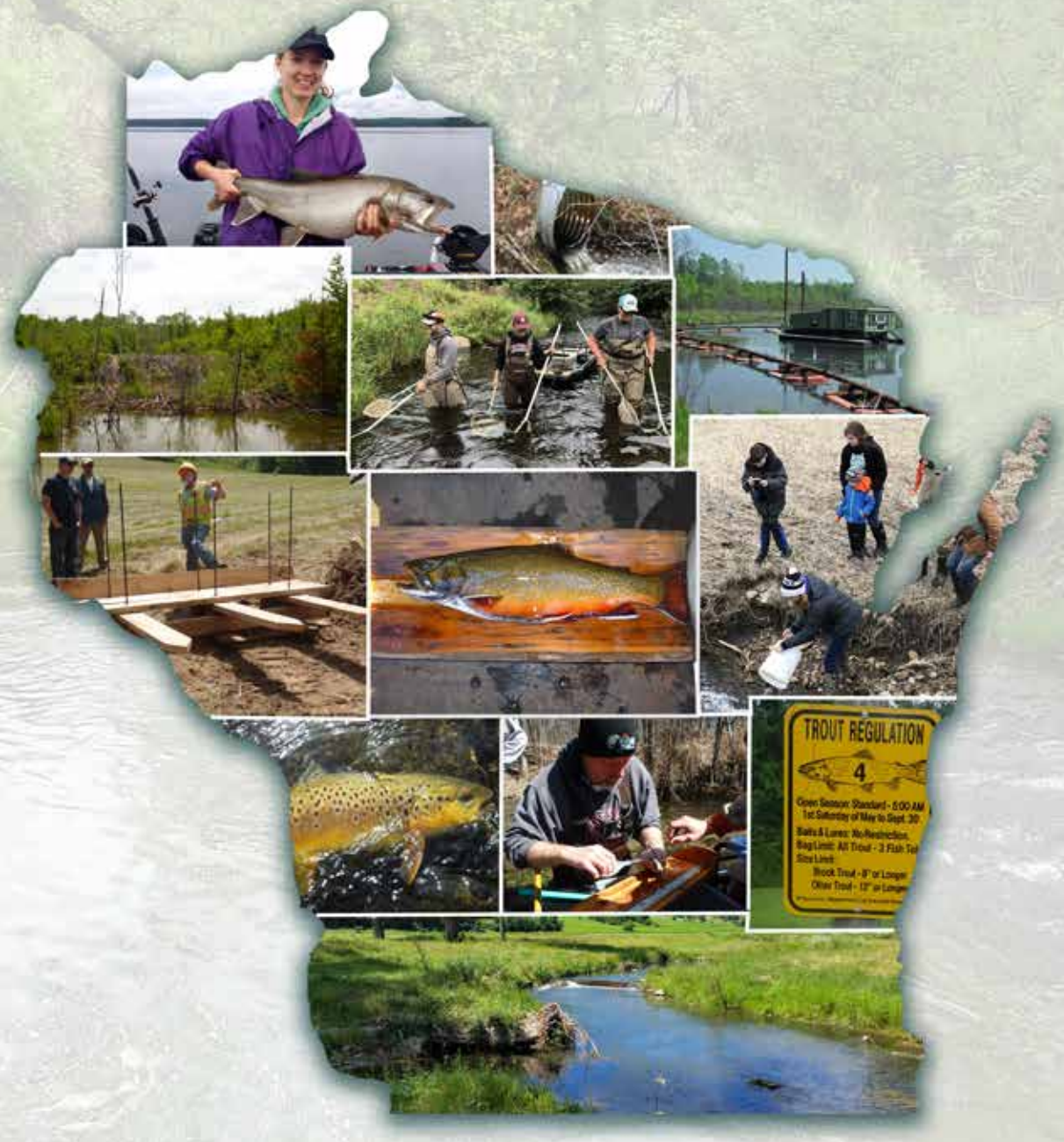
Wisconsin Inland Trout Management Plan 2020-2029



WISCONSIN
DEPT. OF NATURAL RESOURCES

Wisconsin Department of Natural Resources
Bureau of Fisheries Management
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EXECUTIVE SUMMARY

The Wisconsin Inland Trout Management Plan 2019-2029 is the first statewide trout management plan for the Wisconsin Department of Natural Resources (DNR). This plan provides direction for inland trout management in Wisconsin and covers Brook Trout, Brown Trout, Rainbow Trout and Lake Trout in inland lakes, ponds and streams of Wisconsin, including tributaries of the Great Lakes upstream from impassable barriers such as dams and naturally occurring falls. It specifically guides the allocation of resources, identifies constraints, determines locations and prioritization of management activities and provides an internal and external communication tool. It also includes a wide variety of fisheries management activities such as surveys, habitat improvement and protection, stocking, fishing regulations and land acquisition.

The DNR trout team worked with a trout management plan stakeholder team that consisted of stakeholders with diverse representation from each area of the state. The stakeholder team met twice to develop goals and objectives for the plan. The team had the opportunity to review the draft plan. Stakeholders had a wide variety of specific inputs that were incorporated into this management plan. There are certain issues that were important to stakeholders that were beyond the scope and authority of this plan. Specifically, stakeholders wanted the management plan to propose increases in the protection of water quality and quantity, DNR funding and staffing for trout management, efforts to recruit trout anglers and increases in the amount of trout habitat work completed.

In this plan is a description of the current status of trout fisheries in Wisconsin and a summary of trout biology and ecology. We have many great trout fisheries across the state and, in general, we have seen improvements in these fisheries and habitat over the recent decades. However, our trout streams and coldwater resources are still recovering from historical degradation due to a wide variety of human-caused impacts throughout the settlement and industrial development periods of the 1800s and 1900s. Human-caused impacts have been mitigated through strong environmental laws, conservation programs and better agricultural, timber harvest and industrial practices. We have also conducted many habitat improvements, land acquisitions and stocking efforts to improve trout fisheries across the state. In addition to these past impacts, we have identified new and current threats and challenges to trout fisheries management. Some of the top concerns include land use, water quality, and water quantity impacts, climate change impacts, invasive species impacts, and declining angler participation.

VISION

Outstanding trout populations and cold-water resources as part of a healthy ecosystem that provide enjoyment for people of all ages and backgrounds.

The Wisconsin Inland Trout Management Plan has the following 4 major goals:

1. Protect, enhance, and restore sustainable cold-water aquatic habitats and ecosystems.

2. Protect, develop, enhance, and restore trout populations and trout angling opportunities for the diverse preferences and needs of our participants.

3. Collect, develop and use the best science to guide trout management decisions.

4. Maintain and expand partnerships and engage diverse anglers, stakeholders, and the general public on trout management and angling opportunities.

Inland trout management in Wisconsin is a complex network of stakeholder desires and biological and ecological management. This plan begins the process to sort through the management program of inland trout to prioritize workload, resources and core activities. Many of the actions listed in this plan are long term or ongoing core fisheries activities. Other actions will begin to take the trout management program in new directions.

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TROUT MANAGEMENT TEAM

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TROUT MANAGEMENT PLAN

PURPOSE

The Wisconsin Inland Trout Management Plan is intended to:

- Provide direction for inland trout management in Wisconsin
- Guide direction of resources (e.g. budget and staffing decisions, justifications of funding requests and projects)
- Identify constraints
- Determine location and prioritization of where work should be done
- Guide DNR trout team charges and priorities
- Provide an internal and external communication tool

PROCESS

In October 2017, the Wisconsin Department of Natural Resources (DNR) trout team created a public involvement plan to support the development of a trout management plan. Bob Holsman, DNR Resource Sociologist, worked with the trout team to design stakeholder input and to facilitate the public meetings. The public involvement plan was predicated on the formation of an advisory group that cut across regions of the state and sought diverse perspectives on managing inland trout. The plan included a draft timeline for the development of the Wisconsin Inland Trout Management Plan, a list of potential stakeholder groups, a description of how the stakeholder team may be formed, the roles of the stakeholders and the goals of the first stakeholder meeting.

In an effort to be inclusive, yet manageable in size, the DNR recruited up to eight citizen participants (two anglers with one being a Trout Unlimited member, one landowner, one representing business/tourism interests, one representative from a non-consumptive group, one Wisconsin Conservation Congress delegate, one member-at-large, and a tribal representative) in each of four DNR management districts covering the state. During the process, the number of participants increased due to stakeholder gaps. The first meeting was held at the end of January 2018. Stakeholders provided the DNR trout team with a framework to begin drafting a plan. DNR provided stakeholders with background information and process guidance. The team developed

initial broad goals for the plan. Stakeholders also worked in small groups to identify issues of concern as well as benefits of the current state of trout management. At the second meeting on March 3rd, the stakeholder team reviewed the overarching vision statement and broad goals developed in response to input generated at the first meeting. DNR provided the stakeholders with additional background information that had been requested.

Stakeholders requested a strong vision statement highlighting protection and enhancement of coldwater resources. They placed high priority on water quality and quantity; protecting existing water quality and enhancing water quality where feasible. The stakeholders strongly supported increasing DNR funding and staffing to meet their expectations for trout management in the state. Emphasis was also placed upon angler recruitment. Stakeholders placed higher priority on certain management actions (e.g. waters closest to population centers, wild trout management, climate change mitigation). Given that the DNR recently completed a review of trout fishing regulations, the stakeholders were asked to avoid discussion of specific rules. However, stakeholder comments on regulations were generally split between those desiring more restrictive regulations and those desiring less restrictive regulations. There was strong support for the current trout habitat management and enhancement program in terms of staff and equipment. Stakeholders requested an increase of access, including new properties and increased brushing to allow for an increase in fishability.

Stakeholder Team Meeting, January 2018

The DNR trout team recognized stakeholder concerns related to the desire for increased angler recruitment, funding, trout stamps sales, license fees, and staffing levels as well as concerns about water quality issues and other issues not directly in fisheries management authority (but housed elsewhere within the agency). The stakeholders strongly endorsed the need for additional funding to responsibly manage the inland trout resources including license fee increases. These types of efforts would require legislative action and therefore are beyond the scope of this plan. Where possible, the plan continues to implement strategies and actions to collaborate with partners (internal and external) to leverage funding and resources beyond trout stamp and license sales funds. Efforts to protect and improve water quality and mitigate impacts to coldwater ecosystems are generally not under the Fisheries Program purview. Howev-

er, where possible, the DNR addressed these concerns in this plan through strategies and actions that include working cross-program with other sections of the DNR on these topics. Since the stakeholder group was advisory, not all stakeholder concerns and suggestions were included in the plan due to a variety of reasons such as level of detail and Fisheries Program authority. However, all suggestions were captured in the notes and appendices of the plan.

The stakeholders decided not to meet again until possibly after the draft plan was developed. The DNR trout team wrote a draft plan and then shared it with the stakeholders on September 4, 2018.

SCOPE

This plan covers Brook Trout, Brown Trout, Rainbow Trout and Lake Trout in inland lakes, ponds and streams of Wisconsin, including tributaries of the Great Lakes upstream to impassable barriers such as dams and naturally occurring falls. Potamodromous salmonids, trout and salmon that spend all or part of their lives in the Great Lakes proper, are not included in this plan but will be included in the Lake Michigan and Lake Superior management plans. There are certain issues that are important to our stakeholders and to the fisheries management program, but fisheries management does not have the authority nor directive to focus our work on those issues. This plan guides fisheries management activities (e.g. surveys, habitat, stocking, fishing regulations, land acquisition) and does not encompass all DNR activities (e.g. water quality, permitting, angler recruitment etc. are all under the purview of other Bureaus at the DNR). Fisheries Management may be involved peripherally in some of these other issues, and in those cases, the plan has strategies to address the collaboration.

CONTEXT AND IMPLEMENTATION

The Wisconsin Inland Trout Management Plan is framed within the goals, objectives and strategies of the Fisheries Strategic Plan, "In the Year 2025: A Ten Year Strategic Plan for Fisheries Management in Wisconsin. 2015-2025", which is a vision and path to the future of the Fisheries Management Program in Wisconsin. The Fisheries Strategic Plan fits within the framework of the Fish, Wildlife and Habitat Management Plan. *https://dnr.wi.gov/topic/wildlifehabitat/documents/fwhplan.pdf*

Trout management priorities fit within the framework of existing strategic plans and core work developed by the Fisheries Management Bureau, Division of Fish, Wildlife and Parks and the DNR . Fisheries Management defines priorities on a biennial workplanning cycle. The DNR trout team and the Fisheries Policy Management Team will review this plan as part of the biennial workplanning process. Fisheries Management will update this plan with stakeholder input if priorities change due to external factors or emerging issues.

Due to uncertain staffing and funding levels, it is important to be realistic while setting objectives and priorities. As with the Fisheries Strategic Plan, this Trout Plan is written using a stratified approach to priorities. The idea is to provide priorities and strategies under each objective of the plan while also maintaining realistic workloads. Priorities are defined as follows:

Core Strategy: These strategies are the highest priority for allocation of resources and work towards completing the objectives within the goals.

To the Extent Feasible: These strategies are also high in priority, but resources may not be available to address or complete them. Work will continue in these areas as allowed by available funding.

Additional Resources Required: These strategies are important, but additional staff, partners or funding will be necessary to address or complete them.

The DNR is currently working on many of the strategies in the **"To the Extent Feasible"** category and others are actions that have not yet been started. These are important concerns and strategies but are either problems too large to adequately address with current resources or are strategies that would require time from staff already fully allocating their time to other core strategies. Strategies under this category are to:

- Develop new techniques
- Use ecosystem-based approaches to habitat improvements
- Purchase new easements and fee title properties
- Evaluate and improving stream connectivity
- Provide support to partners on watershed and water quality initiatives
- Develop easy access and shoreline access fishing locations
- Provide trout fishing opportunities on inland lakes.

Strategies within this category will be completed pending funding and staffing.

The **"Additional Resources Required"** category includes many important strategies addressing current issues and requests by stakeholders. However, these strategies would require more resources in the form of staff, funding or partnerships to completed. The strategies under this category are to:

- Expand the amount of trout habitat work completed each year
- Develop routine creel surveys on trout waters
- Develop additional trout fishing outreach, web related materials and applications
- Promote Wisconsin trout fishing locally and nationally

TROUT LIFE HISTORIES

Brook Trout, Brown Trout, and Rainbow Trout have three basic life-history forms: stream-resident, lake-adapted, and anadromous. Brook Trout are native to Wisconsin waters, and introduced Brown Trout, and to a lesser extent Rainbow Trout, have become naturalized in some lakes and streams. Anadromous forms in Wisconsin occur in Great Lakes waters and include Coaster Brook Trout in Lake Superior and Steelhead Trout and Brown Trout in Lake Michigan and Lake Superior. Lake Trout are also native to Wisconsin but are highly specialized and restricted to deep lakes. Trout require different habitats during the various stages of their life history, which include habitat for spawning, habitat for rearing during early life stages, habitat for adults, and overwintering habitat. Connectivity among habitat types can be critical to supporting self-sustaining populations of trout in streams.

The Brook Trout, *Salvelinus fontinalis*, is a native trout species.

Brook Trout and Brown Trout spawn in autumn, typically in November, when water temperature declines and day length decreases. Spawning times may extend earlier or later in autumn, depending on stream conditions and the genetic origin of the population. Brook Trout and Brown Trout spawning in Wisconsin typically begins in early October and concludes in December, with peak spawning around mid-November (Brasch et al. 1973; DNR unpublished data).

Most trout spawning occurs in streams. Trout spawn in redds, in which eggs are buried in a gravel nest-like depression in the stream bottom. The gravel in redds allows for stream flow to provide well-oxygenated water to the protected, developing eggs. If flows are insufficient and stream sediment load is high, redds may become buried by silt leading to reproductive failure. Brook Trout are known to detect and spawn in stream areas with upwelling water, which helps keep redds well oxygenated. Upwelling areas in sandy-bottomed streams may also support successful Brook Trout reproduction. Brook Trout are also able to spawn successfully on spring-pond bottoms. Survival of trout eggs and fry in redds can be high. Survival was about

91.5% for Brook Trout in Lawrence Creek, Wisconsin in 1956-1957 (McFadden 1961) and has been noted as 80-90% in general for Wisconsin streams with good habitat conditions (Brasch et al. 1973).

Wild populations of Rainbow Trout are uncommon in Wisconsin streams. Though Rainbow Trout have been extensively stocked in streams, few self-sustaining stream-resident populations have become established. Most wild Rainbow Trout populations occur as lake-run populations using Lake Superior tributaries. Rainbow Trout populations may be limited by unfavorable stream and climatic conditions and competition from Brown Trout. Rainbow Trout evolved as spring spawners in Pacific coastal areas where climatic conditions are wet during winter and

The Rainbow Trout, *Oncorhyncus mykiss*, has been extensively stocked in lakes and streams.

dry during summer. Rainbow Trout emerge as fry later than Brook Trout and Brown Trout and are thought to be more susceptible to recruitment failure attributable to spring or summer flooding, which is characteristic of Wisconsin streams. Wisconsin streams also lack habitat attributes such as deep and fast water over rock substrate typical of native Rainbow Trout rivers.

Brook Trout may mature and spawn at an earlier age than Brown Trout. Male Brook Trout may mature as early as age 0 but typically begin spawning at ages 1–2, whereas female Brook Trout may mature as early as age 1 but typically begin spawning at ages 2–3. Brown Trout typically begin spawning at ages 3–4 (Avery 1985). Trout may spawn in successive years, and the percentage of mature trout in a given age class increases with age.

The average mature female Brook Trout may produce 300 to 400 eggs, with fecundity a function of size and varying from less than 100 eggs in a 5-inch (125-mm) female to 1,200 eggs in a 14-inch (350-mm) female (Brasch et al. 1973). In a study in Lawrence Creek, Wisconsin, Brook Trout fecundity ranged from less than 100 to about 700 eggs in trout 4–10 inches (100–250 mm) (McFadden 1961). In Driftless Area streams, Brook Trout fecundity ranged from 130 to 1,645 eggs in trout 6–15 inches (155–386 mm) (DNR, unpublished data). Brown Trout fecundity in central and northern Wisconsin streams ranged from an average of 285 eggs in 8-inch (200-mm) females to 2,714 eggs in 20-inch (500-mm) females (Avery 1985). In Driftless Area streams, Brown Trout fecundity ranged from 179 to 986 eggs in trout 8–12 inches (210–318 mm) (DNR, unpublished data). Egg production by a spawning Brown Trout is typically greater than egg production by a spawning Brook Trout because Brown

Trout mature at an older age and larger size and can live to older ages and grow to larger sizes. In both species, if fish are the same size but different ages, older fish may produce fewer but larger eggs.

The Brown Trout, *Salmo trutta*, was introduced and has since become naturalized in many streams.

Brook Trout and Brown Trout fry typically emerge from spawning redds from January through May, depending on when spawning occurred and conditions during incubation. Brown Trout spawning from October 1995 to January 1996 with peak spawning in November, for example, emerged from March to May 1996 (Avery and Niermeyer 1999). Rainbow Trout fry emerge later in spring, usually in June. Trout fry need rearing habitat with low water velocity and protective cover during their first month or two following emergence from spawning redds. During spring, trout fry can often be seen along the margins of streams.

Trout are vulnerable during spring to flood events that may wash young trout out of streams. Year-class abundance has been positively associated with flows lower than normal and negatively associated with flows higher than normal (Behnke 1992), which can result in regional trends in recruitment (Zorn and Nuhfer 2007). Flood events occurring any time following emergence through summer, depending on the magnitude of the flood event, can lead to a year-class limitation or failure in which few age-0 trout survive. However, stage-based population models also show that for Brook Trout, population growth rates are sensitive to survival from late in their first growing season (age 0 in autumn) to early in their second growing season (age 1 in spring) (Marschall and Crowder 1996; Peterson et al. 2008). Therefore, first-winter survival is also an important determinant of year-class success.

As trout grow and distribute to other areas of the stream, they begin to establish and defend territories. Defending a territory allows a fish to sequester resources such as access to food and protection from predators or strong flows. Defending a territory is advantageous to the fish when energy obtained by feeding exceeds energy expenditures in holding and defending the territory. Such habitat for adults is limiting in degraded streams, and stream habitat development projects have been used to successfully increase adult trout biomass (Hunt 1988; Avery 2004).

