs on the large blocks of public land along the Mississippi and Wisconsin Rivers, the other State Wildlife Areas located in the Driftless Area are also heavily used. The State Fishery Areas allow hunting and trapping, although in some cases the narrow configuration of the holdings is not conducive to these activities. Most of the access easements that the DNR holds along streams in the Driftless Area are designed to provide angler access and do not allow public hunting and trapping.

In addition to the available public lands, private land enrolled in the Managed Forest Law (MFL) program that is designated "open" for public access provides opportunities to hunt (but not trap), fish, hike, and cross-country ski on the property. Approximately 90,000 acres in the 23 counties that comprise the Driftless Area are enrolled in the MFL program and open to the public.

4. WILDLIFE WATCHING AND OUTDOOR EDUCATION

Wildlife watching occurs throughout the Driftless Area and many local communities host events structured around watching, photography, and enjoying a wide variety of wildlife. An example is the large amount of wildlife watching associated with the spring migration of Neotropical songbirds, waterfowl, birds of prey, and other birds along Mississippi and Wisconsin River valleys. Similarly, watching bald eagles along open water in the winter draws birders from throughout the Midwest. Although little data are available on where birders and other wildlife watchers visit, it is believed that only a minor fraction occurs on the lands included in the DAMP.

5. CAMPING

Many of the public camping opportunities in the Driftless Area are part of the State Park system and tend to be very well used. Devil's Lake, Wyalusing, Governor Dodge, and Perrot State Parks are among the most popular camping destinations in the state. In addition, the Lower Wisconsin State Riverway offers unparalleled camping opportunities along its 92 miles from Sauk Prairie to the Mississippi River. Some county and local parks in the Driftless Area also provide camping opportunities.

No camping facilities are present on the DNR lands included in the DAMP.

6. TRAILS

With its rugged and scenic topography, there is considerable demand for more hiking, off road biking, horseback riding, and cross-country skiing trails throughout the Driftless Area. However, due to the erodible soils and steep grades, locating and maintaining trails that do not damage vegetation and do not result in erosion and runoff problems remains a challenge. The region is home to several rail-trails (e.g., Elroy Sparta, Military Ridge, Red Cedar, Buffalo River, and Chippewa River), most of which are very popular biking destinations.

E. DNR LANDS IN THE DRIFTLESS AREA

1. DEPARTMENT OF NATURAL RESOURCE OWNED AND EASED LANDS

A summary of the different Department's fee and easement lands (acres) that are included in this planning process, *as well as other public lands*, is as follows:

	Properties included in this Master Plan													Other DNR lands in the Driftless Area	Other public & private conservation lands in the Driftless Area**	TOTAL
	Fisheries Management Program										Wildlife Program	End. Resources Program	TOTAL for properties included in this Master Plan			
	State Fishery Areas		Remnant Program		Streambank Protection		Scattered Habitat		Other*							
	Fee	Ease	Fee	Ease	Fee	Ease	Fee	Ease	Fee	Ease						
Baraboo River Region	572	0	2	0	0	170	23	0	6	0	122	0	895	21,223	1,218	**23,335**
Black River Region	4,619	332	513	255	685	140	0	20	4	0	715	414	7,696	17,215	33,723	**58,634**
Chippewa River Region	1,340	740	408	121	275	355	298	0	751	5	1,546	181	6,020	30,880	8,962	**45,861**
Kickapoo River Region	2,538	1,527	667	182	345	148	0	0	74	149	112	2,766	8,508	19,228	117,129	**144,864**
Kinnickinnic River Region	350	155	5	0	853	58	272	7	0	123	91	0	1,914	3,458	763	**6,135**
Lower Wisconsin River Region	2,714	231	1,823	1,046	123	17	82	21	368	21	375	350	7,171	21,037	3,984	**32,192**
Pecatonica River Region	376	36	10	472	526	868	0	0	0	5	0	376	2,669	10,633	3,421	**16,723**
Platte River Region	0	0	27	1,042	0	19	0	0	0	0	0	0	1,089	3,013	13,213	**17,314**
TOTAL	**12,509**	**3,022**	**3,455**	**3,119**	**2,806**	**1,775**	**675**	**48**	**1,203**	**303**	**2,959**	**4,087**	**35,962**	**126,685**	**182,412**	**345,058**

* Includes nonpoint easements, wetland mitigation sites, watershed management projects, public access sites, gift lands, and rearing stations.

** Includes conservation lands owned and eased by federal agencies, counties, private conservation groups and other similar organizations, as described in the Protected Areas Database housed in the Conservation Biology Institute (http://databasin.org/protected-center/features/PAD-US-CBI).

As mentioned earlier, the properties included in this master plan are a subset of all the Department properties in the Driftless Area. There are some properties in the Driftless Area owned by the Fishery Management program that are not included in the DAMP because they are not associated with trout or smallmouth bass water.

2. RECREATIONAL FACILITIES AND INFRASTRUCTURE

a) Facilities and infrastructure common to most DNR properties included in this master planning project.

Given that the primary purpose of most of the properties included in the master plan is to simply provide angling access, not surprisingly there are few (if any) facilities present on the majority of them. A listing by Planning Region is provided in Appendix 3; a summary of the types of recreation facilities found at the properties included in this master plan and their current management follows.

Parking lots
Many of the properties have small gravel parking areas, often located near bridge crossings or other convenient access sites. These parking lots typically accommodate two to five cars and are spaced depending on the Department's land holdings. They are periodically maintained by grading and adding gravel, as needed.

Fencing
In many instances fences border Department ownership parcels. In some cases the fencing is well maintained and used to confine grazing cattle along certain riparian corridors or to specific stream crossing sites. Some fences are very old and no longer maintained.

Snowmobile trails & bridges
Many snowmobile trails cross the lands included in this master plan. Nearly all are maintained by local clubs.

Boat ramps
The Department maintains boat ramps on some of the properties included in this master plan that are along large rivers. In some waters there may be a need to expand existing ramps or develop new ones where there is unmet demand for boat access.