Stream habitat development in Wisconsin streams was predicated on the idea that in some streams adequate spawning and rearing habitat and an abundant food supply would

Weister Creek, Vernon County, Wisconsin, DNR Habitat Restoration Project 2015. Photo. Heath Benike

support more trout if more adult habitat were available. Hunt (1976) demonstrated how stream habitat development could increase Brook Trout biomass, numbers, and production in a long-term project on Lawrence Creek.

That habitat development project narrowed and deepened the stream channel, increased pool area and streambank cover for trout, and used paired bank covers and current deflectors to increase stream sinuosity. Case histories of 103 habitat development projects across the state also demonstrated how trout populations benefited from better habitat (Hunt 1988; Avery 2004). Stream habitat development today is a widely used approach to rehabilitate or restore degraded streams to improve trout fisheries. Increases in trout abundance can be significant when conditions are favorable to successful spawning. In Elk Creek (Richland and Vernon counties), Brown Trout abundance increased by 556% one year after restoration and 1,779% seven years after restoration, yielding a per-mile abundance of about 1,772 age 1 and older Brown Trout (DNR, unpublished data).

Overwintering habitat is also very important to trout. Winter is a dynamic and stressful time for fishes in streams, requiring changes in fish behavior to survive (Cunjak et al. 1998). Trout winter habitat typically includes deeper stream areas with slower water velocity and greater overhead cover, which help trout minimize energy expenditure and offers protection from predators and adverse conditions such as midwinter flood events, de-watering of stream sections, and freezing temperatures (Cunjak 1996). Groundwater input to streams is also important during winter, with Brook Trout sometimes aggregating in pools near areas of groundwater discharge (Cunjak and Power 1986). Age 1 and older trout generally occupy positions in water deeper and faster compared to age 0 trout, which may use interstitial spaces in rock substrate along stream margins (Cunjak and Power 1986; Mitro et al. 2003).

Water temperature is an important determining factor for where trout and other

aquatic organisms live in streams. Trout are ectotherms and exchange heat with and are generally the same temperature as their surrounding aquatic environment. The thermal environment in which trout live can be defined by lower and upper lethal limits, and within these bounds are optimal temperatures for feeding, growth, and reproduction.
Brook Trout, Brown Trout, and Rainbow Trout share similar thermal tolerance limits (Wehrly et al. 2007). Thermal tolerance limits can be defined by water temperatures in which trout have been observed over a defined duration of time. For example, the maximum 3-day mean temperature for a Wisconsin or Michigan stream in which Brook Trout or Brown Trout were found was 75.56ºF (Wehrly et al. 2007). Maximum 3-day mean temperature was determined by taking the highest 3-day moving average for every 3-day interval during the June-August period of record. The maximum n-day daily mean temperature decreased rapidly from 77.54°F to 72.5°F for exposure periods ranging from 1 to 14 days and declined more gradually from 71.78°F to 69.8°F for 21 to 63-day exposure periods (Wehrly et al. 2007). Trout can survive short-term spikes in water temperature, such as those associated with surface runoff during summer precipitation events, provided it does not exceed the upper incipient lethal temperature , which may vary depending on the acclimation temperature for the fish (Elliott 1994). But chronic exposure to elevated water temperatures can be limiting, with the limiting temperature decreasing as exposure time increases (Wehrly et al. 2007).

Within thermal tolerance limits for trout are a series of decreasing preferred and optimal temperature ranges for functions such as feeding and growth. Behnke (2002) notes that species of the genus Salvelinus, which are often referred to as char and include Brook Trout, can be distinguished from species of Salmo such as Brown Trout or species of Oncorhynchus such as Rainbow Trout by their adaptation to and preference for colder water within thermal tolerance limits. Char, which also include Lake Trout S. namaycush, Bull Trout S. confluentus, Arctic Char S. alpinus, and Dolly Varden S. malma, have an opti-

mal temperature range of 50–57.2°F versus 57.2–64.4°F for trout and salmon. However, among the char, Brook Trout are more tolerant of warmer water and are more comparable to Brown Trout and Rainbow Trout (Behnke 2002). Different studies have reported different thermal preferences for trout, which vary due to acclimation temperatures. Brown Trout growth occurs in the temperature range 39.2–66.2°F with maximum growth at about 55.4°C (Elliott 1994). The optimum growth temperature was reported for Brook Trout as 55.4, 57.2, and 61°F and for Brown Trout as 50, 53.6, 55, and 59.9°F, and the final preference temperature was reported for Brook Trout as 52.6, 57.2, 64.4, and 66.6°F and for Brown Trout as 54, 57.7, and 63.7°F (Jobling 1981). Conclusions on how thermal conditions affect trout include the following: (1) acclimation temperature is important in identifying thermal optima, preference, or tolerance; (2) each trout species may thrive under similar thermal conditions; and (3) factors other than temperature may be important in determining which trout species thrives best in a coldwater stream.

Trout size-at-age will vary depending on temperature, oxygen, food availability, stream or waterbody size, and trout density. In small headwater streams, Brook Trout typically grow to 5–7 inches (130–180 mm) and Brown Trout to 10–12 inches (250–300 mm). As stream size increases, trout size may increase. In larger streams, spring ponds or lakes, or in small streams in which a deep or large pool is present, Brook Trout may grow to 16 inches (400 mm) or larger and Brown Trout may grow to 18–24 inches (450–600 mm) or larger, though trout of such size are uncommon. Brook Trout typically live to age 3 and Brown Trout to age 4 in small streams and may be uncommon at older ages. Brook Trout as old as 6 years and Brown Trout as old as 9 years have been observed in Driftless Area streams (DNR, unpublished data). Older ages may be attainable in larger water bodies or in colder water bodies with reduced growth rates. Annual survival rates for trout are typically low and variable. Annual September-to-September survival rates for Brook Trout in Lawrence Creek, Wisconsin, in 1953-1956 were 0.21 (age 0-1), 0.10 (age 1-2), 0.04 (age 2-3), and 0.09 (age 3-4) (McFadden 1961). Annual survival rates for Brook Trout in six streams in southeastern Minnesota (2005-2010) ranged from 0.24 to 0.45 (Hoxmeier et al. 2015). The average apparent survival rate of adult Brook Trout in Ash Creek, Wisconsin, from 2004 to 2011 was 0.15 (DNR, unpublished data). Brown Trout typically exhibit higher survival rates than Brook Trout. Average annual survival of Brown Trout in six Pennsylvania streams ranged from 0.189 to 0.554 (McFadden and Cooper 1962). The average apparent survival rate of adult Brown Trout in Timber Coulee Creek, Wisconsin, from 2004 to 2011 was 0.39 (Wisconsin DNR, unpublished data).

Lake Trout *Salvelinus namaycush* are a highly-specialized trout found in Wisconsin only in deep lakes. Lake Trout are native to North America, and Wisconsin is at the southern

The Lake Trout, *Salvelinus namaycush*, like the Brook Trout, is the other native char roaming Wisconsin's waters.

edge of its range. They are native to two inland lakes in Wisconsin, Trout Lake (117 feet maximum depth) and Black Oak Lake (85 feet maximum depth), and they've been introduced in other deep lakes like Big Green Lake (237 feet maximum depth) and Geneva Lake (135 feet maximum depth). Lake Trout are highly-piscivorous, lake-adapted predators. They are long-lived, often up to 20-25 years in northern parts of their native range but often up to only 10 years in more temperate areas. They grow larger than other trout, typically 16-24 inches and up to 40 inches or more in length.

Like Brook Trout, Lake Trout are fall spawners. However, Lake Trout are unique among species of trout and salmon in that they do not construct redds or nests for spawning. Rather, Lake Trout spawn over rocky areas in lakes, with fertilized eggs falling to the lake bottom. Survival of Lake Trout eggs depends on the eggs falling into protected spaces among the lake-bottom rocks. The absence of rocky areas in lakes may preclude successful spawning by Lake Trout, thereby requiring stocking to support a fishery. Lake Trout fry emerge in spring, about 4-6 months after spawning.

Lake Trout prefer water temperatures of about 50°F, which is colder than temperatures preferred by other trout species in Wisconsin, and such temperatures are best maintained in deep lakes. They also require oxygen levels greater than 4 ppm. These oxygen levels are best maintained in low-productivity lakes. In high-productivity lakes, the decomposition of organic matter can deplete oxygen levels, limiting habitat for Lake Trout. Lake Trout are opportunistic feeders and can eat fish up to one-half their body length, though usually less than one-third their body length.

The Lake Trout is a popular target for ice anglers. Photo: William Helm

TROUT RESOURCES

Wisconsin hosts a wide variety of trout streams, lakes and spring ponds. From the steep, rolling hills and wooded valley spring creeks in the west to the huge, brawling freestone streams of Northern Wisconsin, our state contains a remarkable diversity of unique trout waters. Although, trout streams are found throughout Wisconsin, the highest density of trout streams are found where there is sufficient groundwater input to allow for cold water base flow throughout the summer. These areas are typically found where there is topographic relief or in areas of the north that are water rich (Figure 1).

Wisconsin is made up of 6 ecoregions (Figure 1). There are four large ecoregions in the state; Driftless Area, Southeastern Wisconsin Till Plain, North Central Hardwood Forest, and Northern Lakes and Forests. There are two smaller Corn Belt Plains ecoregions that we combined with the Driftless Area and the Southeastern Wisconsin Till Plains for discussion purposes. Ecoregions are geographical areas that are comprised of similar ecosystems. This includes trout streams. A trout stream is generally more like other trout streams found within the same ecoregion then trout streams found in different ecoregions. Therefore, ecoregions provide a reasonable framework for describing and managing trout habitat and trout populations.

Figure 1. Wisconsin consists of 6 ecoregions. Ecoregions are geographical areas that are comprised of similar ecosystems.

Trout lakes are not as easily defined by ecoregion, and therefore, are described statewide. Trout distribution directly reflects trout water distribution (Figures 2-4).

TROUT STREAMS BY ECOREGION

Driftless Area & Western Corn Belt Plains

The Driftless Area, which extends into Minnesota, Iowa, and Illinois, has not been impacted by past glaciation as much as surrounding ecoregions. It's characterized by ridges and deep valleys (coulees), is overlain by fertile soils that historically supported lush, fire-sustained prairies and savannas and deciduous forests in the absence of glacial impacts, rivers and streams have had the primary role in shaping physical features throughout the area. There are hundreds of named streams in this ecoregion, from small spring-fed coldwater creeks to several of the largest rivers in the Upper Midwest. The Mississippi River forms the western boundary of Wisconsin.

Stream channels within the deep valleys are often at or near groundwater level creating high groundwater input into the streams within this ecoregion. Water infiltrates on ridgetops and valley sides and expresses itself as groundwater in the valley bottoms. The surface discharge of groundwater is thermally stable and averages 50 degrees F yearround. These groundwater inputs through streambed upwelling, seeps, and springs are critically important for coolwater and coldwater river systems. The water is colder than air temperature in the summer and warmer than the air temperature in spring, fall and winter. This creates ideal water temperature conditions for trout by protecting trout from extreme warm water in the summer and extreme cold water in the winter. Most of these coldwater streams within this ecoregion are DNR-designated trout streams.

Many streams in the Driftless Ecoregion support high populations of trout and offer excellent fishing. Many offer the typical run, riffle, pool sequence and contain substrates for all life stages of trout. These same systems offer anglers an iconic experience of stream trout

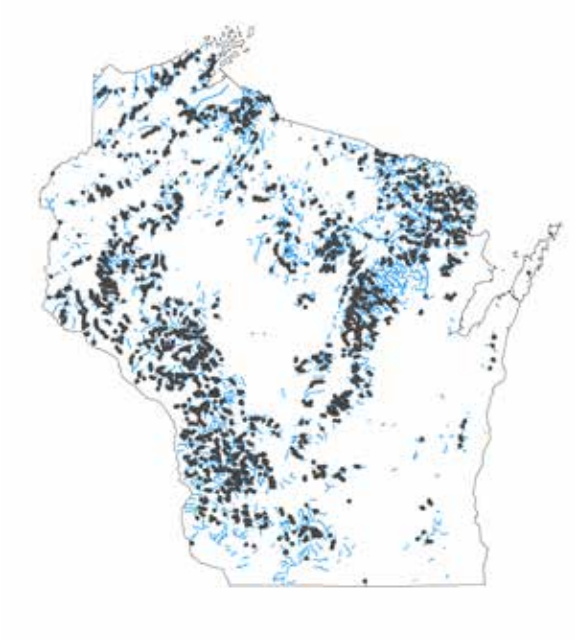


Figure 2. Trout stream surveys from 2007-2014 were exported from the Fisheries Management Database. This map displays where Brook Trout were caught during electrofishing surveys conducted mid-June through mid-July.

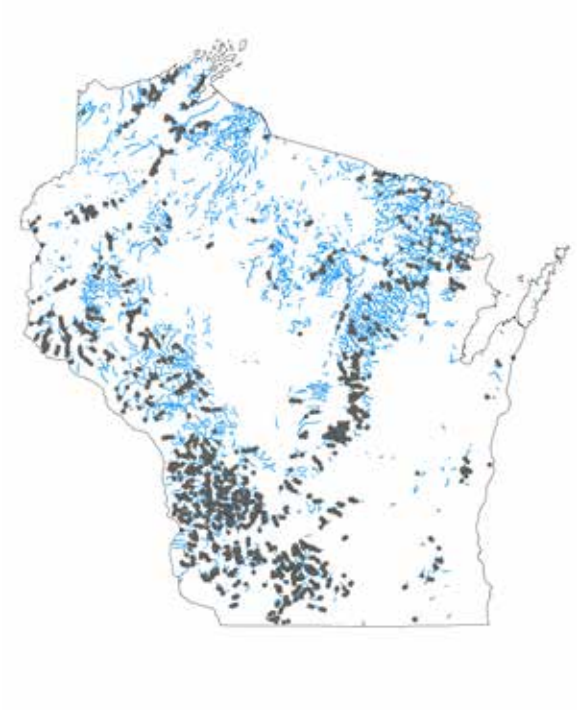


Figure 3. Trout stream surveys from 2007-2014 were exported from the Fisheries Management Database. This map displays where Brown Trout were caught during electrofishing surveys conducted mid-June through mid-July.

fishing. Most of the public fishing areas are found on state or county conservation easements and DNR owned lands, and there are numerous DNR Fisheries Areas within this ecoregion aimed at providing trout fishing opportunities and protecting trout fisheries.

Streams in the Driftless Area have undergone major changes since European settlement in the early to mid-1800s (Trimble 2009, Trimble 2013). European settlers employed practices that were not well suited to the intense rainfall events and steeper slopes of the region. Practices such as plowing up instead of along hill slopes, employing infrequent crop rotations and intensive hillside grazing fundamentally altered the hydrology of the region. In total, these practices reduced groundwater infiltration and increased surface runoff, increasing the frequency of flood events and decreasing groundwater levels. This led to unprecedented erosion in the upland portions of the watershed and deposition in mainstem valleys. The transfer of sediment from upstream reaches to main valleys peaked in the early 1900s, depositing up to 15 feet of sediment in some valleys and causing

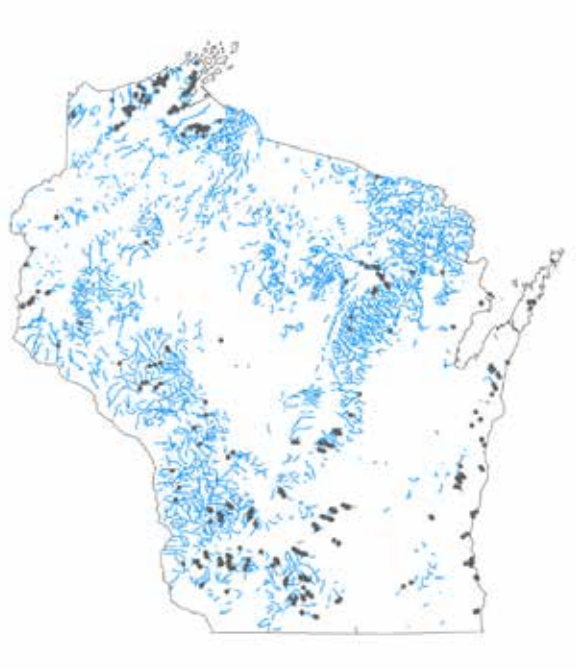


Figure 4. Trout stream surveys from 2007-2014 were exported from the Fisheries Management Database. This map displays where Rainbow Trout were caught during electrofishing surveys conducted mid-June through mid-July.

the relocation of multiple towns in the region. These massive changes to stream habitat and hydrology resulted in the extirpation of most naturally reproducing Brook Trout populations in the region by the early 1900s.

In 1935, the Natural Resources Conservation Service (NRCS, Soil Conservation Service at the time) established the nation's first watershed project in the Coon Creek Watershed (Vernon County). Conservationists worked with local farmers to employ agricultural practices that reduced surface runoff and erosion (e.g. contour stripping, terracing, gully stabilization). These practices were highly successful, resulting not only in improved stream conditions but also increased productivity for farmers who signed up for the program. By the late 1960s, these practices had spread throughout the Driftless area. These practices increased groundwater discharge to streams and decreased the frequency of floods, paving the way for in-stream habitat restoration efforts by the DNR that began in the 1950s and continue today.

Currently, the Driftless Area supports one of the largest concentrations of trout streams in the state. Nearly all these streams are supported by naturally reproducing trout populations and many support trout densities that exceed 1,000 fish per mile. As a result, the area has received nation-wide attention for its quality trout fishing. In 2016, the local economic impact of the trout fishery in the Driftless region (including portions of northeast Iowa and southeast Minnesota) was estimated at $1.6 billion (Trout Unlimited 2016).

Despite the recovery of trout populations in the region, legacy impacts from historic land use practices, changes in farming practices and current and predicted increases in flooding continue to threaten trout stream habitat. For example, the recent decline in conservation reserve program land and removal of conservation practices on some farms could reduce groundwater infiltration and negatively impact stream habitat conditions (Hart 2008, Marshall et al. 2008). Current and predicted increases (WICCI 2011) in severe flooding also pose a significant threat to trout streams in the region. For example, recent flooding in August of 2018 in Vernon, La Crosse and Monroe Counties caused major changes to some streams, in some cases widening and shallowing of previously high-quality adult trout habitat. The impacts of this single flood to DNR stream habitat projects was estimated $1.4 million in damages.

Southeastern Till Plains and Central Corn Belt Plains

There are few coldwater streams scattered throughout the Southeastern Till Plains Ecoregion and overall the density of coldwater streams is low in this ecoregion. Typically, the trout streams in the Southeastern Till Plains are low to moderate gradient and many are wetland dominated. Characteristics of these streams vary, depending on the proximity to the glacial margins. Native, in-stream rock is in low abundance in lower stream reaches. Stream flow is typically mild and winding through relatively flat topography resulting in lower average velocities in comparison to

high gradient, Driftless Area streams. Along the western boundary of the Southeastern Till Plains, streams can have run, riffle, pool sequences. The presence of cobble in the Till Plains, especially close to the glaciated margins, can be quite good. This, in turn, leads to quality recruitment in trout streams with spawning substrate. Away from these cobbled areas, a typical run-riffle-pool sequence can be hard to find. Wetland complexes found in lower reaches play an important role and when combined with the plant communities found along trout streams, they function as filtration buffers that help to improve water quality. Therefore, despite high levels of urban and agricultural land use surrounding these systems, trout populations can be good to excellent where the habitat is still intact.

Just west of Kenosha and extending to the east of Lake Winnebago through the Door Peninsula northeast of Green Bay is the relatively high ridge of the Niagara Escarpment. Springs are located along the Niagara Escarpment that offer excellent water quality. These springs seep from the Silurian Dolomite rock formation found in the headwater locations. The trout streams emanating from these springs tend to be short and become seasonal or non-existent further downstream due to agricultural land practices.

North Central Hardwoods

The North Central Hardwoods Ecoregion is situated throughout Central Wisconsin and extends from the Wisconsin-Minnesota Stateline east to the Bay of Green Bay. Coldwater stream density in this ecoregion is variable. In general, the coldwater streams of this ecoregion are low to moderate gradient and often wetland dominated. There are several areas that have concentrations of coldwater streams within this ecoregion.

The North Central Hardwoods Ecoregion has the distinction of containing a vast lowland plateau that separates the major river drainages of our state. Low gradient streams characterize the middle to southwest portion of the North Central Hardwoods. These streams occupy the landscape once covered by Glacial Lake Wisconsin. The streams contain mostly sand substrate and have historically impacted by drainage ditches. However, many of the current drainage ditches were past streams and many still contain self-sustaining populations of Brook Trout. Several have also been improved with habitat projects. All of these streams drain to the Wisconsin River and are part of the Mississippi River drainage.

In the southeast part of the North Central Hardwoods, streams flow towards Lake Winnebago or even towards Green Bay (the Fox River), and eventually end up in Lake Michigan. This small area is also known as the Central Sand Hills. This area contains a large concentration of more than a hundred coldwater streams that originate in the Johnstown Moraine which starts east of Wausau and extends southward beyond the boundaries of the North Central Hardwoods Ecoregion. Streams are characterized by low to moderate gradient with peat and sand dominated sub-

strates. Towards the headwaters of the Johnstown Moraine, excellent gravel abounds, providing outstanding spawning habitat.

Although public land is not as abundant in the North Central Hardwoods Ecoregion as it is in the Northern Lakes and Forest Ecoregion, there is generally good public access to trout streams in this ecoregion. This is largely due to a dedicated effort by DNR to acquire land around trout streams in the DNR Fishery Areas. Thousands of acres have been purchased with particular focus on the southeaster portion of this ecoregions. However, some trout stream-rich areas within this ecoregion still have limited public access (e.g., Shawano County). There is an effort underway to purchase fishing easements within this locality to improve access to trout streams for anglers.

In the northeast section of the North Central Hardwoods ecoregion extending into the Northern Lakes and Forest Ecoregion there is an area of high concentration of "spring ponds" or spring-fed lakes, ranging in size from a few hundred square feet to 25 acres. These spring ponds provide enough cold water to support trout year round. Many of these spring ponds have become degraded over time due mostly to natural processes. DNR has purchased the land around many of these spring pond to protect these fragile coldwater resources and many of these ponds have been restored through dredging..

On the western side of the state the north central hardwoods ecoregion is located in a transitional zone between the Driftless Area to the south and the Northern Lakes and Forest to the north. This ecoregion harbors a diverse mixture of trout streams in a mixed landscape consisting of blufflands, woodlands, wetlands and agriculture. Many high quality brook trout streams are present especially within the Red Cedar River Drainage as well as streams west of the Chippewa River. Brown trout are generally low in abundance or even absent in many of these waters. East of the Chippewa River to the Wisconsin River very few trout streams are present. This area has streams that have low base flow and limited spring flow and are primarily managed as warmwater streams.

Trout fishing is very popular in this region with the Twin Cities to the west and the Chippewa Valley and I-94 corridor running through the heart of this region. Public access is present on most of the higher quality trout streams and provide anglers with a diversity of opportunity. Most recently additional efforts have been made to purchase angling easements on high quality brook trout streams in the region and many longstanding partnerships have been developed with local angling groups in an effort to conduct stream habitat restoration projects on local waters.

Northern Lakes and Forest

Running across much of northern Wisconsin is the Northern Lakes and Forest Ecoregion. This ecoregion encompasses what many residents refer to as the "Northwoods." Many

of the state's major rivers, such as the Flambeau, Chippewa, Namekagon, Peshtigo, Brule and the Menominee rivers, originate in this ecoregion. This water-rich ecoregion contains many cold-water streams with the highest density being found in the northeast of the ecoregion. There is also a high concentration of spring ponds in the southeast of this ecoregion (described in North Central Hardwoods Ecoregion) and smaller concentrations found throughout the ecoregion. Streams in this ecoregion are diverse and range from low gradient wetland dominated systems to mid-gradient run-riffle-pool, freestone streams. This variability is often expressed within a single stream as it crosses various geological features found in the ecoregion. Stream corridors tend to be heavily wooded with northern white-cedar, black ash, black spruce and tamarack. There are numerous small tributaries and headwater streams that make up the still functioning endemic drainage systems here, many flow through un-forested acidic peatlands (bogs, fens, and muskegs).

Streams in this ecoregion are still recovering from historical destructive logging practices that damaged the stream channels with siltation, erosion and channel manipulation. Historical dams, roads, and railroad grades have impacted the stream channels as well as limited fish movement throughout interconnected systems. Beaver management plays a key role in maintaining many coldwater streams in this ecoregion and in some locations is the primary means of maintaining trout fisheries. In many cases stream corridors are dominated by early successional species such as tag alder which makes fishing extremely difficult, making fishability brushing (cutting or removing some streambank brush) an important part of providing trout fisheries in the north.

Public fishing access is generally abundant in this ecoregion and can be found on Federal (USFS), County Lands and DNR-owned properties such as the many Fisheries Areas. Excellent trout fishing access is available at state parks as well. There are also numerous tributaries to Lake Superior, accessible through State land within the South Shore Lake Superior Fishery Area, that contain stream resident trout year-round.

TROUT LAKES AND SPRING PONDS IN WISCONSIN

Wisconsin has three types of lake systems which are managed, at least in part, for inland trout fisheries: spring ponds, "two-story" lakes, including Lake Trout lakes, and lakes converted from warmwater fisheries to trout-only fisheries.

Spring ponds are natural coldwater lakes and home to native Brook Trout (*Salvelinus fontinalis*) and sometimes naturalized populations of Brown Trout (*Salmo trutta*), and in a few instances, Rainbow Trout (*Oncorhynchus mykiss*). Spring ponds are small (0.1 to 25 surface acres), shallow (< 25 feet max depth), and highly productive systems (> 150 ppm alkalinity) with permanently flowing outlet creeks that are typically Class1 trout streams. Spring ponds are mostly associated with and located in the headwaters of Class 1 trout streams. The largest concentration of spring ponds in the state is found in and around Langlade County with dozens also found in Forest, Oconto, Menominee, and

The largest concentration of spring ponds in the state is found in and around Langlade County with dozens also found in Forest, Oconto, Menominee, and Shawano counties.

Shawano counties. Statewide there are about 1,000 spring ponds, a quarter to a third of which are in Langlade County. A majority of spring ponds support natural reproduction, but degraded spring ponds may benefit from stocking or habitat improvement.

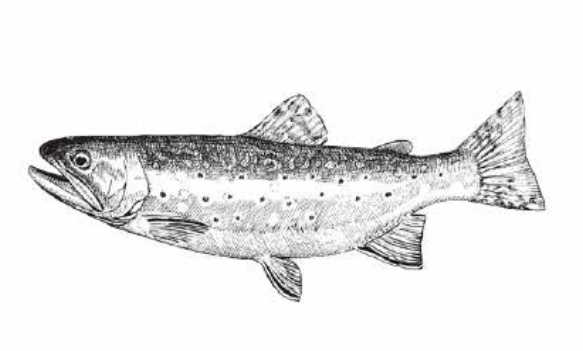
Two-story lakes are lakes managed for both trout and warm water species. These lakes have a cold, well-oxygenated lower layer of water that can support trout year-around and trout can carry over from one year to the next. The upper layer of water in these lakes gets too warm for trout in summer but can support typical warmwater and coolwater lake fisheries (Walleye, Northern Pike, Muskellunge, bass, and panfish). Approximately 60 lakes statewide are being managed as two-story lakes.

Lake Trout are only native to two inland lakes in Wisconsin. Trout Lake and Black Oak Lake, both in Vilas County, each contain a distinct native strain of Lake Trout in their deep, cold, oligotrophic waters. Native Lake Trout are rare in Wisconsin due to our location at the extreme southern end of their native range and the limited number of suitable lakes present. Five inland lakes in north-central Wisconsin are stocked with either the Trout Lake strain or Black Oak Lake strain of Lake Trout primarily to help preserve these unique and native genetic strains and also also provide recreational fisheries for Lake Trout: Long (Black Oak Lake strain), White Sand (Trout Lake strain), and Little Trout (Trout Lake strain) lakes in Vilas County, Big Carr Lake (Black Oak strain) in Oneida County, and Lucerne Lake in Forest County (Black Oak strain). Four additional lakes are managed as recreational Lake Trout fisheries: Geneva Lake in Walworth County, Big Green Lake in Green Lake County, Keyes Lake in Florence County, and Goto Lake in Langlade County. The remainder of two-story lakes in Wisconsin are stocked with Brown Trout, Rainbow Trout, or Brook Trout to offer a coldwater fishery component and to take advantage of the cold and oxygen rich lower layer of water. These two-story fisheries are usually managed as put-grow-and-take fisheries with seasonal restrictions and moderate minimum length and daily bag limits. Trout do not naturally reproduce in these lakes and

the coldwater fishery component is entirely dependent on stocking.

Lake trout are stocked in Goto Lake in Langlade County.

The last type of lake system managed for trout in Wisconsin is warmwater lakes that have been converted to coldwater (trout-only) fisheries management. This is usually done through fish toxicants like rotenone and/or antimycin to completely kill the existing fish community present in the lake so that trout management can be optimized (through reduced predation on trout and more food and living space available for trout). Many of these were originally converted to trout management in the 1960's and '70's and over the years warmwater species have recolonized these lakes to varying degrees. Small glacial kettle lakes in forested regions are prone to winterkill and some of these are also managed as trout-only fisheries. Brook Trout, Brown Trout and Rainbow Trout are usually stocked at harvestable sizes (large fingerlings or yearlings) in these lakes. There were over 200 lakes statewide that were stocked with trout between 2007 and 2014. Trout-only fisheries are usually managed as put-and-take fisheries with low minimum length limits and generous daily bag limits. Stream trout species do not naturally reproduce in these lakes and the fishery is entirely dependent on stocking.



THREATS AND CHALLENGES

Wisconsin's inland trout fisheries exist in a dynamic landscape and climate, with an ever-changing user base and a growing human population that exacerbates multiple stressors on ecological systems. Recognizing these factors, we present concerns raised by stakeholders and staff that may threaten wild trout populations, stream ecosystems, angler participation in trout fishing, and support for a robust fisheries management program. The severity and relevance of these threats and challenges differ among the ecoregions of the state. The differences are touched on briefly in this section and in the goals, strategies, and actions of this plan.

LAND USE, WATER QUALITY AND WATER

Changes in land use have affected and will continue to affect the persistence of coldwater streams and their ability to support trout. Wisconsin's streams, spring ponds, and lakes that support trout are influenced by land forms and glacial geology; natural landcover including forests, grasslands, wetlands, and open water; and land use including agriculture, forestry, and urbanization. The karst topography of soluble limestone and dolomite in the Driftless Area, for example, provides an abundance of coldwater springs feeding productive coldwater streams that support trout. The forested northern region of Wisconsin also provides for cold water in streams. Trout in these streams often rely on connectivity among streams to escape harsh winter conditions and find suitable overwinter habitat in deeper, slower waters and to find cold water refugia during the summer. A look back at the history of land use and conservation in Wisconsin shows how fragile our coldwater resources are and how concerted efforts to improve how we live on the land can also protect, restore, or rehabilitate trout fisheries.

The landcover and land use we see in Wisconsin today have changed markedly over past centuries. The northern forests were logged over and have been replaced by second generation or later re-growth, often with changes in tree species. Timber harvest has left behind a network of impervious road surfaces and has increased siltation in streams. An increase in aspen and other food species preferred by beaver have, at times, led to increases in beaver populations (DNR 2015a), and excessive

beaver colonization of low gradient streams have increased sedimentation and limited trout populations (Avery 2002). The DNR Beaver Management Plan calls for management of aspen and other food species to encourage beavers where beaver activity may be compatible with other resources and to discourage beaver where beaver activity may not be compatible, such as along classified trout streams (DNR 2015a).

More than a third of the state's land is currently used for agriculture (WICCI 2011). Poor agricultural practices in the past have led to significant degradation of trout habitat, with sediment being a major pollutant of our waters (Waters 1995). In the Driftless Area, for example, upland and hillside erosion formed thick deposits in valleys, resulting in the loss of trout habitat in streams. By the mid-20th century, wild trout populations were largely extirpated from Driftless Area streams, which became dependent on stocking to provide fisheries for trout (Klingbiel 1975). The US EPA's National Rivers and Streams Assessment (NRSA) estimates 46% of rivers and streams as being in poor biological condition based on benthic macroinvertebrate surveys (USEPA 2016). Poor biological conditions for coldwater stream macroinvertebrate communities can negatively affect trout condition and abundance. The NRSA identified excess levels of streambed sediment as a problem in 15% of rivers and stream miles nationally. Other leading problems associated with agriculture include high levels of phosphorus and nitrogen in over 40% of stream miles, loss of riparian vegetation in 24% of stream miles, and high levels of riparian disturbance attributable to farming and urbanization in 20% of stream miles (USEPA 2016).

Figure 5. Locations of active high capacity wells in Wisconsin as of January 14, 2019.

Conservation practices and management programs, however, have helped rehabilitate and restore trout habitat in many areas. Soil conservation efforts were first pioneered in Coon Valley, Wisconsin. Changes in agricultural practices have led to stream habitat recovery and the restoration of world-class wild trout fisheries in the Driftless Area and other regions of Wisconsin. Implementation

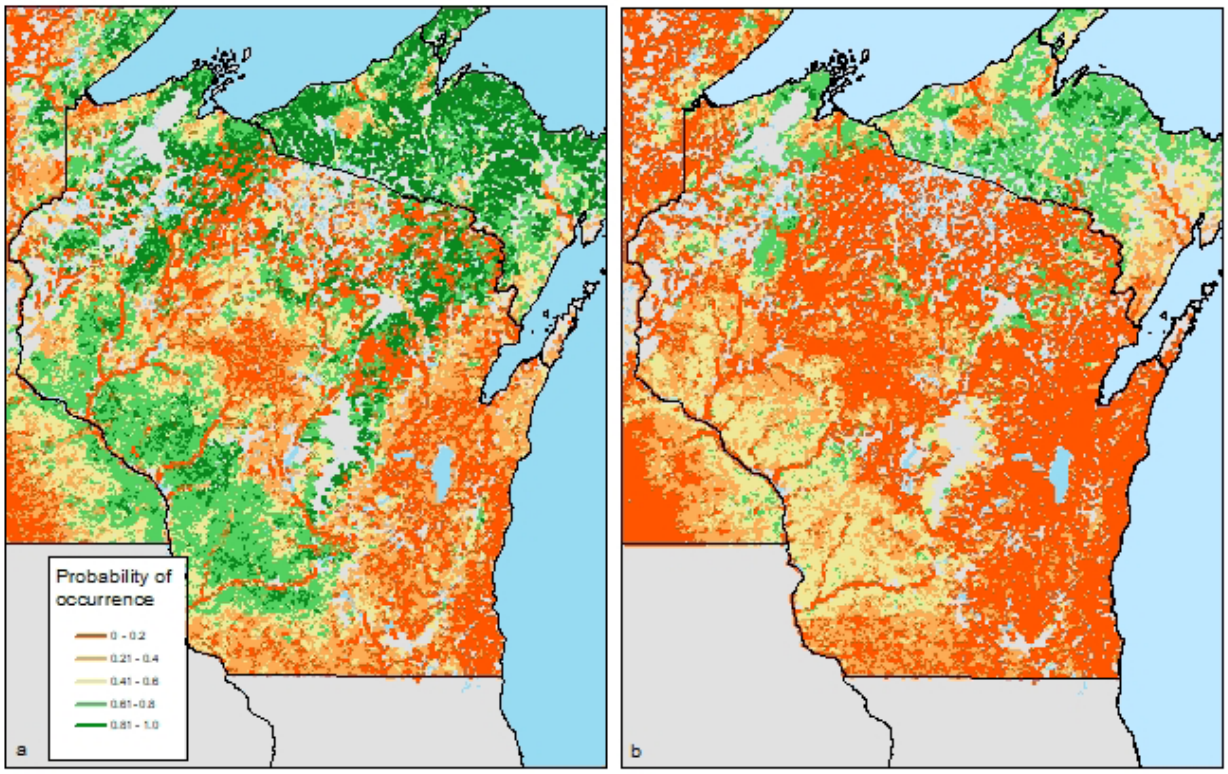


Figure 6: Current (a; late-20th century) and future (b; mid-21st century) probability of occurrence for Brook Trout. Colors indicate probability of occurrence categories: red (0–0.2), orange (0.21–0.4), yellow (0.41–0.6), light green (0.61–0.8), and dark green (0.81–1).

of the Conservation Reserve Program, a federal program that supports planting cool- or warm-season grasses on highly erodible cropland and along stream corridors, has protected environmentally-sensitive agricultural land and benefited coldwater habitat and fish communities (Marshall et al. 2008). Innovative approaches to farming, such as the inclusion of prairie strips, can also help reduce erosion and nutrient loss from farm land (Schulte et al. 2017). This demonstrates that changes in how we use land can benefit streams and trout fisheries. Current efforts to engage agricultural landowners in conservation include the formation of local watershed councils to share and demonstrate effective approaches to farming that benefit the farmer, streams, and fish. Examples of such efforts include the National Fish Habitat Partnership (*http://www.fishhabitat.org/*), the Fishers & Farmers Partnership for the Upper Mississippi River Basin (*https://fishersandfarmers.org/*), and a Wisconsin Department of Agriculture, Trade, and Consumer Protection

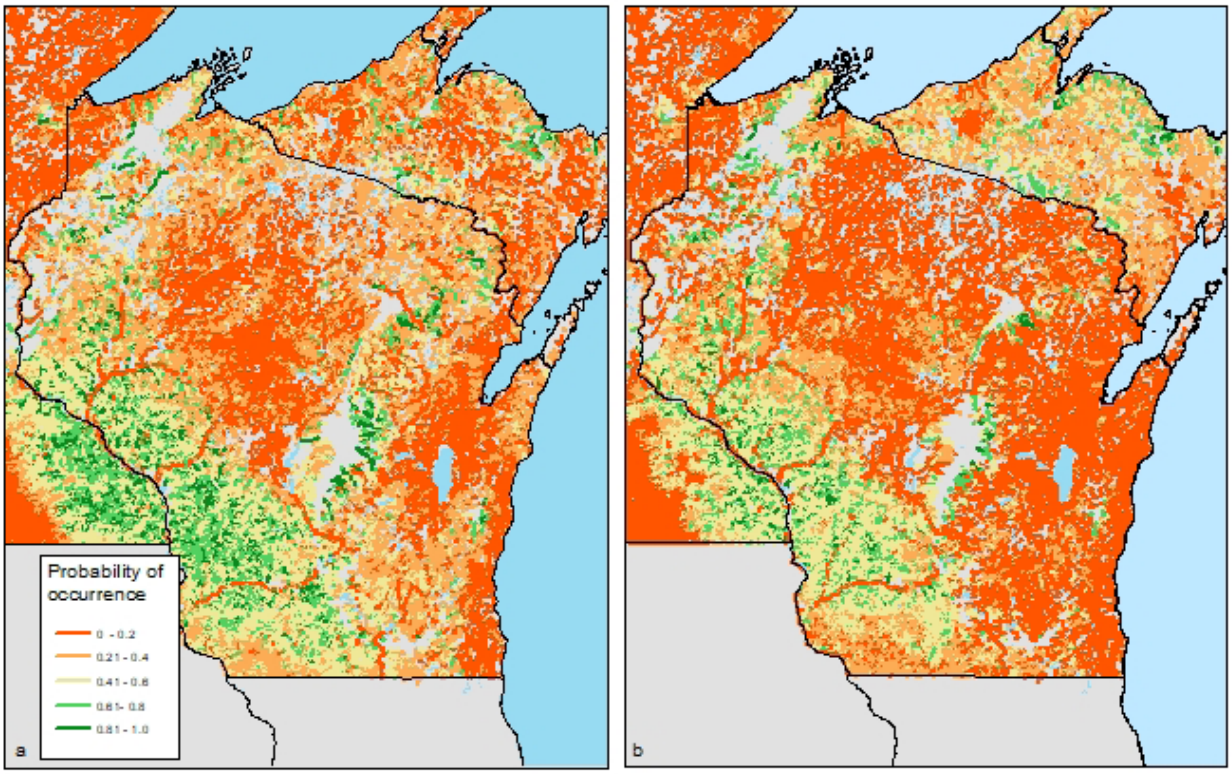


Figure 7: Current (a; late-20th century) and future (b; mid-21st century) probability of occurrence for Brown Trout. Colors indicate probability of occurrence categories: red (0–0.2), orange (0.21–0.4), yellow (0.41–0.6), light green (0.61–0.8), and dark green (0.81–1).

program funding producer-led watershed protection grants to prevent and reduce runoff from farm fields *(https://datcp.wi.gov/Pages/Programs_Services/ProducerLedProjects.aspx)*.