Dikes & dams
The Department maintains some earthen dams on properties in this master plan. These dams are designed to permanently hold water in flowages or are dry and intended to hold water during extreme storm events to prevent downstream flooding.

Stream crossings for cattle and farm vehicles/machines
Given the locations of streams in relation to farm operations, many have improved fords that allow cattle or farm machinery to cross back and forth as needed. Some crossings incorporate "hanging" fences.

Accessible fishing docks/piers
The Department currently maintains some accessible fishing sites along trout waters for people with mobility issues.

3. EXISTING HABITAT MANAGEMENT STRATEGIES THAT ARE COMMON TO MOST OR ALL DNR PROPERTIES.

Many of the properties included in this master planning effort are relatively small, narrow, and irregularly shaped. Given this, and the fact that few ownership blocks are bordered by roads, some active management techniques used on many other Department properties are often difficult or impractical to implement on these properties (e.g., prescribed fire and logging).

There are many similarities throughout the Driftless Area in the active management that does occur on these properties. Rather than describe these management strategies on a property specific basis, this section describes the common aspects of management on Department lands in this master plan. Information is presented on management objectives and prescriptions for the in-stream and the immediate riparian edge, as well as the "back" lands. Some properties contain uncommon or unique recreation facilities, habitats, or management techniques. For example, given the steep topography found at many sites, some support wet and dry cliffs, caves, and unusual micro-climates; these sites in turn often support uncommon or rare species. These unique and unusual elements are described in the Planning Region chapters.

Easements along streams tend to be at least 66 feet wide or more, depending on the landscape and landowner preferences. In addition to providing public access for angling, nearly all easements also include vegetative management rights. Lands where the Department eases vegetative management rights are typically managed similar to fee-owned lands.

There is one notable exception to the narrow, small properties that comprise the lands in this master plan process, Rush Creek State Natural Area, a 2,500-acre property overlooking the Mississippi River in northern Crawford County. The property is part of this master plan because it includes considerable frontage along Rush Creek, a Class III trout stream, and Cooley Creek (Class I), as well as several small tributaries. It also encompasses significant floodplain forest, upland dry forest, oak savanna and woodland, and dry lime prairie habitats. The habitats and management opportunities at Rush Creek are described in more detail in the Kickapoo River Region chapter.

a) In-stream habitat and the riparian corridor (typically within at least 66' feet of stream)

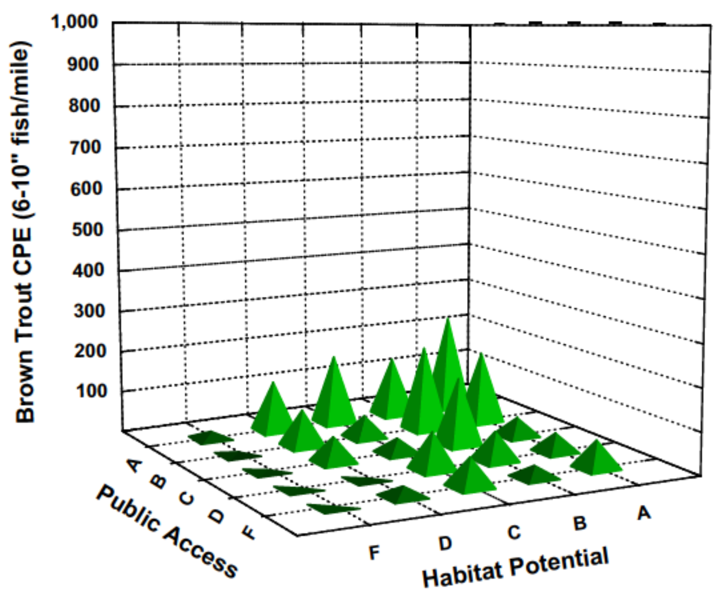
Habitat

The principal goals for trout stream habitat are to: improve trout natural reproduction, abundance and size distribution, provide trout anglers with additional or improved trout fishing opportunities, maintain or provide for healthy fish and riparian plant and animal communities, and to provide aesthetically pleasing areas for all to enjoy. These goals cannot be achieved without access or ownership to the land surrounding the trout streams.

Figure 2.46 shows the relationship between brown trout catch per mile, miles of trout habitat work and brown trout habitat potential. Areas with good habitat potential and more habitat work had higher brown trout catch per mile.

There are different stream bank and in-stream habitat enhancement strategies and restoration techniques to address specific challenges such as cover, depth, temperature, stream morphology. These are explained in a variety of references such as Trout Stream Therapy (Hunt 1993) and Unit Construction of Trout Habitat Improvement Structures for Wisconsin Coulee Streams (Vetrano, 1988). Certain techniques are specific to species and may negatively affect one species while helping another. Differences in Driftless Area geology, land use and cover influence which techniques are applicable. Other stream bank habitat enhancement techniques for Driftless Area salamanders, frogs, snakes and turtles are provided by the Driftless Riparian Habitat Guide.[34]

Figure 2.46: Relationship between brown trout population density, the amount of public access along trout streams and the natural habitat potential for brown trout.



Stream habitat can be divided up in three separate areas**: riparian corridor, stream bank**, and **in-stream.** Listed in each stream segment section are generic goals and challenges independent of stream type. These are universal across the Driftless Area.

Riparian Corridor - The riparian corridor is the gateway to the public interest features found on the banks and in the stream. Common place challenges in the riparian corridor include vegetative succession, land use issues, and user conflicts. The following are goals and primary general strategies to achieve those goals.

Goal 1: Maintain a stream buffer and desired vegetative state

Purchase stream corridors to protect and/ or restore a desired vegetative state. Eliminate or modify troublesome barn yards and grazing, intensive row cropping, lawns, urban impacts or any other type of disturbance that prevents development of a desired vegetative state. Use internal and external partners or a service provider to employ appropriate mechanical (grubbing, clearing, brushing and mowing), chemical (herbicide), or physical (fire) treatments to limit undesirable woody succession and the establishment of nuisance invasive species. This also allows for access to the stream.