Additional threats to trout streams from agricultural land use include manure runoff to streams and loss of baseflow attributable to high capacity wells. Wisconsin has seen an increase in Concentrated Animal Feeding Operations (CAFOs), which are defined as animal feeding operations with 1,000 or more animal units. A DNR water quality protection permit program requires CAFOs to have a Wisconsin Pollutant Discharge Elimination System permit to operate. Although CAFOs must abide by a "zero" discharge standard for runoff to navigable waters, the storage of manure poses a threat to trout streams should an accidental discharge occur. Manure may also contaminate streams when precipitation events follow manure applications to farm fields or when manure contaminates groundwater that feeds streams.

A 2016 statewide survey of agricultural chemicals in groundwater estimated that 41.7% of Wisconsin wells contained a pesticide or pesticide metabolite, up from 33.5% in 2007 (WDATCP 2017). In general, there were more frequent detections of pesticides and nitrate-nitrogen in more intensely farmed areas. Nitrates can be toxic to trout (Camargo et al. 2005) and increases in nitrate-nitrogen in groundwater may increase trout exposure to nitrates. A 2013 survey of 100 small streams across 11 midwestern states, including 6 streams in Wisconsin, detected 94 pesticides and 89 pesticide byproducts, with a median of 54 per stream site (Nowell et al. 2018). Direct toxic effects on fish were deemed unlikely in most streams, but for invertebrates, potential chronic toxicity was predicted to occur in 53% of streams and acute toxicity in 12% of streams, and for aquatic plants, 75% of streams were predicted to have acute but reversible effects on biomass with potential long-term effects in 9% of streams (Nowell et al. 2018). Stream macroinvertebrates are an important food source for trout, so any impacts to macroinvertebrates can in turn impact trout.

High capacity wells are wells that have the capacity to withdraw more than 100,000 gallons per day, either from a single well or from a group of wells on the same property or adjacent properties under the same ownership. High capacity wells can affect the quantity of groundwater feeding trout streams. Groundwater pumped from a well may be diverted from a stream or other waterbody it would otherwise feed. As agricultural land use increases in Wisconsin, the use of groundwater for irrigation will increase. This is of particular concern in the North Central Hardwood Forest (Figure 5).

Sand mining in Wisconsin also poses a threat to trout streams. Sand mining has occurred in Wisconsin for more than a century, but recent demand for sand by the petroleum industry for use in hydraulic fracturing has led to a rise in permit requests to mine industrial sand. Permitting for mines may include permits related to stormwater and high capacity wells. As such, mines can have direct and indirect effects on streams and other water bodies and the aquatic organisms that live in them. Although substantially restricted in Wisconsin, sand mining from within stream channels and from the banks can directly impact fisheries by the removal of material from the stream channel or lakebed. That action can cause increased siltation, erosion, loss of spawning and nursery habitat, loss of macroinvertebrates, and mortality of aquatic organisms (Kanehl and Lyons 1992). Groundwater use, groundwater contamination, stormwater runoff, and the dewatering process from sand mining may indirectly affect streams and other waterbodies (DNR 2012, Kanehl and Lyons 1992, Waters 1995). The northern Driftless Area and western portion of the North Central Hardwood Forest are ecoregions most affected by sand mines.

Another land use threat to trout fisheries is urbanization. Trout are considered sensitive

to extensive urban development (Lyons et al. 2010). Urban development results in an increase in connected impervious surfaces in a watershed. Impervious surfaces such as roads and buildings increase storm water runoff to streams and reduce groundwater recharge from infiltration of precipitation. For watersheds with connected impervious surfaces in the threshold range of 8–12% for macroinvertebrates (Stepenuck et al. 2002) and 6–11% for fish (Wang et al. 2003), minor changes in urbanization can lead to major changes in coldwater macroinvertebrate and fish communities.

CLIMATE CHANGE

Climate change is considered a major threat to the persistence of salmonids in streams around the world. Warming atmospheric temperatures will affect water temperatures, and changes in precipitation may lead to drought or flooding, leading to changes in groundwater recharge and groundwater effects on stream temperature. In Wisconsin, the climate has become warmer and wetter since the 1950s, with annual average nighttime low temperatures increasing 33.08–35.96°F, annual average daytime high temperatures increasing 32.54–33.08°F, and average annual precipitation increasing 50–100 mm (Kucharik et al. 2010; WICCI 2011). Heavy precipitation events, defined as rainfall events of 2 inches or greater within a 24-hour period, have increased in frequency in Wisconsin and across the continental United States and are projected to increase in frequency under multiple climate change scenarios (Kucharik et al. 2010; WICCI 2011; Janssen et al. 2014). In 2018, multiple localities in Wisconsin experienced rainfall events exceeding 10 inches in a 24-hour period (NWS, NOAA 2018), leading to widespread flooding and damage to stream banks, road crossings, and nearby properties.

Brook Trout and Brown Trout need cold water to survive and water temperature is a critical factor in determining where they can live. Trout are ectotherms meaning their bodies exchange heat with and are generally the same temperature as their surrounding environment. Temperature affects biochemical and physiological processes in trout, and trout have adapted to cold temperature regimes in which they can function efficiently. Trout have a thermal niche with lower and upper lethal limits, and within this range are optimal temperatures for body functions such as feeding and growth and life history events such as reproduction. High temperatures may directly lead to trout mortality, but other changes in the aquatic environment, ecological community, and individual behaviors related to temperature warming may also lead to trout loss prior to temperatures elevating beyond thermal tolerance limits.

Identification of fish populations in streams vulnerable to changing climatic conditions has become critical for aiding resource management agencies in the development and implementation of climate-change adap-

Downstream of Sutherland Bridge, June 2018 flood. Photo: Bill Heart

tation strategies (Mitro et al. 2011; WICCI 2011; Mitro et al. In review). In Wisconsin, web-based stream temperature and fish distribution models in FishVis were used to predict current (late-20th century) and project future (mid-21st century) distributions of Brook Trout and Brown Trout (Stewart et al. 2016; Mitro et al. In review). The models predict the suitability of habitat for trout in individual reaches using environmental variables in a geographic information system. Environmental variables modeled include adjacent and upstream channel characteristics, surficial geology, landcover, and climate. Future projections of air temperature and precipitation were obtained from 13 general circulation models downscaled for Wisconsin.

Currently 21,283 miles of streams are suitable for Brook Trout and 12, 434 miles for Brown Trout. Models project a decline in stream habitat of 68% (6,832 miles) for Brook Trout (Figure 6) and a decline of 32% (8,493 miles) for Brown Trout (Figure 7). These projected declines, while substantial, were smaller than earlier projections from first-generation models (Mitro et al. 2011). The updated models explicitly link precipitation to groundwater and stream temperature and account for projected increases in precipitation that may enhance groundwater inputs to streams and partially offset higher air temperatures.

Climatic changes are expected to increase the frequency and magnitude of heavy precipitation events, which can have a negative impact on instream habitat projects, culverts, and nearby roads and crossings. Instream structures can become washed away, buried, stranded, or otherwise altered such that they no longer perform their intended function as trout habitat. Following destructive flooding events, stream habitat funds and work crews are diverted from new stream habitat projects to focus on repairing and maintaining old projects.

Stream flooding may have both negative and positive effects on trout populations, depending on the timing and magnitude of flooding. Heavy precipitation events that occur when newly-emerged trout fry are most vulnerable

may lead to lower recruitment or year-class failure when few young-of-year trout survive (Zorn and Nuhfer 2007). Flood events can also increase streambank erosion and sediment input to streams, and flood events can reduce available trout habitat by destroying habitat development projects. Flooding may be more destructive to stream banks and in-stream habitat structures in high-gradient streams. A positive effect of flooding is the clearing of sediment from streams, leading to an increase in exposed gravel suitable for trout spawning, which may lead to higher recruitment in future year classes.

Adaptation strategies that can potentially offset negative effects of climate warming can be implemented across scales from the landscape to the stream. At the landscape level, strategies may include improved agricultural land-use practices to limit surface water runoff, erosion, and nutrient loss attributable to precipitation events and to increase groundwater recharge. Such practices include no-till farming, contour plowing, rotational grazing, use of cover crops during winter, use of prairie strips, and establishment of riparian buffers (Lyons et al. 2000; Blann et al. 2002; De Baets et al. 2011; Schulte et al. 2017). Enrollment of the most environmentally-sensitive lands into protective conservation programs and limiting impervious surfaces may also help increase groundwater recharge to maintain cold stream temperatures (Wang et al. 2003; Marshall et al. 2008). Managing riparian vegetation to provide shading may also help maintain cold thermal conditions suitable for trout (Cross et al. 2013). Instream strategies may include sloping erosive streambanks to open streams to their floodplain and to reduce sediment loading, narrowing and deepening stream channels to maintain cold stream temperatures, and installing physical habitat to promote self-sustaining trout populations (Hunt 1976). Used in combination, landscape conservation practices and triaging instream habitat restoration efforts can potentially buffer vulnerable streams to some of the effects of climate warming.

Figure 8. VHS infected and suspected waters.

INVASIVE SPECIES

Invasive species, as defined in Wis. Stat. 23.22(c), are nonindigenous species whose introduction causes or is likely to cause environmental or economic harm or harm to human health. Here we are concerned with any nonindigenous animal, plant, fungi, or pathogen that may directly or indirectly cause harm to trout or trout fisheries. Invasive species often succeed when introduced to a new environment because their natural competitors or predators that may keep their populations in check are not present. Changes in environmental conditions, such as degradation to stream habitat, may also increase the likelihood that introduced species successfully invade and proliferate to the detriment of native species.

Per NR 40, all non-native fish, including Brown Trout and Rainbow Trout, are considered invasive species. However, many fish species that we consider invasive were intentionally introduced and their fisheries may be regulated. Common Carp, *Cyprinus carpio,* and Brown Trout, for example, are not native to North America but have established naturalized populations and displaced native fishes. Common Carp were imported into Wisconsin in 1879 and Brown Trout were imported in 1887. Both species provide fisheries in Wisconsin, but whereas Common Carp are often subject to suppression or eradication efforts, Brown Trout are considered a sport fish and are currently propagated and stocked in some Wisconsin waters. That said, DNR stocking guidance has been updated to protect native Brook Trout fisheries by precluding Brown Trout stocking in designated watersheds.

Where Brown Trout and Brook Trout coexist in Wisconsin streams, Brown Trout typically displace Brook Trout. Following the 19th century introduction of nonnative 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 are not naturally adapted to co-occur. Plots of adult Brown Trout versus Brook Trout catch per effort in Wisconsin streams where the two species coexist show that these species rarely occur at or near equal abundances in sympatry. Rather, streams tend to be dominated by one species over the other. There are several potential reasons why this happens. Competition between Brown Trout and Brook Trout may lead to differences in reproductive success and survival, favoring one species over another. Degradation to stream habitat conditions may favor one species over another (e.g., Brown Trout tolerate warmer water temperatures than Brook Trout), and parasites and pathogens that affect Brook Trout in their native environment may not affect Brown Trout. Gill parasite *Salmincola edwardsii* infects native Brook Trout in Wisconsin, for example, but Brown Trout are not susceptible to the parasite, and gill parasites such as Ergasilus spp. that infect Brown Trout in their native range are not present in Wisconsin.

Not all non-native trout introductions in Wisconsin have been successful in terms of establishing self-sustaining populations and fisheries. Rainbow Trout have frequently been stocked in Wisconsin streams but rarely establish self-sustaining populations. Whereas Brook Trout and Brown Trout spawn during autumn, Rainbow Trout spawn during spring. Brook Trout and Brown Trout emerge from spawning redds earlier in spring than Rainbow Trout and can grow before Rainbow Trout fry emerge, conferring on them a size advantage and thus a competitive advantage, during their first year of life. Spring flooding in Wisconsin also appears to be more detrimental to later-emerging Rainbow Trout fry. Rainbow Trout, which are native to Pacific drainages in western North America, prefer deep and fast currents in streams with rocky substrate. Such streams and rivers are uncommon in Wisconsin.

Trout are susceptible to viral hemorrhagic septicemia virus (VHSV). The variant VHSV type IVb was first detected in Wisconsin in May 2007 and is considered an invasive species (Mitro and White 2008). Salmonid exposure to VHSV in Wisconsin has been limited to Great Lakes waters and has not occurred in inland streams (Figure 8). In a laboratory study on the comparative susceptibility of representative Great Lakes fishes to VSHV-IVb, salmonids including Brook, Brown, and Rainbow Trout were found to be less susceptible to the pathogen than cool water species such as Largemouth Bass *Micropterus salmoides* and Yellow Perch *Perca flavescens* (Kim and Faisal 2010). However, infected trout exhibited mortality rates as high as 80% (Kim and Faisal 2010). Common signs of viral hemorrhagic septicemia include hemorrhaging internally or externally at the base of fins, eyes, gills, or skin, anemia or pale gills, darkening of skin, distended abdomen, exophthalmia or pop-eye, lethargy, and abnormal swimming. In salmonids, the most common lesions include hemorrhages in the swimbladder and degenerative changes in the liver (Kim and Faisal 2010).

The New Zealand mud snail *Potamopyrgus antipodarum* is a recent aquatic invader of some Wisconsin trout streams including Black Earth Creek. New Zealand mud snails are small (< 6 mm) and have a spiral shell with an operculum covering the shell's opening. All New Zealand mud snails in North America are clonal females and reproduce asexually. They can reach densities of hundreds of thousands per square meter in coldwater streams, which may crowd out other benthic organisms consumed by trout. New Zealand mud snails are likely spread among streams by movement of angling equipment such as felt-soled waters.

Didymo *Didymosphenia geminata*, also commonly known as rock snot, is a diatom or photosynthesizing algae that may anchor to and form a dense mass covering submerged substrates in streams or other water bodies. Didymo is not present in Wisconsin but is regulated as an invasive species that could pose a threat. When established, didymo can alter the ecology of streams by affecting nutrient cycling and invertebrate diversity. Did-

ymo is thought to be easily spread by anglers using felt-soled wading boots.

Some plant invaders of stream riparian areas may impede anglers from using stream resources. Wild parsnip, *Pastinaca sativa*, for example, is an herbaceous biennial native to Europe but now widespread in Wisconsin. The sap of wild parsnip is toxic and irritating in the presence of sunlight, causing blistering following contact with human skin. Anglers may be limited from fishing streams surrounded by wild parsnip during summer.

The Wisconsin Chapter NR 40 invasive species list identifies prohibited and restricted species of algae and cyanobacteria, fungus, plants, aquatic and terrestrial invertebrates, fish, and other aquatic and terrestrial vertebrates. Non-native trout species are also on the list. Not all species on the list are threats to trout, and a species omission from the list does not preclude future inclusion on the list.

ANGLER PARTICIPATION

License sales provide a critical source of funding for managing fisheries and wildlife in Wisconsin. They provide a direct source of funding to the DNR, and for those anglers who choose to fish for inland trout, the trout stamp provides funding for stream habitat management. Fishing license sales are also an indirect indicator of federal aid for fisheries programs derived from excise taxes on the sale of fishing equipment. The Dingell-Johnson Sport Fish Restoration Act apportions funding to states based in part on state fishing license sales. Therefore, trends in fishing license sales or participation rates in the sport of angling are critical to the maintenance of state fisheries management programs.

Fishing license sales appear stable nationally at about 33 million anglers over the age of 16. In Wisconsin, fishing license sales have increased slightly in recent years, with Wisconsin fishing license sales of about 1.4 million in 2017 and per capita fishing participation at twice the national average (Holsman 2016). Forecasts suggest the overall number of anglers in the United States will increase through 2060 in conjunction with an increase in population, but per capita participation rates are expected to decline.

Although annual participation in angling appears stable, a recent survey indicates that there is a dynamic "churning" of individuals in and out of angling from year to year (American Sportfishing Association 2015). About the same number of anglers leave as join in a given year. Highlights of this study include: (1) only 4% of licensed anglers purchased a license each of the past 10 years, (2) 46% of licensed anglers do not renew their license in a given year, (3) about 52% of anglers who purchased a license in a given year also purchased a license the previous year, (4) the number of female anglers has grown in recent years but their churn rate is about 13% higher than the rate for male anglers, (5) annual churn rates are lowest among the 55-64 age group (about 39%) and highest among the 18-24 age group (about 55%), and (6) the

churn rate for urban resident anglers is about 13% higher than rural resident anglers and 7% higher than suburban resident anglers (American Sportfishing Association 2015). Such variation from year to year in angler participation suggests both an opportunity to increase angler participation and the potential to lose participants depending on what drives participation and to what extent management agencies can influence participation.

Another participation issue is that in any given year, many people who purchase a fishing license and trout stamp do not fish for trout that year. In a 2011 survey of resident Wisconsin anglers who purchased an inland trout stamp, about 32% of respondents did not do any trout fishing (Petchenik 2014). For those who purchased a license and stamp and did not fish, a lack of time was the most cited reason for not fishing (62%).

In 2017, the DNR fisheries program contracted with Southwick Associates, a market research, statistics, and economics firm specializing in the hunting, shooting, sportfishing, and outdoor recreation markets, on a data mining project that would provide insights into angler behavior and license purchasing trends. Results from the project will be used to develop demographic-based marketing strategies.

Ten years of license sales records (2006 to 2015) were analyzed. This includes an analysis of the Inland Trout Stamp purchase trends (analysis on purchased stamps only; does not include the estimated portion from the conservation patron license). Residents ranged from 111,700 to 124,000 over the 10-year period with an average of 117,670. Nonresidents ranged from 19,800 to 22,300 over the 10-year period with an average of 20,910. Overall, residents are up 9.7%, nonresidents are up 14.6% and new anglers are up 7.6% over that 10-year period. An infographic of a portion of the results from the analysis are displayed in Figure 9.

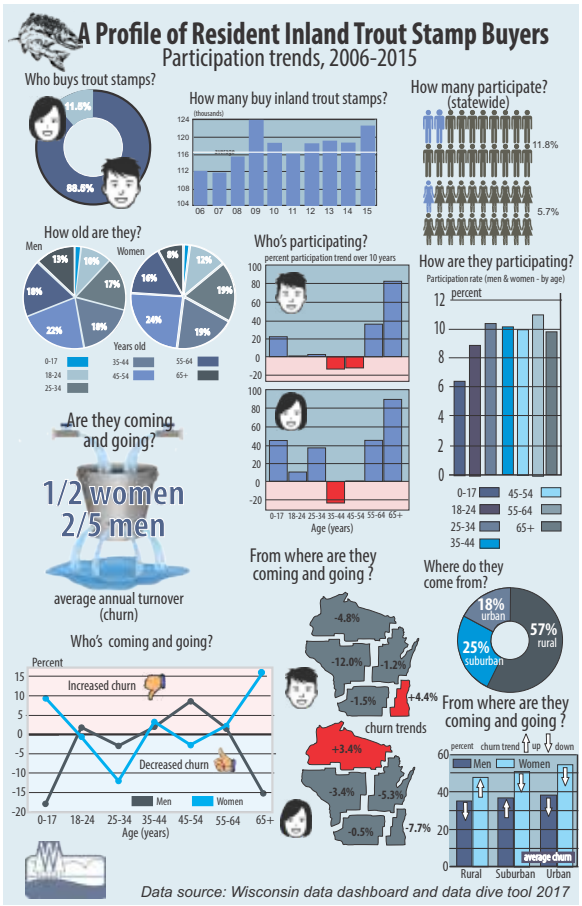


Figure 9. Infographic created from a summary of Wisconsin resident inland trout stamp purchases from 2006-2015.

MANAGEMENT PLAN GOALS

Goal 1. Protect, enhance, and restore sustainable cold-water aquatic habitats and ecosystems.