Goal 2: Maintain and develop floral and faunal diversity to preserve ecological form and function and possibly serve as source population and genetic reserves for propagation and management needs.

Periodic inventory and monitoring of parcels to catalog communities and to assess performance and successional progression is necessary and to document unique or discreet genotypes where appropriate. Develop property specific conservation or introduction plans where appropriate. Use a prescriptive approach to encourage development of targeted species or guilds. Work with other programs (wildlife, endangered resources, forestry) to maintain and develop diversity . If invasive plants exist (e.g., reed canary grass, buckthorn, teasel, parsnip, Japanese hops, leafy spurge), it may be difficult and costly to re-establish native plant species. The potential for failure may be high and should be considered when developing

[34] Driftless Area Habitat Guide. Undated document by Trout Unlimited. 44 pages.

vegetative management plans. Biologists and property managers may also consider development of other wildlife habitat including prairie, native tree and shrub plantings and wetland scrapes.

Goal 3: Provide public access and allow for changing user needs and expectations

Purchase stream corridors to provide recreational access to trout and smallmouth streams. Develop sufficient boat access to the larger warm or cold water streams. Conduct routine user surveys and focus groups to define changing desires. The master planning process establishes schedules for review and user inputs. Access for older anglers is important. User conflicts may also arise in the riparian area (e.g., bike paths, hunting, horseback riding, and fishing).

Stream Banks - The stream bank is the interface and the buffer between the land and the water. Its ability to control erosion, provide ecological services such as infiltration and food production for native animals, and facilitate geomorphological processes such as flood conveyance and channel migration are critical. Challenges facing stream banks in the Driftless region include improper form, fishability, vegetation management, erosion, compaction, livestock, row cropping, non-metallic mining, and beaver activity.

Goal 1: Stabilize banks, reduce bank erosion, and in-stream nitrification and sedimentation.

The most common method used is bank sloping (3:1 or flatter) while establishing vegetation with possible toe rip-rap. Banks which are unable to be sloped may be stabilized with rip-rap or other acceptable practices such as woody debris or mats made of natural material. Rip-rap is not required along all portions which are sloped. Not rip-rapping along an entire project area helps maintain aesthetics and reduces project cost.

Goal 2: Provide flood flow conveyance, reduce flood energy and allow for channel migration and open flood water connections with floodplain features such as ox bows, sedge meadow wetlands, or other side channel wetland features which harbor aquatic species.

Sloping the banks (3:1 or flatter) allows for the dissipation of flood flow, reduction of flood energy, and lateral migration across the floodplain of the channel. Bank height should be reduced to allow seasonal flood patterns to develop for recharge of these riparian habitats. This may also help with groundwater recharge within the local area.

Goal 3: Manage vegetation consistent with the local ecology and landscape.

This can be achieved by the removal of undesirable species, including brushing and clearing. Grasses or trees should be consistent with the local landscape. Native plantings are recommended, however care should be taken not to invest too much time or money on native plantings when invasive or existing vegetation will establish over plantings. It is also important to maintain terrestrial habitat for biological diversity (non-game/game species, sources of food for trout).

Goal 4: Provide and maintain public access.

Providing access can be achieved by bank sloping and by managing vegetation for walking ease and increased fishability. Vegetation can be mowed, grazed and managed for desired grass species.

Goal 5: Reduce impacts from grazing, row cropping, nutrient runoff and other urban or agricultural practices.

Providing a buffer through acquisition or purchase of an easement can help address negative urban or agricultural practices including nutrient and sediment runoff. Reducing adverse grazing impacts can often be achieved by rotational grazing or reducing number of animals per acre. Fencing along the stream bank has been used extensively in the past, however it is not recommended. Maintenance, repair and

replacement of fence in the floodplain present significant management problems. In some areas yearly floods make it impractical. A minimum of 33 to 66 foot buffer strip should be maintained between the stream and row crops, lawns or other disturbances to allow re-vegetation and infiltrate undesirable runoff. Cattle and equipment crossings and watering areas should be installed where necessary.

Goal 6: Restore wildlife habitat in conjunction with stream bank restoration.

Opportunities exist to enhance wildlife habitat for reptiles and amphibians while restoring stream banks such as connecting oxbows, creating ponds, installing islands, hibernacula and basking sites.

In-stream habitat - In-stream goals focus on protection and rehabilitation/restoration. The challenges facing in-stream habitat include sedimentation, temperature, lack of cover, insufficient water depth, lack of habitat diversity, invasive species, reduction of stream flow due to water diversion, use and drought, and fish impasses such as culverts and crossings.

Goal 1: Provide sufficient habitat form and function to support all life history stages of trout (trout carrying capacity, natural reproduction, size structure) and invertebrate production.

Sedimentation, insufficient temperature and insufficient cover are common problems associated with trout streams that may affect various life stages of trout and their food sources. Below each issue and the general strategies for solving are explained.

Channel Constriction:

Unlike bank sloping which helps reduce sediment delivery from eroding stream banks, channel constriction facilitates silt removal. When trout streams have become wide and sluggish and in-stream substrate is dominated by sand and silt, such streams can be narrowed to increase velocity, expose coarse substrate for spawning and aquatic insect production, improve average depth and reduce surface area. Such deepening and narrowing will help retain groundwater temperatures conducive to long term trout survival and reproduction, and limit exposure to hot and cold air temperature variations over the seasons. Wide sluggish channels are often narrowed using standard bank sloping, grading and rip rapping at the water-land interface. Local stream segments in good shape can be used as guides of how far narrowing needs to occur. Caution is needed when narrowing small streams to prevent water cress or reed canary infestation that could lead to channel braiding and fishability concerns.