Quality trout populations and cold-water ecosystems depend on quality habitat. Many cold-water habitats have been impacted and degraded through a variety of historical and contemporary actions including:

- Past logging practices
- Historical log drives down streams
- Wildfires
- Land use changes within watersheds
- Agricultural practices
- Loss of native vegetation in riparian corridors
- Erosion
- Nutrification
- Siltation
- Dams and mill ponds
- Beaver dams
- Poorly designed and installed culvert and bridge crossings
- Groundwater withdrawals
- Aging of springs and spring ponds
- Climate change

However, cold-water habitats have also been protected and improved through Federal, State and local regulations, land protection, habitat restoration and enhancement projects and other conservation efforts.

Weister Creek, Vernon County, Wisconsin, DNR Habitat Restoration Project 2016. Photo. Heath Benike

Habitat work is a priority and core strategy within this goal, yet the costs of habitat work have increased over time. Attaining the goal will require additional assistance through increased partnerships and collaboration, and/or increased fees or additional funding sources. However, increasing the amount of hab-

itat work accomplished is not likely because of increasing costs over time. It is more likely that less habitat work will be accomplished in the future.

Objectives and strategies have been identified to better assess and understand cold-water habitat needs, and specific methods and plans are listed to protect, restore, and enhance cold-water habitats and ecosystems. Water quality protection and other water quality/watershed protection & improvement management activities are critical for trout. In this plan there are numerous mentions of collaborating with other programs on water quality and quantity issues. However, many factors impacting these aspects of trout habitat are governed by other DNR programs and by state and Federal laws which are not part of this trout management plan.

Objective 1.1. Identify, maintain, improve, and restore the natural potential of aquatic ecosystems through targeted, effective use of habitat management principles.

CORE STRATEGY

Strategy 1.1.A. Evaluate and develop guidance on the current habitat

Large wood installation projects to enhance trout habitat are common on many wood-limited streams and often involve partner organizations, as shown here with the Brule River Sportsmen's Club in Douglas County.

program to include structure, staff roles, use of contractors, staff workload, trout stamp allocations, site selection, grant process and appropriate use of coldwater habitat funds.

Action 1.1.A.1. Develop an internal trout habitat management team that is charged with developing and prioritizing coldwater habitat management projects for Wisconsin.

Action 1.1.A.2. Identify and designate habitat management units in need of instream/riparian habitat rehabilitation, including connectivity, or designate areas for protection of instream/riparian habitat.

Action 1.1.A.3. Develop an inventory of potential habitat restoration and maintenance projects.

Action 1.1.A.4. Prioritize trout habitat sites based on ecological landscapes or other appropriate management unit that achieves management objectives.

Action 1.1.A.5. Prioritize future habitat work in areas that will be more resilient to climate change and/or other future threats or variables.

Action 1.1.A.6. Develop measurable objectives for habitat work in the future (e.g. 25 miles of maintenance and 10 miles of new projects per year).

Action 1.1.A.7. Document DNR habitat practices and guidelines.

Rowan Creek 2011. Photo: Joanna Griffin

CORE STRATEGY

Strategy 1.1.B. Plan, conduct, and complete habitat enhancement, restoration or maintenance projects.

A beaver dam. Photo APHIS WS

Action 1.1.B.1. Continue to conduct stream and river habitat projects (e.g. enhancement, restoration or maintenance work).

Action 1.1.B.2. Continue spring pond dredging restoration projects.

Action 1.1.B.3. Continue to replace, repair, and remove road-stream crossings that are impacting habitat and stream connectivity

Action 1.1.B.4. Develop a database for existing and future stream habitat enhancement, restoration and maintenance projects.

CORE STRATEGY

Strategy 1.1.C. Continue to manage beavers that impact trout streams.

Action 1.1.C.1. Continue to implement beaver management consistent with the Wisconsin Beaver Management Plan 2015-2025 and any successors to this plan.

Action 1.1.C.2. Continue to maintain beaver dam free waters with a contract through APHIS WS.

Action 1.1.C.3. Evaluate effectiveness of beaver removal program and prioritize streams targeted to make efficient use of available funding.

To the Extent Feasible

Strategy 1.1.D. Use existing knowledge, develop new techniques, apply ecosystem principles for enhancing and restoring trout habitat, considering all life stages of trout and the broader ecosystem.

Action 1.1.D.1. Integrate with other DNR programs (e.g. non-game, forestry and wildlife) on habitat project design and implementation.

Beneficial culvert placement.

Action 1.1.ED2. Focus on native planting in conjunction with habitat restoration.

Action 1.1.D.3. Incorporate non-game habitat into restoration projects.

Action 1.1.D.4. Consider watershed approach to developing objectives for habitat projects.

Action 1.1.ED5. Consider existing and develop new techniques for enhancing or restoring trout spawning, nursery, juvenile and adult habitat in lakes and streams.

To the Extent Feasible

Strategy 1.1.E. Evaluate and improve stream connectivity at road crossings, dams and other structures.

Action 1.1.E1. Prioritize culverts in need of replacement or repair.

Action 1.1.E.2. Apply for grants to remove and maintain culverts.

Action 1.1.E.3. Collaborate with partners to identify and replace culverts.

Action 1.1.E.4. Participate and provide input into potential dam removal and fish passage projects.

To the Extent Feasible

Strategy 1.1.F. Collaborate with partners to achieve habitat management goals and objectives

Action 1.1.F.1. Work with partners to develop technical materials and update

websites for streambank habitat enhancements.

Action 1.1.F.2. Prioritize habitat restoration and maintenance projects with local partner groups.

Managed grazing in Northeastern Wisconsin 2014. Photo: Joanna Griffin

Action 1.1.F.3. Pursue grants and other funding sources to conduct additional projects or to enhance projects.

Objective 1.2. Develop a long-term acquisition, management, and maintenance strategy for Fisheries owned or managed properties (i.e. master planning).

CORE STRATEGY

Strategy 1.2.A. Establish and implement plans for our properties to provide for resource protection and recreation.

Action 1.2.A.1. Develop criteria for active and passive management of publicly owned lands along trout streams and their associated riparian areas.

Action 1.2.A.2. Pursue partnerships on our fisheries lands where appropriate to achieve our management objectives.

To the Extent Feasible

Strategy 1.2.B. Continue to purchase easements and acquire properties.

Action 1.2.B.1. Identify, review, prioritize and acquire stream bank protection easements and fee title purchases to protect or enhance quality habitat, healthy systems, and access.

Objective 1.3. Collaborate with other DNR programs and partners to protect habitat and water quality.

CORE STRATEGY

Strategy 1.3.A Provide input on environmental and permitting processes.

Actions 1.3.A.1. Continue to work with Drinking Water and Groundwater to review high capacity well approvals.

Action 1.3.A.2. Continue to work with the DNR water regulation and permitting programs to review and provide input as needed on permits related to trout streams.

Action 1.3.A.3. Advise local governments and other stakeholder when developing management plans or reviewing projects that may affect trout streams.

Action 1.3.A.4. Collaborate with wildlife, parks, forestry, natural heritage conservation, and other DNR programs as well as local governments as needed to best manage and protect trout streams and their associated riparian and upland habitats.

Action 1.3.A.5. Participate in planning processes at the state, county and local level to address coldwater resources concerns.

Action 1.3.A.6. Provide technical input into water quality and watershed plans.

New Zealand mud snails

To the Extent Feasible

Strategy 1.3.B. Provide support on watershed and water quality issues and projects.

Action 1.3.B.1. Work with partners on nonpoint source nutrient reduction land management, best management practices programs and projects.

To the Extent Feasible

Strategy 1.3.C. Protect trout waters and lands from invasive species.

Action 1.3.C.1. Collaborate on angler outreach, support tools for invasive species protection, and use consistent messaging.

Action 1.3.C.2. Work with DNR programs to control and monitor aquatic invasive species.

Goal 2. Protect, develop, enhance, and restore trout populations and trout angling opportunities for the diverse preferences and needs of our participants.

Wild trout populations are vulnerable to a variety of human-caused stressors. These include habitat degradation, overharvest, loss of genetic diversity, and competition with other introduced fish species. The DNR has improved and maintained wild trout populations and angling opportunities through a variety of management actions throughout recent history.

Continued and additional actions are listed below to better understand and improve wild trout populations and angling opportunities within Wisconsin. Angler opportunities go beyond the fish populations and also relates to improving physical angler access to trout waters and providing diverse angling opportunities (ie. – put/take fisheries, harvest opportunities, action waters, trophy waters). Goal 2 seeks to balance concerns with wild trout population conservation and provide varied trout angling opportunities throughout the state of Wisconsin.

Objective 2.1. Protect, enhance and restore native and wild trout populations.

CORE STRATEGY

Strategy 2.1.A. Continue and improve upon the wild trout broodstock program.

Action 2.1.A.1. Continue DNR's wild trout broodstock program.

Action 2.1.A.2. Identify multiple genetic sources for broodstock.

CORE STRATEGY

Strategy 2.1.B. Develop plan to restore and protect native Brook Trout and Lake Trout.

Action 2.1.B.1. Identify genetic sources of trout populations in Wisconsin waters, determine potential genetic stock boundaries and maintain genetic diversity.

Action 2.1.B.2. Identify and develop Brook Trout reserves for protection and management.

Action 2.1.B.3. Develop and Implement management actions to protect native trout populations (e.g. actions that favor Brook Trout over Brown Trout where appropriate and habitat techniques that favor Brook Trout over Brown Trout when they coexist).

Action 2.1.B.4. Review stocking guidance to eliminate conflict with native trout populations management goals.

Action 2.1.B.5. Identify waterbodies with natural reproduction of native trout and implement management strategies to maintain and protect them.

Fishing on the Mecan River . Photo: Joanna Griffin

To the Extent Feasible

Strategy 2.1.C. Continue to develop and implement a process for DNR to move fish from one water to another.

Action 2.1.C.1. Continue to collaborate with other agencies to allow for a process to transfer fish to improve or reestablish native or wild trout populations, with fish health and genetics considerations.

Objective 2.2. Provide increased opportunities for anglers and remove barriers to resource access.

CORE STRATEGY

Strategy 2.2.A. Continue to Implement the Streambank easement program (see page 69).

Action 2.2.A.1. Continue to acquire fishing and habitat easements.

Action 2.2.A.2. Continue to work with partners to convert short term easements into perpetual easements.

CORE STRATEGY

Strategy 2.2.B. Continue to maintain and develop resources and websites displaying regulations and access.

Action 2.2.B.1. Continue to maintain and develop a dynamic web viewer and mapper with regulations, habitat projects, stocking, access and survey data.

Action 2.2.B.2. Continue to update regulation pamphlets each year.

Action 2.2.B.3. Continue to mark and sign fisheries areas, easements and access.

Trout fishing regulation sign - 2016 in Iowa County. Photo: Joanna Griffin

Action 2.2.B.4. Work with partners to advertise, post and map non-DNR fishing easements.

To the Extent Feasible

Strategy 2.2.C. Strive to acquire and manage property based on intended angler uses.

Action 2.2.C.1. Prioritize acquisitions intended to provide angler access and habitat protection.

Action 2.2.C.2. Maintain angler access on priority state properties (e.g. mowing, brushing, and herbicide application) and consider and identify angling opportunities and accessibility when setting property objectives throughout Wisconsin.

Action 2.2.C.3. Control invasive plants on DNR properties/public lands near trout streams.

A male Brook Trout comes to the net.

To the Extent Feasible

Strategy 2.2.D. Improve and develop good shorefishing or angler access opportunities on DNR-owned and other public properties;

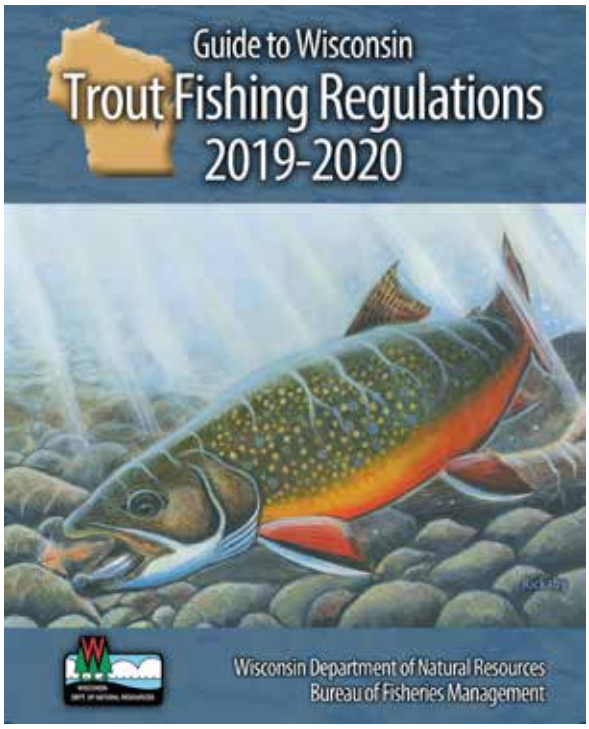
Action 2.2.D.1. Utilize pier grant program and other resources to provide public fishing areas near fishery areas with trout streams and lakes.

Action 2.2.D.2. Prioritize habitat project locations to meet angling demographics, changing populations, and in urban areas to meet angler demands.

Objective 2.3 Manage and provide for diverse recreational fishing opportunities, including trophy, action,put-grow-take, angler access and changing demands.

CORE STRATEGY

Strategy 2.3.A. Review, maintain and develop trout fishing regulations.



Trout Fishing Regulation Pamphlet

Action 2.3.A.1. Review all trout fishing regulations at least once every 10 years to adapt to changing fisheries and angler interests (e.g. next review will end in 2026).

Action 2.3.A.2. Continue to work towards regulation consistency by type of stream, species managed or area of the state.

Action 2.3.A.3. Explore ways to provide more opportunities (e.g. increased season length).

Action 2.3.A.4. Continue to determine and modify regulations based on biology and management goal of the water, watershed or management unit.

Action 2.3.A.5. Continue to modify trout fishing regulations on individual waters as needed.

CORE STRATEGY

Strategy 2.3.B. Optimize the use of hatchery trout.

Action 2.3.B.1. Review, analyze and evaluate current trout stocking to determine the most effective way to meet current and future demands.

Action 2.3.B.2. Review and update trout stocking guidance at least two times during the term of this plan (i.e., every 5 years).

Action 2.3.B.3. Maintain healthy trout in hatcheries (infrastructure, staffing, disease testing, etc.).

Action 2.3.B.4. Improve communication between hatchery staff, central office management, research, and fisheries biologists so needs and limitations are understood in all directions.

Action 2.3.B.5. Discuss options for stocking sterile Rainbow or Brown Trout strains to allow for angling opportunities while still protecting native Brook Trout.

Action 2.3.B.6. Stock fish at the correct size, time, location and rate to obtain the best performance in meeting watershed or waterbody specific management objectives (e.g. stream classification and angler use and preference).

Green Lake Coop Rearing Facility raises around 30,000 Lake Trout each year to stock into Green Lake

Action 2.3.B.7. Evaluate the use of trout and consider non-trout species in the urban fishing waters.

Action 2.3.B.8. Continue to utilize broodstock and catchable size trout for put-and-take fisheries where appropriate.

Action 2.3.B.9. Continue to work with our partners to collaborate on stocking efforts.

To the Extent Feasible

Strategy 2.3.C. Understand and incorporate angler preferences.

Action 2.3.C.1 Continue to include trout questions in the angler diary/creel mail survey.

Action 2.3.C.2. Conduct a follow-up mail survey on trout fishing and trout streams 5-10 years after regulations change or coordinate with the next regulation review.

Action 2.3.C.3. Continue to work with lake associations and angler groups to gather input on their preferences.

To the Extent Feasible

Strategy 2.3.D. Continue to provide trout fishing opportunities on inland lakes.

Action 2.3.D.1. Develop stocking guidance for Lake Trout with genetics consideration.

Action 2.3.D.2. Evaluate lakes with potential for establishing Lake Trout (using Inland strains) and meet criteria for introduction.

Action 2.3.D.3. Continue to manage two-story fisheries throughout the state.

Trout sampling on Lawrence Creek in April 2018. Photo Joanna Griffin

Goal 3. Collect, develop and use the best science to guide trout management decisions.

Fisheries management is an established science. To provide the public with trout management that is effective and justifiable, fisheries managers should base decisions on sound scientific research. Fisheries managers and researchers should also strive to use the best available scientific methods when collecting and analyzing fishery data and pursue research that advances our ability to effectively manage trout fisheries in the state.

Recognizing that the science of fisheries management is dynamic and constantly improving, a quality trout fisheries management

program requires opportunities for staff to stay up to date on advances in the field of trout fisheries management. The cost of certain surveys and management activities (e.g. creel, habitat enhancement) is high. The DNR needs to continue to evaluate and improve upon its activities to be effective and efficient to balance workload and cost to obtain the most appropriate data within means.

Objective 3.1. Evaluate management actions by monitoring trout fisheries.

Fisheries staff collecting a fin clip for genetic analysis of the Brook Trout population in Pompey Pillar, Iowa County, WI

CORE STRATEGY

Strategy 3.1.A. Regularly monitor and assess trout populations in Wisconsin waterbodies using accepted protocols to determine population trends and the effects of management actions.

Action 3.1.A.1. Continue to monitor trout streams, spring ponds, and lakes on a rotational or annual basis.

Action 3.1.A.2. Continue to store all survey data in the DNR statewide Fisheries Management Database.

Action 3.1.A.3. Analyze trends in annual and rotational stream, spring pond, and lake data.

Action 3.1.A.4. Provide data summaries and comparative tools for biologists (using any classification system developed for trout waters).

Action 3.1.A.5. Regularly evaluate survey program to make sure data collected are sufficient to answer management questions and modify protocols if needed.

Action 3.1.A.6. Disseminate results of surveys in DNR Fisheries report series, professional and public presentations or

through other formal reporting or publication.

Action 3.1.A.7. Use data collected by other DNR programs and partners to expand our knowledge base.

To the Extent Feasible

Strategy 3.1.B. Evaluate specific fisheries management actions on streams, spring ponds, and lakes and disseminate results.

A large brown Trout from a Pierce County Trout Stream. Photo Heath Benike.

Action 3.1.B.1. Evaluate habitat projects and techniques.

Action 3.1.B.2. Evaluate stocking.

Action 3.1.B.3. Evaluate regulations.

Action 3.1.B.4. Develop and implement a trout sampling protocol for two-story lakes.

Additional resources required

Strategy 3.1.C. Regularly collect angler data to determine whether management objectives are being met.

Action. 3.1.C.1. Conduct creel surveys on high-priority streams and lakes.

Action 3.1.C.2. Explore angler self-reporting (e.g. log books programs, angler diaries) and drone surveys.

Action 3.1.C.3. Collaborate with DNR social scientists to develop and implement angler questionnaires that allow the evaluation of angler preferences, demographics, and attitudes toward regulations and management programs.

Action 3.1.C.4. Disseminate results of creel surveys in professional presentations, DNR Fisheries Management report series or through other formal reporting or publications.

Objective 3.2. Conduct research to evaluate fisheries management actions, threats to trout fisheries, and opportunities to improve trout fisheries.

CORE STRATEGY

Strategy 3.2.A. Continue to collaborate with DNR Office of Applied Science and DNR social scientists on research to evaluate fisheries management actions, threats to trout fisheries, and opportunities to improve trout fisheries.

Action 3.2.A.1. Collaborate with Office of Applied Science staff to prioritize research topics addressing the evaluation of management actions, management units and species movement, threats to cold-water resources (e.g. climate change, groundwater withdrawals, interactions between native and non-native species), and opportunities to improve trout fisheries.

Action 3.2.A.2. Assist in the development and prioritization of trout related research projects.

Action 3.2.A.3. Assist in the collection and analysis of data.

Action 3.2.A.4. Collaborate with Office of Applied Science staff to develop management recommendations from research findings.

Taking a temperature reading at Cold Spring in Sawyer County. Photo: Dave Carlson

CORE STRATEGY

Strategy 3.2.B. Continue to collaborate with partners outside of the DNR, such as researchers from the University of Wisconsin System and research-based conservation organizations, to conduct research addressing fisheries management actions.

Action 3.2.B.1 Communicate regularly with research partners.

Action 3.2.B.2 Collaborate with research partners when appropriate (e.g. Brook Trout genetic analyses).