Deflectors and Stream Barbs:

These devices are triangular structures placed along the bank and constructed of rock, logs or a combination of the two. The primary purpose is to deflect the current away from the bank. In the process the stream becomes narrower and deeper near the outer edge, which creates deep water habitat and/or scours fine sediment which improves coarse substrate, invertebrate and spawning habitat. These structures can be used in combination with boulders and root wads to improve adult trout cover.

Animal Exclusion:

Often stream channels are severely degraded from overgrazing which causes stream widening and siltation. Overgrazing can be addressed through total exclusion by fencing, using barbed wire, horse wire, or electric fencing. However, such measures are often damaged by flooding. Proper rotational grazing methods have been proven to be a highly effective alternative. Grazing animals can help control infestations of saplings and harmful invasive plant species. Fenced gravel crossings can provide water to animals without causing bank damage. Both partial and total exclusion can result in the maintenance of healthy stable stream beds

and banks. Healthy stream banks and near shore vegetation provide outstanding juvenile trout habitat and terrestrial invertebrate production.

Brush Bundles:
In low gradient streams with high sand and silt loads, brush bundles can be installed and staked into place as an alternative to using bank sloping and rip rap to narrow streams. Brush bundles are placed in slow moving areas along the banks and allowed to silt in, eventually becoming established vegetation. If placed as a deflector, sediment may accumulate downstream of the deflector.

Shade:
Trout have specific temperature requirements to carry out their life cycle. Both woodland and prairie streams support outstanding trout fisheries. Streams that suffer from thermal stress will benefit from stream narrowing, increased depth and shade whether provided by prairie grasses or suitable woody tree and shrub species. If woody vegetation is planted, species less likely to attract beaver are recommended.

Cover:
Trout cover comes in several forms: overhead cover, broken water or depth. In each case cover provides protection from overhead predation and provides safe feeding. The physical or mechanical installation or manipulation of the in-stream cover can improve trout density and size structure. In many cases we attempt to mimic natural woody habitat using local sources of wood.

The most common types of overhead cover used to restore trout streams in Wisconsin include:

Root Wads:
The root and bole of a mature tree placed in the stream with the root planted outward and upstream at an angle. The bole is deeply trenched into the stream bank often using riprap to secure it. The root ball either rests on the bottom of the stream or is submerged slightly elevated in a pool. The root wad should be placed so that debris may pass over it during major flood events.

Half log, whole log, or tree drop covers:
These are often mid-stream devices placed on the edge of the main channel and parallel to the flow or installed much like a root wad with the tree top placed in a downstream direction. These devices may be elevated using blocks or boulders and secured with rebar, cable restraints or entrenched into the bank and secured with rip rap.

Boom Covers:
Boom covers are artificial devices designed to mimic a natural undercut bank. These are often placed on deeper inside bends of eroded stream banks and covered with rock and soil, then re-vegetated to appear as a natural undercut bank. Three types, Lunker, Sky Hook, and Jetted boom covers, are used in Wisconsin and are dependent on stream gradient and substrate type. Such structures, placed properly in the stream, will last indefinitely. Caution is required in the presence of both brook and brown trout. Brown trout tend to dominate native brook trout in this type of habitat.

Boulder Retards:
A boulder retard is a large boulder (2-4 ft in diameter) or cluster of boulders placed in runs or pools to create side cover, travel lanes and channel breaks. Often boulders are placed in conjunction with other habitat features to improve in stream cover diversity. Boulders that project slightly above normal stream flow levels provide feeding and loafing sites for birds and mammals in close proximity to water.

Weirs, Vanes, and Plunge Pool Pools:

These structures create deeper areas of stream with low current velocity where trout can avoid overhead predation and find secure overwinter cover. Depth of a suitable pool may vary based on species and stream width. Most pools are less than six feet deep. Large deep areas sometimes promote rough fish abundance over desirable coldwater species. Pools may be excavated or natural pools may be enhanced. Usually some form of hydraulic lift and plunge is needed to maintain and sustain pool creation or enhancement. This is accomplished using rock and/or log weirs and vanes. Large rock or a log is placed across the entire stream width and keyed into the bank so that the base flow is directed away from the banks. The bed of the stream is raised slightly to create head. The plunging action of water flowing over the vane or weir creates or maintains a scour hole. Such pools may be enhanced by the addition of root wads, boulder clusters or bank covers.

Goal 2. Reconnect stream reaches where they have been disconnected by human activities, structures or natural causes (e.g., improperly placed culverts, abandoned or failing dams, ditching, slides, rock falls or beaver dams).

Beaver Control:

While beaver and trout have evolved over time, large scale manipulation of stream side vegetation, allowing growth of streamside early succession tree species encourages heavy beaver colonization and beaver dams. Where they are not regularly removed by the flooding found in higher gradient streams, excessive dam building can have devastating effects on cold water temperature regimes, spawning and invertebrate habitat and adult trout cover. Beaver control and dam removal often are necessary on our best trout streams to maintain quality cold water fish communities.

Dam Removal:

Since European settlement, dams were built on Driftless Area trout streams in order to provide electricity or power saw and flour mills. Such dams can partially or completely destroy trout habitat and cold water temperature regimes. Removal of dams and remnant dam sills remain an important method for restoration of coldwater fish communities and allow fish passage for re-colonization

Hydraulic Connections:

Retaining hydraulic connections to back waters and oxbows helps maintain stream ecology, form and function. When narrowing or armoring a stream bank, openings connecting wetlands, ponds, back waters or oxbows can be retained to allow unlimited passage of biota such as minnow, reptiles and amphibians. Such action promotes biodiversity and the trout forage base. Where conditions allow, artificial oxbows or waterfowl scrapes can be constructed to encourage a wide range of species.

Meanders:

Many streams have been ditched and straightened. Such actions destroy fish habitat and destabilize the streambed resulting in further downstream problems. Ditched or straightened channels can be restored by adding meanders, which reintroduce natural stream dynamics that improve channel stability, habitat quality, aesthetics, stream form and function. Such action requires a high level of engineering to be successful.

Incision and Grade Controls:

Streams naturally down cut or adjust to major perturbations in the valley floor from years of sediment deposition. Down cutting of the stream bed results in the stream incising in the valley floor. The incision process creates raw banks that release tons of sediment to the stream bed annually. While this is a natural healing process, that process can be accelerated through the installation of grade controls. Grade controls come in a variety of weirs or sills constructed of logs, boulders and or rock placed across the channel and properly keyed into the bed and banks of the stream. Grade controls resist erosional forces and reduce the upstream energy slope to prevent bed scour. These are often built in combination with plunge pools or spawning riffles.

Fish Passage:

Dams on inland trout streams rarely allow fish passage. Over time opportunities become available to remove small, often antiquated dams. Most low head dams can be quickly and simply eliminated by jack hammering and excavating the concrete structure and replacing it with a weir or vane that allows fish passage. Large dams present significant challenges and require extensive engineering to remove or provide fish passage. Improperly installed, under designed or dilapidated bridges and culverts can block fish passage and impound water. Problems with such structures in many cases can be addressed through regular maintenance or replacement. The following aspects must be addressed: proper size to address flood flows and debris passage, elevation and slope to prevent impassable vertical drops or upstream impounding, and proper installation and maintenance which limits debris accumulation, washouts or upstream or downstream grade changes.

b) Back lands

Nearly all Department properties in this master planning project that are owned in fee title contain some lands away from the immediate stream corridor. For example, in some cases the Department's ownership consists of a linear series of 40-acre parcels. Depending upon topography, soils, and aspect, these lands are often comprised of a mix of forests, wetlands, or grasslands. In some instances, lands are in agricultural use either through pasturing or sharecropping agreements with local farmers.

Table 2.4: Vegetation on DNR properties included in this master plan.*

Cover type	Percent
Forested	*54%*
Oak	19%
Jack, Red, White Pine	9%
Central Hardwoods	7%
Bottomland Hardwoods	6%
Northern Hardwoods	3%
Aspen	2%
Red Maple	2%
Scrub Oak	2%
Swamp Hardwoods	2%
Walnut	1%
Miscellaneous /Other	1%
Non-Forested	*46%*
Marsh/lowland herbaceous	16%
Grass/herbaceous	12%
Lowland brush	12%
Farmland	2%
Open water	2%
Upland brush	1%
Miscellaneous /Other	1%

*Source: Division of Forestry WisFIRS database.

When determining appropriate habitat management objectives for a property, managers use their professional judgment and, in collaboration with staff from throughout the Department, take into consideration a range of factors. Some of the factors include: the size and configuration of the property, soils, habitats native to the site, habitats on adjacent lands, slope and aspect, micro-climate conditions, and recreational use and potential. Property managers work with staff from fisheries, wildlife, forestry, and endangered resources in developing and implementing habitat management plans.

As mentioned previously, active management techniques such as logging and prescribed burning are difficult or impractical on some of these lands due to their small sizes and narrow configurations, steep slopes, or isolated locations. What follows are general descriptions of habitats that occur on DAMP lands and management opportunities.

i) Prairies, grasslands, and oak opening (savanna) habitats.

Once common, prairies and oak openings are now rare communities within the Driftless Area; only a few small remnants occur on the properties included in this master plan. These habitats tend to occur on slopes too steep to till or in low areas subject to frequent floods. In many cases, prairies and savannas have become overgrown with shrubs or undesirable, low-quality trees.

Management opportunities are often focused on removing invasive plants, reducing the density of trees (particularly low-value species), and invigorating native grasses and forbs through prescribed fires. Where possible and practical, hedgerows, fence lines, small conifer plantations, and small low quality forest patches can be removed to increase the size of unbroken grassland/prairie area. Where opportunities exist to increase or establish oak on oak opening restoration sites, oak can be planted at appropriate densities.

When native grassland and prairie conditions have been seriously degraded, extensive restoration using timber harvest, herbicides, grubbing, cropping, and re-seeding are often used. While extensive restorations provide only a portion of the biodiversity present in a native prairie or savanna, they provide important habitat for many wildlife species dependent on these habitat types.

ii) Wetlands

Compared to the rest of the state, wetlands are smaller and less common in the Driftless Area and almost always restricted to riparian corridors in valley floors. Most of the larger fishery properties contain at least some wetlands.

Open Wetlands: Sedge Meadow, Wet Prairie, and Wet-mesic Prairie

Today, these open wetlands are much less abundant in the Driftless Area than they once were. Many have been lost or severely degraded by drainage, flooding, lack of fire, or invasive species. Degraded sedge meadow/wet prairies are typically dominated by reed canary grass as a result of grazing and/or ditching, or are being invaded by woody vegetation due to the lack of disturbance (e.g. fire on the site). Especially in the case of reed canary grass dominated sedge meadows, restoration can be a monumental task given the tools currently at hand.

Opportunities exist to restore sedge meadow/wet prairie and wet-mesic prairie community types on many properties. Often, the most pressing need is to address invasive species to reduce competition with native species and to address hydrology impairments.

Shrub-carr

Shrub-carr wetlands provide important wildlife habitat, especially as winter cover. Typical shrub-carr wetlands are habitat types that are in a state of succession due to a lack of fire. Historically, shrub-carr rarely formed in the presence of periodic fire events. In the absence of this natural disturbance, maintenance of this habitat type requires periodic management treatments to maintain this type. Management and restoration opportunities are typically focused on areas that do not have high potential for management as sedge meadow, wet prairie, or wet mesic prairie.

Forested Wetlands: Bottomland Hardwoods and Swamp Hardwoods

The bottomland hardwood and swamp hardwood forest types are associated with wet soils in flood plains, depressions, and stream/river bottoms. The major commercial tree bottomland hardwood species are eastern cottonwood, green ash, river birch, swamp white oak, and silver maple. The major components of the swamp hardwood type include black ash, American elm, and red maple. Bottomland hardwood forests are intricate and variable ecosystems due to species richness, flooding, ice movement, internal drainage patterns and the pattern of deposition and development of soils is complex. Given the almost infinite variability of bottomland hardwood site conditions, as well as the species mix and silvicultural characteristics, no single regeneration prescription will function adequately on most bottomland sites. This is true for swamp hardwood stands as well.

iii) Agriculture crops and food plots.