Objective 3.3. Develop and maintain an up-to-date trout stream, spring pond, and lake classification list to facilitate adaptive management and policy decisions.

CORE STRATEGY

Strategy 3.3.A. Maintain and improve upon the comprehensive trout stream classification list (NR 1.02) for use in making informed management decisions.

Action 3.3.A.1. Develop an appropriate management unit (e.g. watershed, stream reach) for managing trout populations.

Action 3.3.A.2. Continue to classify and reclassify trout streams, giving highest priority to streams not currently classified and to the reclassification of streams with improved habitat and fisheries.

Spring pond

Action 3.3.A.3. Provide updates to the public every other year on changes to trout stream classification status.

Action 3.3.A.4. Maintain and update the GIS database and mapping tool storing documentation and information associated with stream classification.

Action 3.3.A.5. Continue to coordinate classification with the DNR Water Resources program.

Action 3.3.A.6. Maintain and update the trout stream classification guidance in the Fisheries Management Handbook.

- Improve guidance on trout class evaluations on streams where stocking occurs but may support natural reproduction.

- Consider modifying the monitoring protocols and management units/classification extents (e.g. watershed level).

- Consider modifying the classification list to include Class II with natural reproduction and Class II without natural reproduction and develop a sub-classification scheme that is species specific.

- Consider a Class I nursery stream that has high abundance of young-of-year trout but may not support multiple year classes or a fishable population of trout.

Action 3.3.A.7. Consider modifying existing NR 1.02 to clarify the definitions of trout stream classifications.

To the Extent Feasible

Strategy 3.3.B. Develop a new or use an existing lake classification system to help inform trout fisheries management and policy decisions.

Action 3.3.B.1. Evaluate the current lake classification system.

Action 3.3.B.2. Identify criteria for establishing and managing a two-story lake.

Action 3.3.B.3. Increase research on Lake Trout lakes (e.g. natural reproduction, stocking, habitat).

To the Extent Feasible

Strategy 3.2.C. Develop a new stream management classification

system to help inform trout fisheries management and policy decisions.

Action 3.3.C.1. Incorporate NR 1.02

Action 3.3.C.2. Evaluate the stream classification system.

Action 3.3.C.3. Determine the appropriate management unit to account for fish movement and use of stream habitat.

Action 3.3.C.4. Determine how to use the classification system in making management decisions.

Objective 3.4. Recruit, hire, develop, retain, and support a world-class fisheries staff and program (management, habitat, and fish culture).

CORE STRATEGY

Strategy 3.4.A. Provide training, education, professional development, and necessary certification opportunities to fisheries staff involved in trout management.

Action 3.4.A.1. Provide training and necessary certification opportunities for permanent and limited term (LTE) staff.

Action 3.4.A.2. Provide opportunities for staff to attend both local and national professional fisheries conferences.

Action 3.4.A.3. Provide staff access to the most recent fisheries literature .

Action 3.4.A.4. Encourage staff to present and/or publish fisheries management evaluations and research results.

To the Extent Feasible

Strategy 3.4.B. Provide adequate resources to habitat crews and fish managers.

Action 3.4.B.1. Determine the best equipment for our work needs (e.g. changing practices may require different equipment).

Action 3.4.B.2. Continue to provide equipment to the appropriate staff (acknowledging regional differences).

Objective 3.5. Monitor and assess trout health.

An infestation of gill lice on the gills of a Brook Trout.

CORE STRATEGY

Strategy 3.5.A. Continue to comply with health certification requirements for trout stocked by state hatcheries and by private aquaculture to prevent introduction of fish pathogens into aquatic systems.

CORE STRATEGY

Strategy 3.5.B. Respond to fish kills in a timely fashion and collaborate with other programs to investigate origin and cause of event.

To the Extent Feasible

Strategy 3.5.C. Develop monitoring and response plans for assessing disease presence and parasite burden to determine threat potential containment strategies.

Additional Resources Required

Strategy 3.5.D. Provide training for field staff in identification of fish diseases and parasites.

Goal 4. Maintain and expand partnerships and engage diverse anglers, stakeholders and the general public on trout management and angling opportunities.

Stakeholder engagement is crucial to effectively manage our trout fisheries throughout the state of Wisconsin. The DNR needs actively engaged stakeholders to help guide decisions as well as directly participate in management actions. Maintaining and expanding partnerships will help the DNR accomplish more and develop better management projects and strategies. Knowledge of the fisheries that our state contains, as well as the productivity of the fisheries, drive anglers and non-anglers to participate in our program. Therefore, goal 4 focuses on outreach and education to inform anglers and non-anglers alike on what the trout program has to offer. This helps the DNR keep the public informed and engaged on new and emerging issues, research priorities, and management goals.

The DNR strives to engage stakeholders and the general public in our decision making through the Wisconsin Conservation Congress and a variety of traditional and emerging stakeholder engagement techniques. More emphasis on recruiting anglers is reflected in the trout program's collaboration with the DNR Recruitment, Retention and Reactivation Program (R3). However, the R3 program is a program unto itself and includes much more than trout angling and is guided by separate (but related) goals and strategies. Therefore, R3 is not a focus of this Trout Management Plan.

January 2018 Trout Management Plan Stakeholder meeting

Objective 4.1. Engage existing trout anglers, recruit new trout anglers, and prepare for future generations by collaborating with diverse supporters through education, outreach, and promotion.

CORE STRATEGY

Strategy 4.1.A. Engage Wisconsin Conservation Congress on trout management issues.

Action 4.1.A.1. Continue to have DNR trout team representation on the Wisconsin Conservation Congress Trout committee.

Action 4.1.A.2. Continue to have Wisconsin Conservation Congress representation on Fisheries management teams.

CORE STRATEGY

Strategy 4.1.B. Engage the public on trout management issues.

Action 4.1.B.1. Utilize information and guidance from stakeholders in the decision-making process.

Action 4.1.B.2. Notify the public on high-profile trout management issues through press releases or other techniques.

Action 4.1.B.3. Collect feedback from the public and stakeholders on high profile trout management issues using online surveys and mobile technology.

To the Extent Feasible

Strategy 4.1.C. Collaborate with the DNR Recruitment, Retention, and Reactivation (R3) program and other partners to engage anglers and build more interest in trout fishing and trout resources.

Angler landing a trout on a Driftless stream in Vernon County. Photo: Kirk Olson.

Action 4.1.C.1. Assist the R3 program in engaging with trout-oriented stakeholders to build more interest in trout fishing and trout resources.

Action 4.1.C.2. Engage and promote trout fishing to anglers and non-anglers from all backgrounds and of all age groups.

Action 4.1.C.3. Identify partners and promote partnerships that provide access to trout streams and resources.,

Objective 4.2. Promote public awareness, understanding, and involvement with the trout program and use resources to strengthen, maintain, and develop partnerships.

CORE STRATEGY

Strategy 4.2.A. Educate anglers, legislators, fishing associations, tribal partners, the Conservation Congress, the general public and others on the use of license sales to support the fisheries program and report out on expenditures and project accomplishments.

Action 4.2.A.1. Provide funding reports to demonstrate where funding comes from and how it's utilized (e.g. Trout Stamp, License Fees).

CORE STRATEGY

Strategy 4.2.B. Improve communication of value-based and science-based research, decisions and methodology by engaging stakeholders in developing research priorities and proposals.

Action 4.2.B.1. Engage stakeholders in planning for future threats to trout fisheries in Wisconsin.

Action 4.2.B.2. Publish Office of Applied Science research papers and reports to the DNR website to make the connection between research and management.

Action 4.2.B.3. Publish fisheries management reports to the online platform for public viewing.

To the Extent Feasible

Strategy 4.2.C. Keep the general public and stakeholders informed on important emerging issues and

trout management policies using new and traditional communication tools.

Action 4.2.C.1. Clarify policies with partners.

Action 4.2.C.2. Clearly communicate best management practices to partners.

Action 4.2.C.3. Provide education/outreach on trout related topics including:

- Inland Lake Trout resources
- Invasive species: how they can be prevented and controlled, and safety issues related to them
- Safe handling techniques and proper fish release
- The Responsible Release Team is working on policies and recommendations due early 2019

Additional Resources Required

Strategy 4.2.D. Develop outreach plans, materials and specific reports.

Action 4.2.D.1. Publish annual statewide accomplishment highlights and status report on trout streams and management actions through social media that include:

- Information on where anglers can fish for trout, including diverse angling opportunities.
- Where trout are stocked/not stocked and why
- The various trout regulations and why they are used.

Action 4.2.D.2. Continue to develop and improve an online trout angling mapping tool.

Action 4.2.D.3. Develop specific materials and social media to improve public understanding of conservation issues related to fisheries habitat.

Action 4.2.D.4. Increase public awareness of public easements, fee title areas, and stream restoration projects by improving signage, including acknowledgment of volunteer/partner support.

Action 4.2.D.5. Provide publications, news articles and social media posts on put and take fisheries.

Additional Resources Required

Strategy 4.2.E. Promote Wisconsin Trout Fisheries locally, statewide, and nationally.

Action 4.2.E.1. Promote angler opportunities to both residents and non-residents.

Action 4.2.E.2. Promote the use of easements and public access to fishing.

Action 4.2.E.3. Convey the idea that regulations are not complicated and efforts are being made to simplify trout regulations throughout the state.

Action 4.2.E.4. Promote economic development and wealth retention in the state of Wisconsin by showcasing the trout resources and habitat.

Action 4.2.E.5. Educate the public on the economic impact of trout fishing in local areas of the state.

Action 4.2.E.5. Explore the possibility of corporate or private sponsorship for stream habitat work (if within DNR authority) by:

- Listing sponsors through signage at stream access locations.
- Listing sponsors in the trout fishing rules and regulations brochure.

MANAGEMENT IN WISCONSIN

The DNR trout management program is guided by NR 1.02 Inland fisheries management. The following actions are essential to carry out an effective fish management program: land acquisition and development, habitat protection and improvement, surveys and research, propagation, rearing and distribution, population manipulation, rules, and trout stream classification.

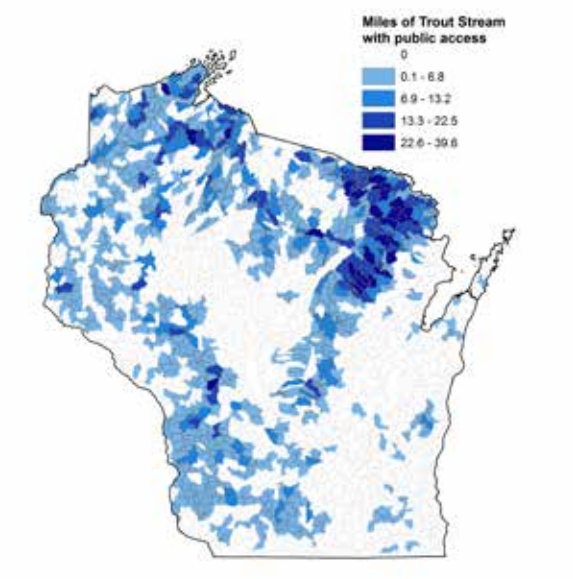


Figure 10. Total miles of trout streams with public access within each HUC12..

The DNR is only able to provide natural resources enhancement services where public access is present. "Natural resources enhancement services" means funding or activities that increase the recreational or environmental values of a waterway. These services include but are not limited to fish stocking, fish removal or other types of fish population management, habitat development, financial assistance for aquatic plant harvesting and lake restoration grants as defined in s. NR 191.42.

HABITAT PROTECTION AND IMPROVEMENT

Land acquisition and development

Land acquisition and development is a core function of the DNR and critical component of trout management. Land is acquired and managed to provide angler access, protect coldwater habitats, and to allow the DNR to conduct habitat improvement projects. Wisconsin trout stream are surrounded by public land (Figures 10 and 11). Many types of public land offer these important functions but the DNR has three main strategies that focus on fisheries, particularly coldwater fisheries:

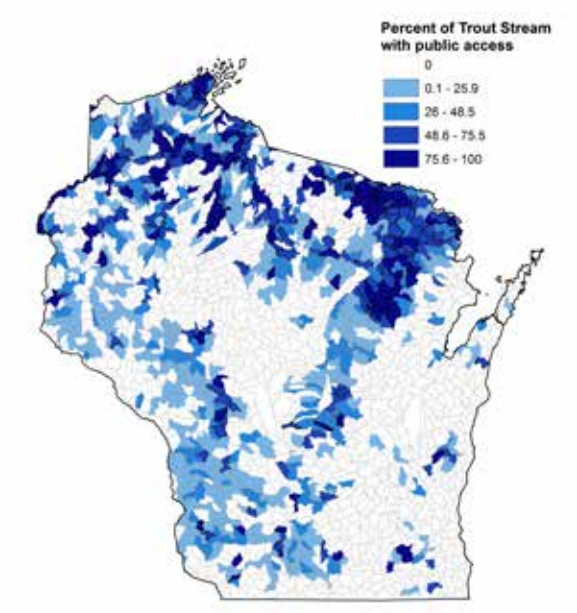


Figure 11. Percent of trout streams with public access within each HUC12.

1) Stream Bank Protection (SBP) or stream bank easements; 2) Fishery Areas; and 3) statewide Cool and Coldwater Remnant Area program. Since 1989, the Knowles-Nelson Stewardship Program has provided substantial funding to pursue these strategies—this program is set to expire on June 30, 2020.

The Knowles-Nelson Stewardship Program is the backbone of Wisconsin's public lands program. It provides the funds for all DNR land acquisition not funded specifically by other Stewardship Program components. This mandate is extensive and has resulted in land acquisition among 547 existing state parks and trails, flowages, fishery, wildlife, state forest, and rivers projects. The Knowles-Nelson Stewardship program began in 1989 and has changed over the years. Stewardship funding reductions were made in the FY 2014-2015 budget and further reductions in FY 2016 – 2017, and FY 2018-2019. The DNR, with Natural Resource Board approval, periodically updates its acquisition strategy. The latest strategy spans from 2010-2019. The DNR emphasizes the following land acquisitions: land that preserves or enhances the state's water resources (including Lower Wisconsin State Riverway; wild rivers and lakes, and the shores of the Great Lakes), land for the stream bank protection program, land for habitat areas and fisheries, land for natural areas, and land in the middle Kettle Moraine. The Knowles-Nelson Stewardship Program is set to expire on June 30, 2020.

One element of Knowles Nelson Stewardship, the Streambank Protection Program (SBP) was established in 1989 to protect water quality and fish habitat of streams, with highest priority given to protecting urban and agriculture runoff. The Streambank Protection Program (SBP) purchases easements directly from landowners. In return for payment, the public can fish, hike, watch wildlife, snowshoe and cross-country ski on these easements. The DNR also purchases the rights to conduct instream and riparian habitat management activities along the stream corridor within the easement. The easement area is generally 66 feet of land from the stream bank on either side of the stream. Easements are perpetual and remain on the land even if it sold or deeded to an heir. Once the terms of

the easement are agreed upon, a professional appraiser will estimate the market value of the easement. When the appraisal is completed and the value of the easement has been estimated, the landowner has the right to either accept or reject the offer. Since its inception, SBP has protected and provided public access to 276 miles of stream easements, of which 202 miles were along classified trout streams *(https://dnr.wi.gov/topic/fishing/streambank/).*

Fishery Areas are intended to enhance and maintain habitat for fish and wildlife associated with riparian zones and provide a place where people can fish. Hunting, trapping, berry picking, hiking, and other low-impact uses are also generally allowed. Individual Fishery Areas are established through the approval of the Natural Resources Board and the Governor. Fishery Areas have both a defined boundary within which the DNR is authorized to attempt to purchase land (referred to as a "project boundary") from willing sellers and a set number of acres the DNR is authorized to acquire within the boundary (the "acreage authority"). In many cases, the acreage authority is smaller than the total number of acres within the project boundary. The DNR has the authority to acquire fee and easement ownership within Fishery Areas. Wisconsin's Fishery Areas are predominantly along coldwater streams, encompassing most of the state's premier trout streams. Of note: the legislature subsequently amended the Streambank Protection Program to enable the DNR to also acquire fee title along twenty separate stream projects. These Streambank Protection Fee projects have project boundaries and acquisition goals, similar to the State Fishery Areas.

The statewide Cool and Coldwater Remnant Area program was initiated when the Outdoor Recreation Act Program (ORAP) was introduced in 1961. The focus of the Remnant Area program is to acquire fee title to critical fishery habitat (e.g., spring heads, spawning areas, and other coldwater resources) that is in danger of being destroyed through incompatible land use. The Remnant Area program enables the DNR to acquire either fee interest or easements. In 1985, a master plan for the Remnant Areas program was created which defined the criteria that waters would need to meet to be a priority for acquisition. The water resource must include two of the three following criteria to be eligible for acquisition: 1) The water resource contains critical habitat such as spawning areas, spring heads, or that, which is otherwise critical to the fish species intended for management; 2) The parcel has potential for increased production of important fish species through development on lands encompassing the critical habitat; and 3) The parcel will safeguard critical habitat from destruction through incompatible land use, such as risk of erosion or non-point source pollution.

Fee and easement ownership

In legal terms, land is often referred to as a "bundle of rights" —that is, a set of dis-

tinct and separable rights. Some commonly known parts of the "bundle" include the mineral, access, and development rights. These rights can be bought and sold (within some parameters) individually, in combination, or as a complete set (commonly referred to as "fee simple" or "fee title").

For example, a landowner can sell or donate the right to hunt, cut timber, or mine gravel. The sale or transfer of rights can be for a set period of time (e.g., 20 years) or can be permanent. The ability to sell or donate certain rights to a property has proven to be an effective and efficient tool to protect many different types of lands and resources.

Easements are the most common legal agreement used by landowners to sell or donate specific rights to another person, organization, or agency. Easements go by different names, typically according to the resource of interest: historic preservation easements, agricultural easements, access easements, conservation easements, and others. In most cases, particularly for conservation and access purposes, easements involve the permanent transfer of rights.

Not surprisingly, easements are popular with many landowners because they enable them to sell or donate particular rights (often some of the most financially valuable ones) while retaining ownership of the property. Easements are recorded on the title so that all future owners of the land are bound by the original agreement.

DNR lands management

Wisconsin DNR owns and manages over 1.6 million acres of properties on behalf of Wisconsin's 5.8 million residents. DNR Fisheries manages 161 named properties, totaling 118,000 acres of fee title lands and over 12,900 acres of easement lands.

Master Planning is DNR's contract with the public, the Public Trust, and future generations regarding how the DNR manages state property. These properties provide a wide range of recreation opportunities and diversity of habitats throughout the state. They are managed according to a set of goals and objectives described in "master plans", which are updated periodically.

The DNR develops master plans to describe and direct how its properties will be used, managed, and developed. A master plan for a DNR property details the authorized resource management, recreation management – including the level and types of public uses permitted – and facility development needed to support management on the property. It acts as a blueprint for the property, providing for consistent, long-term management.

Master plans are statutorily authorized in Ch. 23 and 28 and administered by law under NR 44 and NR 1.60.

The planning process is described in three Phases. Phase I is essentially the DNR's homework step and includes biotic invento-

Figure 12. Ecological Landscapes in Wisconsin.

ries, a rapid ecological assessment, and a Regional Property Analysis. Once the DNR has finished its homework staff share the results and documents with the public at open house style meetings. At this point the DNR has no management plan drafted and is primarily in a listening "mode". Phase II is the meat of the planning process including drafting visions, goals and management alternatives for the properties. Phase II culminates in public information meetings. After the public input process is complete, DNR staff sit down, sort through the public input and finalize the draft plan. Phase III is the Natural Resources Board Review and Approval Phase.

The DNR is now embarking on a regional approach to developing master plans, based on Ecological Landscapes (Els), 16 regions of the state that are distinguished by unique ecological characteristics and management opportunities (Figure 12).

Trout stream classifications and protection

Trout streams (Figures 13 and 14) have been classified since at least 1951, but the classifications were not in rule until 1981 when s. NR 1.02(7), Wis. Adm. Code went into effect.

Figure 13. Classified trout stream distribution in Wisconsin

Pursuant to s. NR 1.02(7), Wis. Admin. Code, the DNR is directed to identify and classify trout streams according to standards in that section to ensure adequate protection and proper management of this unique resource. The DNR uses the results from ~300 surveys

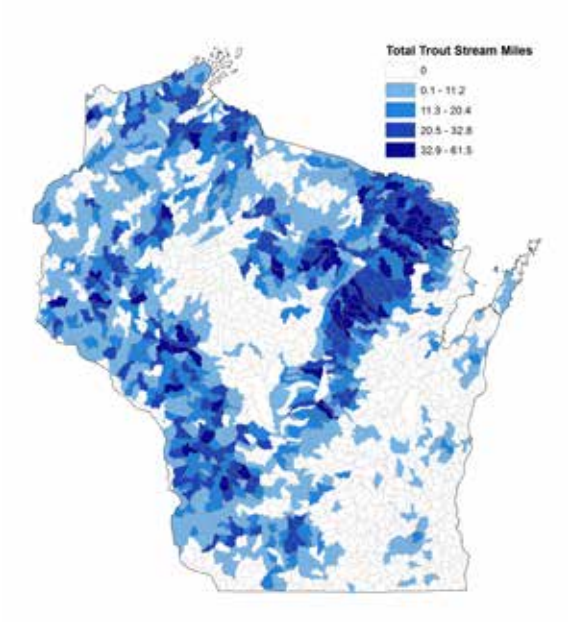


Figure 14. Total classified trout stream miles by HUC12

of stream sites conducted annually across the state to continuously update the classification system based on the standards and procedures in the administrative code. The code requires the DNR to maintain a list of classified streams for public information but specifically states that the list "shall not be assumed to be exhaustive."

Class I Trout Stream: a stream or portion thereof with a self-sustaining population of trout. Such streams contain trout spawning habitat and naturally produced fry, fingerling, and yearling in sufficient numbers to utilize the trout habitat; or contains trout with 2 or more age groups, above the age of one year, and natural reproduction and survival of wild fish in sufficient numbers to utilize the available trout habitat and to sustain the fishery without stocking.

Class II Trout Stream: a stream or portion thereof that contains a population of trout made up of one or more age groups, above the age one year, in sufficient numbers to indicate substantial survival from one year to the next, and may or may not have natural reproduction of trout occurring; however, stocking is necessary to fully utilize the available trout habitat or sustain the fishery.

Class III Trout Stream: a stream or portion thereof that requires the annual stocking of trout to provide a significant harvest; and does not provide habitat suitable for the survival of trout throughout the year, or for natural reproduction of trout.

Trout stream classification changes are made every odd year in January and the current published list and maps can be found here:

(http://dnr.wi.gov/topic/fishing/trout/streammaps.html). http://dnr.wi.gov/topic/fishing/trout/streamclassification.html.

Fisheries staff continue to collect stream survey information based on our statewide rotational monitoring schedule, and to go

through the classification process on individual streams for which they collect data.

Because trout streams are important and protected resources, they are referenced in several places in administrative code and receive extra protection.

Trout streams are given increased protection in several places in NR 20 (fishing: inland waters):

Table 1. A summary of the classification changes made from 2015-2018.

	New Classification			
Original Classification	Class 1	Class 2	Class 3	Total Miles
Class I		1.62		1.62
Class 2	38.13		5.7	43.83
Class 3		164.55		164.55
Unclassed	7.97	96.78	2.04	106.79

- NR 20.05(5) prohibits fishing in trout streams during the closed season, except that rough fish may be taken by hand
- NR 20.08(5) prohibits taking of aquatic insects from trout streams for use or sale as bait, except by a licensed angler during the open season for use on the same stream
- NR 20.14(6) prohibits minnow traps in trout streams during the closed season, except by permit
- NR 20.14(7) limits the number of minnow traps in trout streams during the open season to 3, except that licensed bait dealers may operate 20. Minnow traps on trout streams during the open season shall be raised and the minnows removed at least once every 24 hours
- NR 20.16(1)(b)2. specifies that anglers fishing during the early trout season must use artificial lures while fishing for any species of fish in trout streams
- NR 20.20 specifies that rough fish in trout streams may only be taken by hook and line during the open season, or by hand year-round.

Fisheries biologists are responsible for working with other DNR programs that regulate activities in trout streams (e.g. water quality standards, high capacity wells, habitat structures).

The administrative code for water quality standards, NR 102.04(3)(a) classifies cold-water communities using trout stream classification. NR 102.04(4)(e) sets unique temperature and dissolved oxygen requirements for trout streams. Also, in NR 102.10 and 102.11, many trout streams are listed as Outstanding or Exceptional Resource Waters and given the increased protection of those designations. NR 103.04 (water quality standards for wetlands) lists trout streams as areas of special natural resource interest.

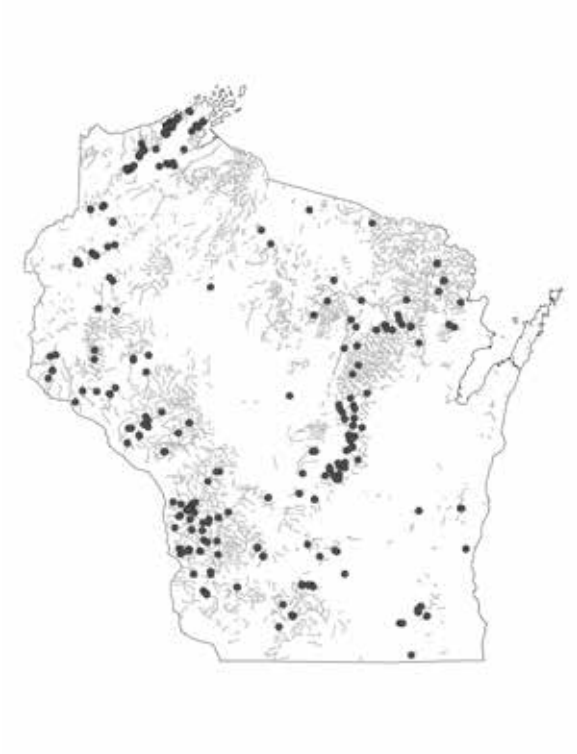


Figure 15. Habitat work locations from 2011-2016.

Trout streams are also given more protection in NR 820 (groundwater quantity protection). Trout streams and areas within 1,200 feet of a trout stream are considered groundwater protection areas.

The placement of structures, dredging and similar activities in or adjacent to navigable waters often require permits from DNR. Wisconsin Statutes, Chapter 30, "Navigable Waters, Harbors and Navigation" and Chapter 31, "Regulation of Dams and Bridges in Navigable Waters establish the permit programs. Permits are often necessary to maintain water levels and flows, protect habitat and keep streams free of obstructions. DNR implements a three-tier system of authorization based on the projected level of environmental impact which includes exemptions, general permits, and individual permits.

General Permits are granted for projects that meet pre-specified design, construction and location requirements. For activities where no exemption or general permit is available, a more detailed Individual Permit application is required.

Fisheries biologists have a role in reviewing trout stream related Chapter 30 permits to ensure that the practice is beneficial or not harming the resource.

Trout habitat improvements

Wisconsin has a long history of trout habitat improvement with goals to improve natural reproduction, abundance and size distribution, provide aesthetically pleasing areas for all to enjoy, maintain or provide for healthy fish and riparian plan and animal communities and to provide tout anglers with additional or improved trout fishing opportunities (Figure 15). Current methods and techniques vary widely by stream type, species managed and watershed. Instream, stream bank and riparian corridor habitat enhancements (typically within 66 feet of the stream) would not be possible without access or ownership to the land surrounding trout streams.

Typically, management goals for riparian corridor habitat improvements projects are to maintain a stream buffer and desired vegetation, maintain and develop diverse plants and animals, and provide public access. Management goals for stream bank improvement projects may include goals to stabilize banks and reduce bank erosion, connect channel to floodplain, manage appropriate vegetation and wildlife, reduce impacts from agricultural practices, and provide and maintain access for the public. Habitat techniques and methods are geared to provide habitat to support trout at various life history stages. (e.g. channel constriction, deflectors, animal exclusion, brush bundles, overhead cover, root wads, logs and trees, boulders, pools and weirs) and to reconnect streams reaches where they have been disconnected by human activities or natural causes (e.g. beaver control, dam removal, fish passage, meanders). Habitat techniques vary by region because of differences in the landscape. Some of the goals and techniques for the different ecological regions are described below.

Driftless Area

Habitat restoration techniques vary considerably throughout the Driftless Area. In the far west, which is the heart of the Driftless Area, intensive habitat restoration work is conducted using multiple pieces of heavy equipment and considerable amounts of rock. Highly erosive streambanks are re-sloped and stabilized and reconnected to the floodplain. In-stream habitat is added in the form of rock weirs, bank cover structures, log sills and log mats to stabilize banks, rock and wood deflectors, cross logs, boulder clusters, LUNKERS, root wads, and brush bundles. Habitat restoration work has also incorporated techniques that provide benefits beyond trout such as hibernaculum and wetland scrapes for reptiles, amphibians, and waterfowl and brushing projects to create upland habitat for game species such as rabbits.

Southeastern Till Plain and Central Corn Belt Plains

Streams in this ecoregion reside within rolling terrain, wetlands and urban waters. They tend to be lower gradient with slower velocities. Habitat work generally focuses on remediating disturbances related to a long history of urban and agricultural development. Stream realignments have been performed in the southeast to re-meander previously ditched streams. Other projects include the use of coir logs and cut brush to narrow ditched stream channels, cut-off braiding, mobilize soft sediment accumulations, and concentrate stream flow. Installation of habitat structures and coarse woody structure is also common following remediation projects. These activities are routinely completed by DNR staff and volunteers from various co-operator groups (Trout Unlimited chapters, angling clubs, school groups, etc.). Culvert removal and replacement projects that contribute towards improved fish passage, fluvial geo-morphology and reduce thermal pollution have also improved trout habitat in

this ecoregion. Urban waters have also been a priority in the south to provide additional fishing and access for anglers where opportunities are limited.

North Central Hardwoods

Trout habitat techniques are variable and are based on stream and watershed characteristics. In the northeast portion of this ecoregion, trout habitat work is primarily fishability brushing and brush bundling. Brush bundling is a cost-effective way to narrow the stream channel to promote scouring and deepening of the channel. In addition, wood may be added to the stream to provide overhead cover and refuge areas. Maintenance of existing habitat structures that were installed in the past is also part of the trout habitat efforts. New habitat structures are generally not used in this area anymore to eliminate the need for long-term maintenance. These streams tend to be flashy, as they experience rapid changes in flow and velocity during storms. Thus, the stability and function of habitat structures are difficult to maintain.

In the southern portion of this ecoregion, the predominant habitat type is the central sands (sandy soils and sandy stream beds). In the central sands, creating habitat by installing habitat structures is an effective tactic. Because these streams have high groundwater inputs and tend to be stable, these techniques can work well, without having excessive maintenance issues to keep structures functioning. Brush bunding is also used in the streams in this portion of the ecoregion. In general, vegetation management is an important component of trout habitat management. In this portion of the ecoregion, invasive buckthorn is substantially altering the riparian habitat by eliminating native vegetation, causing erosion, and limiting fishability of these streams. In areas with invasive buckthorn encroachment, mechanical and chemical treatments are being used to treat riparian areas. These areas then need to be managed to maintain meadow habitat, by keeping buckthorn from re-establishing. Another strategy being used is to remove buckthorn and then plant desirable tree species that will hopefully establish and provide a riparian habitat that is diverse and stable.

Northern Lakes and Forests

Habitat management actions in this ecoregion are variable, as some techniques are more appropriate than others, depending on the stream and its watershed. For example, habitat management on Lake Superior's south shore tributaries is directed toward enhancing spawning and rearing habitats for lake-run salmonids and resident Brook Trout. Management techniques rarely include habitat structure installations in the Lake Superior Basin, as the highly variable and flashy stream flows from logging-era land use have and continue to create unstable streambeds and banks on which to work. Upper reaches of the mainstem Bois Brule River and its tributaries, however, are predominantly groundwater fed and therefore maintain stable flow regimes.

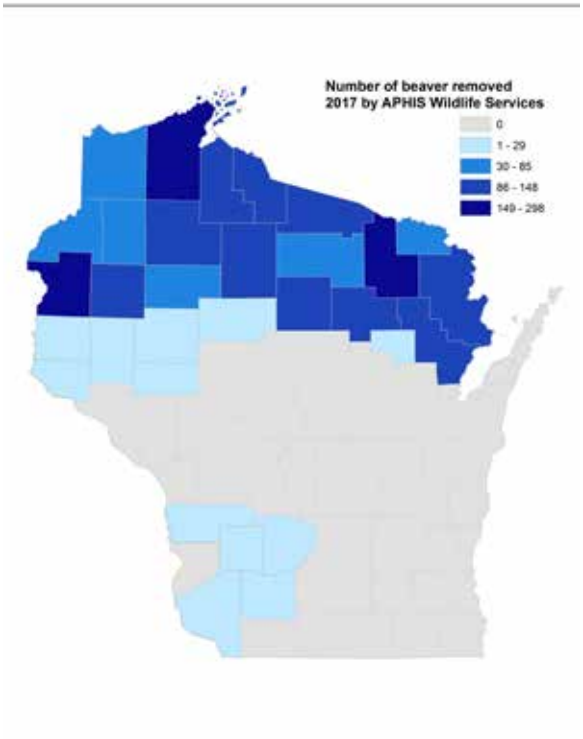


Figure 16. The number of beaver removed by APHIS WS in 2017, summarized by county (APHIS WS 2017 personal Communication).

In such streams, habitat structures have included large wood installations, such as logs and companion root wads. Other habitat actions include brush bundling to decrease stream widths and increase stream depth, as well as general brushing to improve angler access. Many streams are actively managed as free-flowing, with a beaver control program (Figure 16) in place to minimize beaver dam impediments to fish passage. Buckthorn control is another important aspect of habitat management in the northwest, particularly within the White River Watershed. Habitat management in the northwest extends beyond stream channels, primarily in the Lake Superior Basin, with focused landscape-level land management toward reducing runoff rates to stream channels.

One of the most important habitat improvements on many streams in the Northern Lakes and Forests is restoring stream connectivity. Many northern stream reaches do not contain all the necessary habitat for all life stages of trout and seasonal migration is very important to maintaining healthy trout populations. For example, adults often migrate to small tributaries to spawn and then migrate

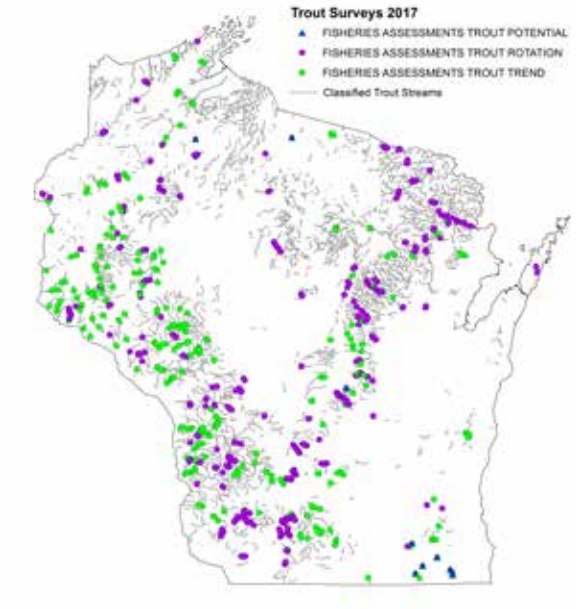


Figure 17. Trout stream sampling locations from electrofishing surveys completed in 2017 were extracted from the Fisheries Management Database by survey type.

to larger downstream locations to overwinter. To improve migration the primary technique is replacement of culverts with ones that are adequately sized and set at a proper depth. Improperly placed culverts are often perched or set incorrectly leading to velocity barriers, depth issues, or ponding issues that impede fish passage.

SURVEYS

Trout streams are sampled on a rotational basis within watersheds around the state. Within a watershed, a selection of streams is surveyed annually (1-year rotation) as trend streams (Figure 17). Trend streams allow year-to-year comparisons of trout abundance and other metrics. A randomization process is used to select other streams within watersheds to survey on a 3, 6, or 12-year rotation. Multi-year rotation surveys allow for all streams within a watershed to be surveyed at least once over a 12-year time frame. Randomization in the selection process allows for annual comparisons of survey data at the watershed scale.

The current stream survey protocol is as follows:

Sample Size: The number of sites to sample on a segment vary by length of the segment: 0 sites on segments less than 0.5 miles, 1 site on segments 0.5 to 1.5 miles, 2 sites on segments from 1.5 – 3.0 miles, and 1 site per 3 miles (minimum of 3 sites) on segments greater than 3.0 miles. Trout streams of management interest less than 0.5 miles should have 1 site. Sites should be chosen to be representative of the habitat within the segment..

Site Length: Length of survey sites should be at least 35 times mean stream width on stream segments ≥ 3 meters wide and at least 100 meters on streams < 3 meters wide.

Timing: Monitoring should take place between June 15 and September 15 to allow capture of young-of-year (age 0) trout. Trend sites should be sampled about the same date each year so they can be compared over time.

Data Collection: At all sites biologists collect and measure lengths of all gamefish, exotic fish species, and threatened and endangered fish species. If large numbers of gamefish are encountered at a site, only the first 200 fish of each species need to be measured. Measurement of fish weight is optional. At one site per segment biologists collect, identify and count all fish species for calculation of an Index of Biotic Integrity (IBI) score.

Trout surveys are categorized as a trend site, if sampled each year or every other year. Surveys labeled as trout rotation are sampled every certain number of years. Surveys labeled as trout potential are streams that are not as well sampled and may or may not hold trout and become a classified trout stream
When resources and priorities allow, biologists conduct more in-depth surveys and evaluations of management actions (e.g. stocking and habitat assessments and creel surveys). Sampling may occur before and af-

ter a stocking event or management action to evaluate the response. A creel survey is a tool used to measure the fishing activities of the anglers and to estimate the number of fish harvested on a water. Creel clerks collect the target fish, catch, harvest, lengths of harvested fish and hours of fishing by counting and interviewing anglers.

Methods for catch per mile calculation

Brook Trout and Brook Trout catch per mile data from 2007-2014 were exported from the Fisheries Management Database. If a survey was conducted on a classified trout stream or was listed as a managed stream and no trout were found, that survey was added to the data set with 0 Brook Trout and 0 Brown Trout.

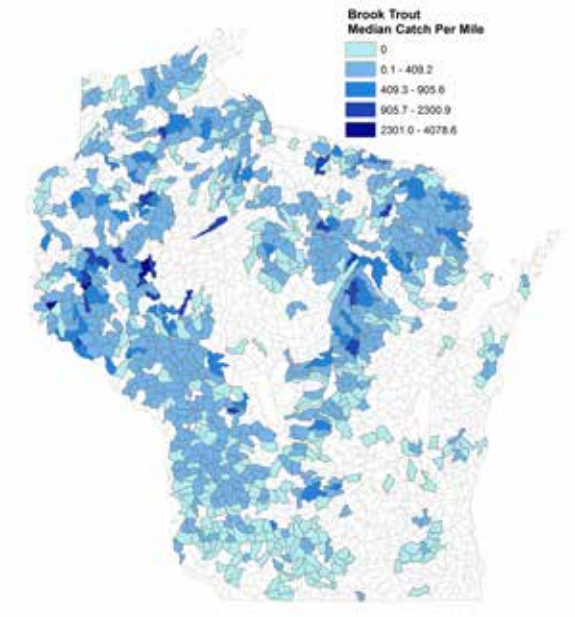


Figure 18. Median catch per mile by HUC 12 of all sizes of Brook Trout.

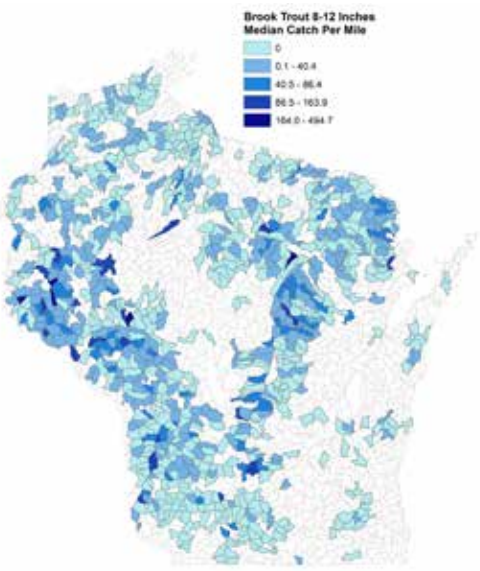


Figure 19. Median catch per mile by HUC 12 of Brook Trout 8-12 inches.