There are some agricultural lands found on fishery properties. In some situations, these are newly acquired lands that are farmed for several years in order to develop the proper soil conditions and cover crops to better allow the site to be restored to native vegetation. In other situations, the land is farmed to meet management objectives for the site. In some cases, the best ecological role for these lands is to be returned or converted to a forested state either through the planting of trees or their seeds.

iv) Forested (upland) habitats.

The Driftless Area contains a variety of different types of upland forest resources ranging from large blocks of oak – hickory forests to pine plantations to narrow bands of centuries-old pine relicts clinging along the edges of winding cliffs. The major types of forests found in the Driftless Area include the following.

Oak

Oak woodlands historically developed or regenerated following significant disturbance, such as the prairie and oak savanna fires that were once common to this area prior to European settlement. Generally, site disturbance is required to regenerate existing stands and to maintain an oak component in mixed stands. Management will typically involve even-aged harvest practices of various types and sizes occurring at intervals of 100-150 years. Oak is highly valuable for a wide variety of game and non-game wildlife species.

Central and Northern Hardwoods

Central hardwood tree species, such as black cherry, American elm, black walnut, bitternut hickory, and shagbark hickory tend to grow in partial shade to full sun, whereas northern hardwood tree species, such as sugar maple and basswood, tolerate more shady conditions. This variation in shade tolerance means that either even-aged or uneven-aged regeneration systems are used depending upon the tree species being favored. Even-aged silvicultural methods, such as overstory removal or shelterwood, tend to keep all the trees approximately the same age by harvesting the entire stand at 80-150 year intervals. Uneven-aged methods, such as single-tree or group selection, tend to create a stand with trees of three or more distinct age classes.

Aspen

Although a small forest component on these properties, aspen provides cover for wildlife, including woodcock which has had declining numbers in the U.S. This early successional forest type requires disturbance and abundant sunlight to regenerate. It is typically managed using complete even-aged harvests at intervals of 45-60 years.

Conifer Plantations

Red pine and other conifers were planted 25 to 50 years ago in various small plantations or shelter belts on a number of the wildlife areas.

F. OTHER PROTECTED AND PUBLICLY-ACCESSIBLE LANDS ALONG TROUT AND SMALLMOUTH BASS WATERS IN THE DRIFTLESS AREA.

The Department does not maintain complete geo-referenced data on a significant number of non-DNR public properties or private conservation lands and for the most part they not included in any of the tables or maps found in the Planning Region chapters. The exception is Fort McCoy, which is located mostly in the Kickapoo River Region and a small amount in the Black River Region; it is included in the data presented for those chapters.

1. OTHER PUBLIC LANDS

a) Fort McCoy

Fort McCoy has approximately 71 miles of coldwater streams and tributaries that drain into the Kickapoo and Black River regions. The majority of the streams are Class I trout water maintaining naturally reproducing brook and brown trout. The impoundments on Fort McCoy coldwater streams provide a variety of uses for recreation, military training, and habitat for fish and wildlife. Much of Fort McCoy is naturally well-suited for fish and wildlife habitat.

b) County fishing lands and easements

Dane County has acquired a combination of 20-year and permanent fishing access easements in the Blue Mounds Branch, Pleasant Branch, and Primrose Branch-West Branch Sugar River watersheds. In some cases these easements provide miles of high-quality angling opportunities.

2. CONSERVATION ORGANIZATIONS WITH PUBLICLY-ACCESSIBLE LANDS

Several conservation organizations own or manage lands along trout and smallmouth bass streams. Although some of these lands are only open to members or have restrictions on their public uses, many are open to the general public for trout and bass fishing. Examples include the chapters of Trout Unlimited, several rod & gun clubs, and land trusts.

G. FINDINGS & CONCLUSIONS

This section presents a summary of the major the findings and conclusions for a range of issues concerning the Driftless Area, the eight Planning Regions, and the use and management of the Department properties included in this master plan process. These findings and conclusions focus on both the current condition of the sport fisheries and the recreation opportunities that exist now, as well as what future opportunities may be based on projected climate changes. This integration of information on predicted future stream health and temperature resilience – and the fisheries' response – make this a unique project.

In developing these findings and conclusions, the root question is: based on recreation and conservation needs, the attributes and features of the Driftless Area, the desired recreation experiences, the desired resource management goals, and other factors, what is this collection of streams and the DNR's land ownership along them best suited to provide over the next several decades that is most in need from a broad perspective?

The findings and conclusions are defined as:

Findings: Findings are statements of fact drawn from the body of the Regional and Property Analysis. Their purpose is to:

- highlight and summarize the Driftless Area's resources and attributes and the primary capabilities and limitations for management and recreational use, and
- highlight and summarize the regional needs or opportunities that could be addressed through the master plan.

Conclusions*:* Conclusions are statements of informed opinion *based* on the findings. They are used to identify the ways and degree that the DNR's existing or future properties along trout and smallmouth bass streams may or may not provide for regionally important resources or recreational needs.

These findings and conclusions strongly influence the range of protection, restoration, and management options that will be developed in the proposed master plan.

1. FINDINGS AND CONCLUSIONS RELATED TO THE OVERALL DRIFTLESS AREA

Finding: Over many decades the Department has acquired fee simple and easement interests in properties along trout and smallmouth bass waters using different acquisition authorities. In many instances the Department has used different acquisition authorities to acquire adjacent parcels. This has largely been a consequence of landowner interest (in selling fee title or an easement), the availability of funding under different programs, and staff preferences. The resulting assortment of DNR's ownership interests has led to confusion about allowable recreation uses in different stretches of ownership with the public and staff and has presented records management obstacles for the Department.

Conclusion: Simplifying the Department's approach to fee and easement acquisition along trout and bass waters would be beneficial to anglers and the Department.

Finding: Land enrolled in conservation programs (e.g., CRP and WRP) dramatically increased in the 1980s and 1990s. These lands absorb more precipitation than cropland and result in more groundwater recharge of streams and less surface runoff. In turn, this has resulted in significant improvements in the water quality and temperature in trout streams and a large increase in trout populations. Further downstream, these waters support increasingly

large bass populations. Recently there has been a significant reduction in the amount of land enrolled in conservation programs in the Driftless Area and this has had a negative impact on some waters.
Conclusion: Providing options for landowners to keep lands along or near headwater creeks as well as trout and bass streams in permanent vegetation, rather than converting out of conservation programs, will be critical in maintaining the improvements that have occurred to many fisheries over the last 20 years.

Finding: Maintaining permanent vegetation along headwater streams can significantly benefit downstream water quality by reducing the amount of polluted runoff entering streams. Many of these small streams may not harbor "fishable" trout populations and, as such, acquiring public access is not critical.
Conclusion: Protecting narrow corridors along headwater creeks, even without public access, can provide significant benefits to trout and bass waters downstream where fish and fish populations are large enough to support meaningful angling opportunities. Acquiring conservation easements without public access along strategic headwater creeks may be a cost effective approach to providing high quality angling opportunities.

Finding: The RPA incorporates the results of two different modeling efforts – one that predicts the natural habitat potentials and levels of land use stress and a second that projects the future distribution of trout and bass based on climate change impacts to streams. Like all models, they project most likely outcomes based on data inputs. These models are not intended to be precise at a small scale – a particular stream segment – but rather are designed to predict the most probable outcomes from a broader perspective. Thus, although there are instances of where local conditions vary from what the models predict, the climate and habitat models used in the Regional and Property Analysis are science-based and unbiased.
Conclusion: The Department will benefit from utilizing the best available stream habitat and climate modeling science to guide planning of future habitat management and land acquisition in the Driftless Area. The Department often possesses empirical site-level data which can be used to refine scientific modeling results.

Finding: For each of the eight planning regions, the Regional and Property Analysis incorporates a science-based comprehensive "report card" that spatially summarizes the following:

- The factors that provide good natural habitat and that cause habitat stress for all three species.
- Existing thermal conditions of trout streams and their resilience to climate change.
- Trout stream restoration work completed.
- The distribution and abundance of trout and smallmouth bass, based on electro-shocking survey work.
- Projected resilience of trout and expansion of smallmouth bass resulting from climate change.
- The amount and distribution of public access for angling.
- The potential demand for angling.

Conclusion: Utilizing the elements of the report card will help the Department identify habitat management strategies and acquisition priorities.

2. FINDINGS AND CONCLUSIONS RELATED TO ECOLOGICAL ISSUES.

Finding: Although most properties included in this RPA are small, narrow, and disjunct, there are some opportunities to manage for regionally-significant ecological features. Examples include: floodplain forests, oak savanna, mesic and wet-mesic prairie, sedge meadows, and cliffs. Occurrences of high quality, ecologically-significant areas were identified in the Rapid Ecological Assessment (Appendix 2).
Conclusion: The Department should protect and manage high quality occurrences of ecologically-significant native communities on DNR lands.

Finding: Invasive terrestrial species are a significant problem on some DAMP Lands and can affect both the ecological values of these properties and recreational access to streams.

Conclusion: The Department in collaboration with partner groups, will need to continue to identify and, where feasible, treat infestations of invasive species.

Finding: Aquatic invasive species have become established in many trout and bass systems in the Driftless Area, but to date have only marginally compromised these fisheries. Several aquatic invasive species that have caused much more significant impacts on trout systems elsewhere have not yet colonized here (e.g., Rock Snot, Asian carp, etc.)
Conclusion: The Department, in collaboration with partner groups, will need to continue to identify and treat infestations of invasive species.

3. FINDINGS AND CONCLUSIONS RELATED TO STREAM HABITAT QUALITY AND THERMAL RESILIENCE.

Finding: The natural habitat factors most influential in determining the presence of brook trout, brown trout, and smallmouth bass have been identified through modeling.
Conclusion: Efforts to protect and manage populations of these species are most likely to be successful in waters that have high natural habitat potential. The Department, in collaboration with partners, should focus trout and bass management and protection efforts in areas with high natural habitat potential.

Finding: The types and relative influence of land use stressors on brook trout, brown trout, and smallmouth bass have been identified through modeling.
Conclusion: Efforts to protect and manage populations of these species are most likely to be successful in waters that have modest or lower levels of land use stress. The Department, in collaboration with partners, should focus trout and bass management and protection efforts in areas with lower levels of land use stress.

Finding: Streams in the Driftless Area are predicted to have varying levels of resilience to warming due to climate change (warming air temperatures and different precipitation patterns). Nearly all stream reaches are predicted to experience increases in July mean temperatures. Many stream reaches will see a shift to a warmer thermal class (e.g., from cold to cold transition or cold transition to warm transition) and for some streams that are currently at a thermal threshold, this is predicted to result in an elimination of their trout population.
Conclusion: To ensure that limited resources are used most effectively, the Department and partner groups will need to incorporate projected stream thermal resilience to climate change in decisions about where to focus management, restoration, and protection efforts along trout waters.

Finding: The amount of trout habitat work completed over the last 40 years varies considerably across the Driftless Area. Some watersheds have been the focus of considerable efforts while many others have received little, if any, attention. This is driven by a number of factors including acquisition of land or land rights, funding availability, existing stream conditions, and partner interest. Trout densities are typically very high in areas where habitat restoration, in particular in-stream improvement, has been completed. Restoration work also improves the "fishability" of streams.
Conclusions: Future stream restoration efforts should be focused where they will provide the most benefits for maintaining and enhancing future trout and bass populations and where they will meet high angling demand.

4. FINDINGS AND CONCLUSIONS RELATED TO SPORT FISHERY PERFORMANCE.

Finding: There is considerable variation in the distribution, abundance, and size of trout and bass populations in the Driftless Area. The largest factors influencing this variability are habitat and water quality, but it is also affected by competition, fishing pressure, regulations, and stocking. For example, the highest densities of brown trout occur in the Kinnickinnic and Kickapoo River regions as well as portions of the Lower Wisconsin and Pecatonica River regions. For brook trout, portions of the Chippewa, Black, Kickapoo, Kinnickinnic, and the Baraboo Hills all currently support large populations. Smallmouth bass populations are ubiquitous in the Platte River Region, and elsewhere, are primarily found in large rivers.
Conclusion: The DNR and partners will need to continue to focus future management and protection efforts in watersheds with the highest probability of supporting healthy populations of target species.

Finding: The only native salmonid to historically populate Driftless Area streams is the brook trout. Following the 19th century introduction of non-native brown trout to Wisconsin streams, the distribution of brown trout has increased and the distribution of brook trout has decreased. Streams that support trout tend to be dominated by either brook or brown trout; only a limited number of systems support roughly equal numbers of both species. Streams that have different conditions in different reaches or barriers to movement can be dominated by one species of trout in one reach and the other species in a different reach.
Conclusion: The Department will need to consider how in-stream and riparian habitat management objectives may affect the outcomes of inter-specific competition between brook trout and brown trout differently.

Finding: At the sub-watershed scale, there is a strong positive relationship between cumulative acquisition of lands along streams and the degree of habitat work and the corresponding sport fishery performance and angling use. In other words, trout populations increase in response to large amounts of publicly owned lands adjacent to trout streams with restored habitat, which in turn attracts increased angling interests.
Conclusion: For streams with large amounts of publicly-owned lands and restored habitat, priority can be given to maintaining their excellent sport fisheries.

5. FINDINGS AND CONCLUSIONS RELATED TO CLIMATE CHANGE.

Finding: Research suggests that brown trout may be more adaptable to warming stream conditions and are able to outcompete and displace brook trout in most cold transition/warm transition waters. Models predict that with a warming climate brook trout will be lost by the mid-century from most of the stream reaches where they now occur and that brown trout will be lost from only a minor amount of stream reaches. The losses of brook and brown trout are unevenly distributed across the Driftless Area. The Black River Region is predicted to retain the most stream miles supporting brook trout. In fact, the Black River Region in part will likely serve as a core "reserve" area for brook trout in the future. In particular, the contiguous Fleming Creek, Beaver Creek, and the Upper Trempealeau River watersheds will likely be critical in future management of brook trout in Wisconsin. The Kickapoo and Lower Wisconsin regions are projected to retain the largest number of stream miles supporting brown trout.
Conclusion: The Department should balance conservation principles of native species management of brook trout with realistic future environmental conditions for brown trout. The Department will need to pursue additional efforts with partners to remediate the effects of climate warming on brook trout in the Driftless Area. Acquisition of riparian lands along headwater areas, by itself, will not remediate at-risk streams from the effects of climate warming.

Finding: Smallmouth bass are expected to expand their distribution throughout the Driftless Area as the impacts of climate change affect stream conditions. In particular, the miles of streams and rivers harboring smallmouth bass are predicted to increase between 50 – 100% in the Platte and Pecatonica regions.
Conclusion: In-stream management strategies will need to be adjusted in those waters where smallmouth bass do not currently exist but are expected to inhabit in future decades as water conditions change.

6. FINDINGS AND CONCLUSIONS RELATED TO ANGLING, ANGLING ACCESS AND DEMAND.

Finding: Public access along trout streams is patchily distributed across the Driftless Area. In some areas, there are publicly-accessible lands along over 50% of the trout stream miles while one-third of sub-watersheds with trout streams have no publicly-accessible lands. Generally, publicly-accessible lands tend to be concentrated along trout and bass waters with higher densities of fish. However, there are many stream reaches with high densities of trout that have only a very small amount, or no, publicly-accessible lands.
Conclusion: There are many opportunities for the Department and partners to provide angling access on high quality waters where no, or only a very limited amount of, public access exists now.

Finding: Angling demand is not equally distributed across the Driftless Area. The Driftless Area is "bookended" by two large metropolitan areas, the Twin Cities and Madison. Many residents of these population centers fish for trout and bass and create very high angling pressure on streams that are readily accessible. As a result, although there are a number of publicly-accessible lands along streams and rivers near these cities, they tend to be crowded and heavily fished by anglers looking for opportunities within close proximity of home.
Conclusion: Although acquiring land and easements is more expensive near urban areas, providing additional angling access near the areas with the highest population densities will meet the most angling demand and may be the most efficient use of limited funds.

Finding: Smallmouth bass anglers often fish larger rivers in small watercraft. An exception is the Platte River Region, where there are numerous wadeable smallmouth bass streams.
Conclusion: Acquisition of contiguous riparian lands is more critical for trout angling, whereas acquisition of angler/canoe access points is more critical for smallmouth bass angling on larger rivers of the Driftless Area.

Finding: The Department has recently completed a statewide trout angler survey to better understand preferences, motivations, and activities of trout anglers.
Conclusion: Survey results will aid the Department in tailoring habitat management for Driftless Area stream properties. The Department will also consider survey results in setting new acquisition priorities.

7. FINDINGS AND CONCLUSIONS RELATED TO OTHER RECREATION

Finding: The Department acquires easements which are often at least 66 feet from either side of the stream. Although the Department can authorize some land use activities on easements it acquires, these narrow strips of land are typically managed as natural vegetation that provide improved water quality and valuable angling access. As such, easements offer excellent angler access, but are limited for other recreational opportunities. Moreover, most easements do not allow for hunting and trapping opportunities.
Conclusion: The Department will need to weigh the costs and benefits of acquiring fee title or easement as it develops master plan alternatives.