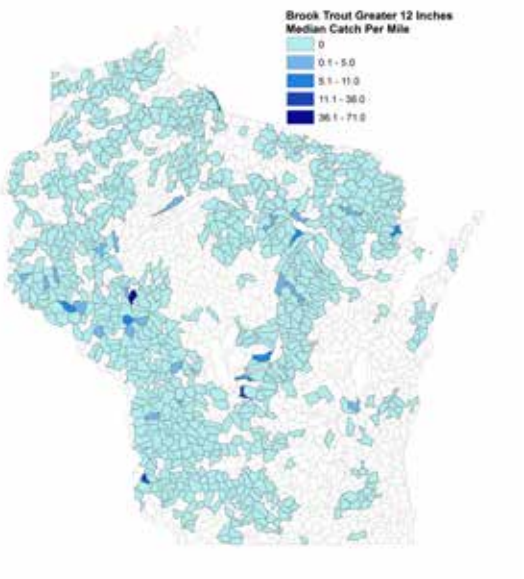


Figure 20. Median catch per mile by HUC 12 of Brook Trout greater than 12 inches.

Zeros were also added if a survey contained one species and not the other. The first day of electrofishing was included if the survey contained multiple days of effort or multiple pieces of effort on the same day (e.g. population estimate). In other words, only the marking run of a population estimate, was kept and the recapture run was removed from the dataset. If a survey included multiple pieces of effort, the data were summed by the sample date. The data were spatially joined to ecoregions, classified trout streams and HUC12s (sub-watershed). Catch per mile is calculated by dividing the number of fish caught by the number of miles sampled. In some surveys, the number of fish measured was less than the number caught. The catch per mile was adjusted based on a ratio. The data were averaged at each site and then treated as independent data points if there were multiple sites on a stream. Catch per mile was then averaged at each site and a median of all catch per miles was calculated for the entire HUC12. These data have been summarized in multiple ways in Figures 18-30.

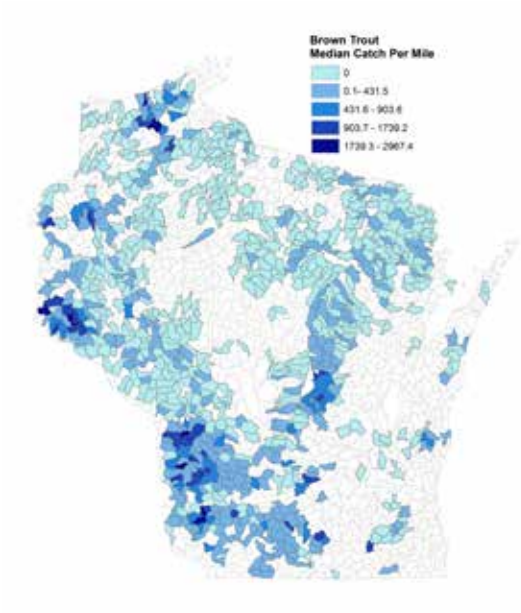


Figure 21. Median catch per mile by HUC 12 of all sizes of Brown Trout.

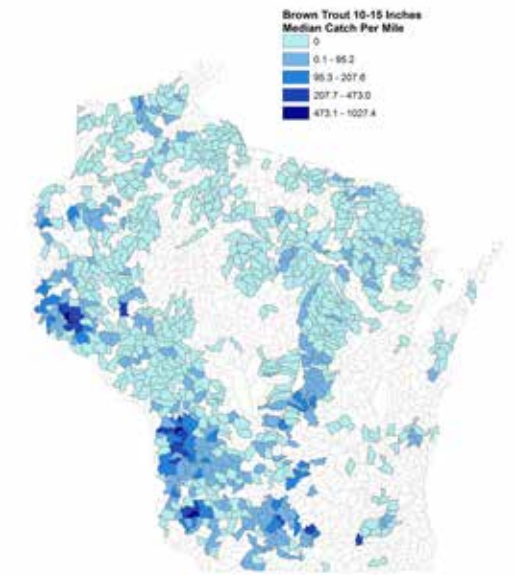


Figure 22. Median catch per mile by HUC 12 of Brown Trout 10-15 inches.

RESEARCH

Wisconsin has a long history of conducting research to support trout management. James McFadden conducted one of the first comprehensive studies of a Brook Trout population and fishery, here in Lawrence Creek, in the 1950s. Robert Hunt led a research group that studied Brook Trout angling regulations

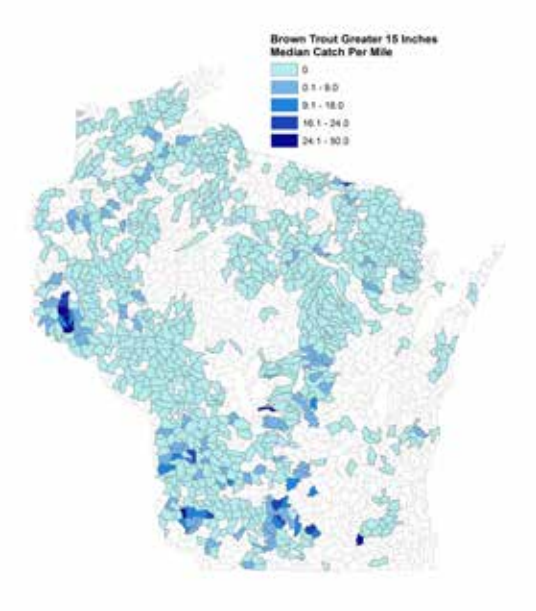


Figure 23. Median catch per mile by HUC 12 of Brown Trout greater than 15 inches.

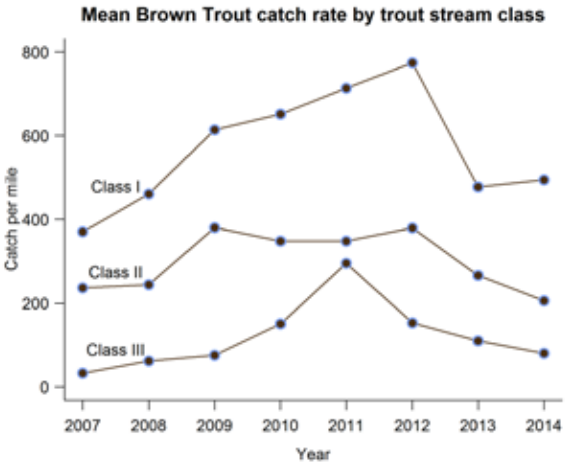


Figure 25. Mean Brown Trout total catch per mile by trout stream classification over time.

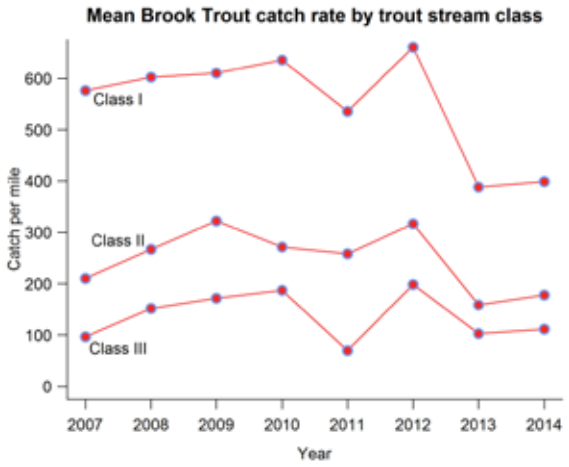


Figure 24. Mean Brook Trout total catch per mile by trout stream classification over time.

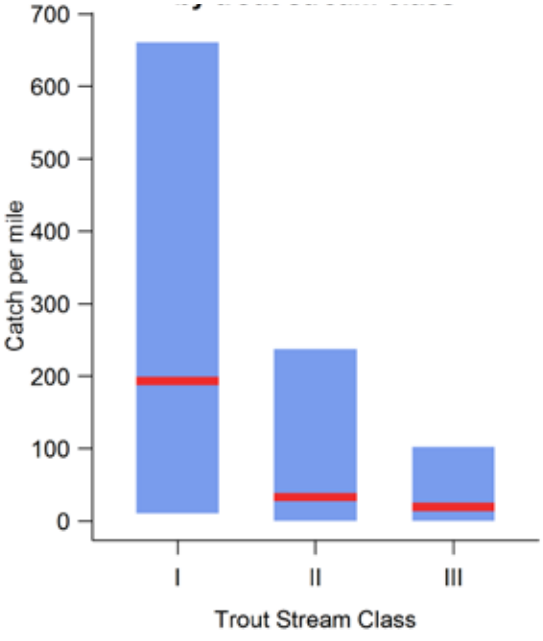


Figure 26. Mean Brook Trout total catch per mile by trout stream classification. The middle line is the median and the ends of the box are the 1st and 3rd quartile of all surveys.

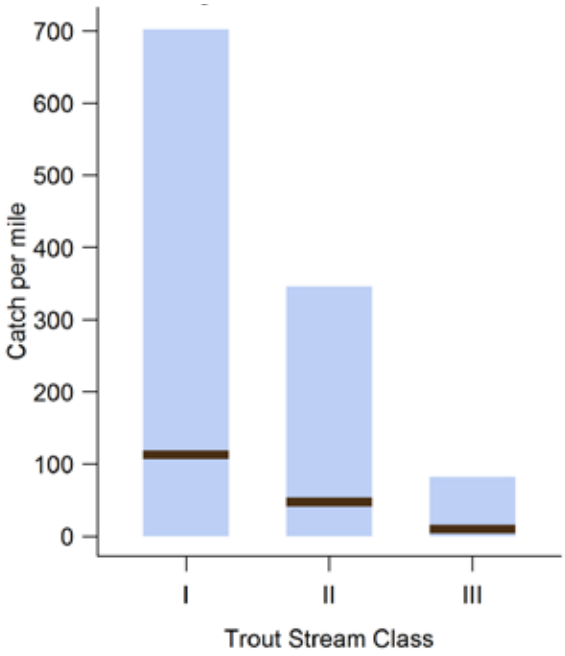


Figure 27. Mean Brown Trout total catch per mile by trout stream classification. The middle line is the median and the ends of the box are the 1st and 3rd quartile of all surveys.

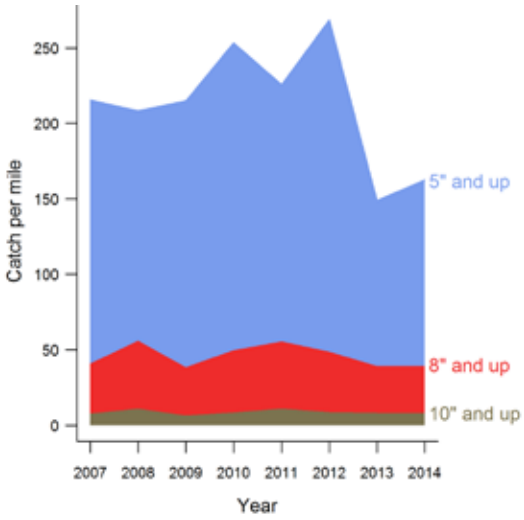


Figure 28. Mean adult Brook Trout catch per mile by size class over time.

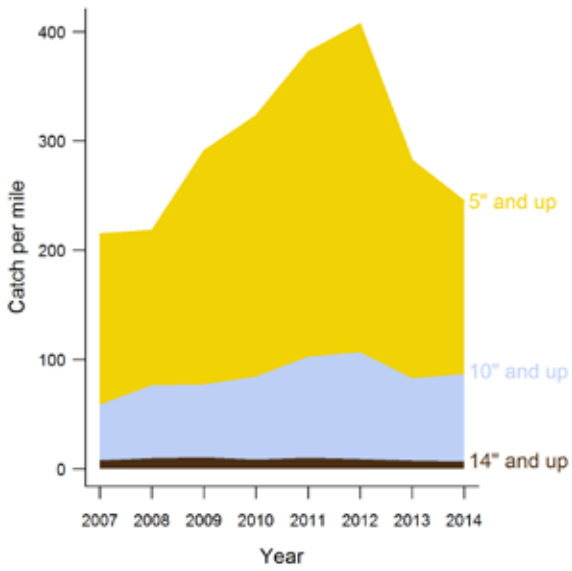


Figure 29. Mean adult Brown Trout catch per mile by size class over time.

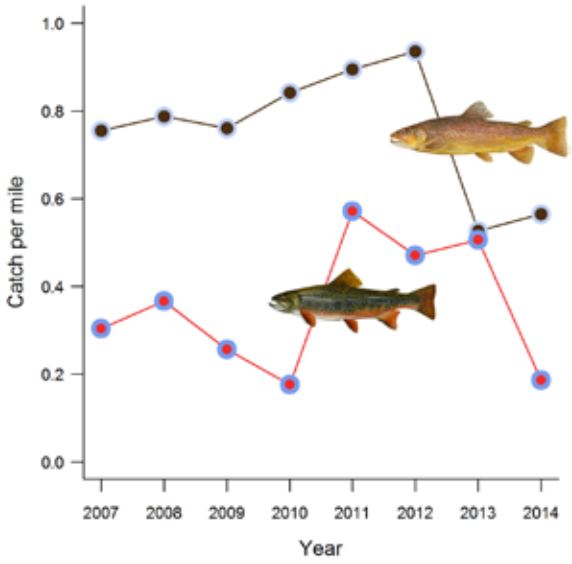


Figure 30. Mean adult Brown Trout catch per mile by size class over time.

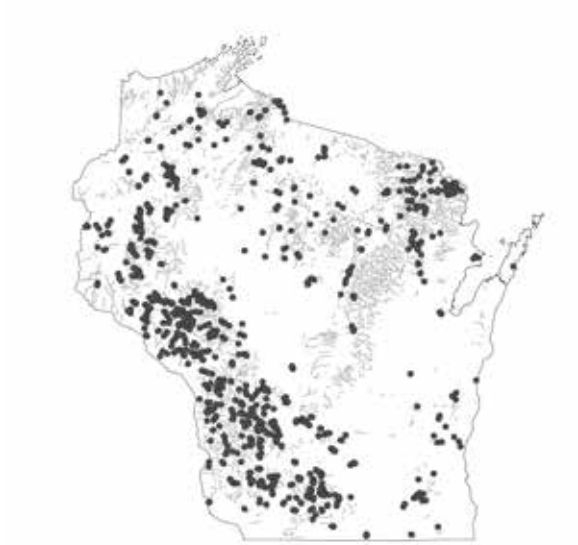


Figure 31. DNR hatchery, pond, and coop pond stocking locations of inland Brook Trout from 2007-2017.

Figure 32. DNR hatchery, pond, and coop pond stocking locations of inland Brown Trout from 2007-2017.

and pioneered trout stream habitat development to restore trout populations in degraded streams. Ray White and Oscar Brynildson wrote a guide on instream habitat management in the 1960s, and Ray White currently works to educate biologists on the latest science supporting stream habitat management. Edward Avery conducted research on wild Brook Trout and Brown Trout fisheries and on how beaver control could benefit trout streams. And many other Wisconsin fisheries researchers and managers contributed to a growing body of knowledge on trout stream population dynamics and management of their fisheries.

Current DNR trout research is focused on Wisconsin's inland streams on issues including stream habitat restoration, propagation

Figure 33. DNR hatchery, pond, and coop pond stocking locations of inland Rainbow Trout from 2007-2017.

and stocking, trout population response to environmental change, age and growth, and trout-parasite dynamics. Collaborative work with University of Wisconsin partners includes trout genetics and genomics studies and human dimensions studies on riparian land management. See *https://dnr.wi.gov/topic/WildlifeHabitat/research/index.html* for additional details on DNR trout research projects.

Figure 34. DNR hatchery, pond, and coop pond stocking locations of inland Lake Trout from 2007-2017.

PROPAGATION, REARING AND STOCKING

Trout have been stocked in Wisconsin since the late 19th century. The propagation and introduction of trout in Wisconsin waters was initially private. In 1872, $500 was ap-

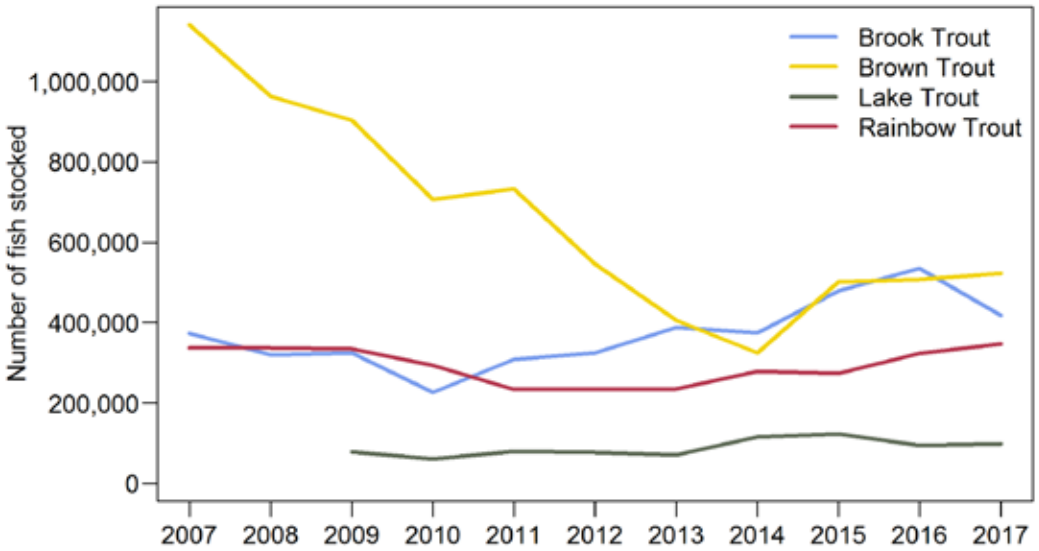


Figure 35. The number of inland Brook Trout, Brown Trout, Rainbow Trout, and Lake Trout stocked over time from 2007-2014 from WDNR hatchery, pond, and coop ponds.

propriated by the state for the importation of Rainbow Trout eggs from California for propagation in private ponds, with 20,000 Rainbow Trout raised and stocked in Geneva Lake and the Madison lakes. A state fish hatchery was recommended in 1874 and therefore a fish hatchery was established at Nine Springs southwest of Madison in 1875. Two thousand mature Brook Trout were used for broodstock, along with a smaller number of Rainbow Trout and Atlantic Salmon. In the same year, a temporary hatchery was set up in the Milwaukee water works for 10,000,000 Whitefish and Lake Trout eggs. By 1883, the Madison fish hatchery was producing 2,000,000 Brook Trout fry and 100,000 Rainbow Trout for stocking. Brown Trout eggs were first imported from Germany to Wisconsin for propagation in 1887. Additional trout hatcheries were established in Bayfield in 1895 and Wild Rose in 1908.

Trout were stocked extensively across Wisconsin in the early 20th century at the request of Wisconsin residents. Early Commissioners of Fisheries reports detail the number of trout stocked, the streams in which they were stocked, and the Wisconsin resident who requested the stocking.

Stocking today (Figures 31-36) supports put-and-take fisheries (Class III streams and lakes), put-grow-and-take fisheries (Class II streams, spring ponds, and lakes), and restoration or rehabilitation of wild trout fisheries (Class I streams and spring ponds). The Nevin Fish Hatchery, located in South Central Wisconsin, currently raises and stocks "wild" Brook Trout, "wild" Brown Trout and domestic Rainbow Trout. "Wild" trout are derived from wild brood sources and include F1 (first filial generation or one generation removed from the wild) and F2 (second filial generation or two generations removed from the wild) trout. Most stocked "wild" trout are F2 fish. Domestic trout are derived from broodstock maintained in hatcheries and may be 30 or more generations removed from the wild. The Osceola and St. Croix Falls Fish Hatcheries, located in Northwestern Wisconsin, currently raise domestic and "wild" Brook Trout, domestic Brown Trout and domestic Rainbow Trout.

The DNR created a "wild" trout stocking program in 1995 to improve the genetics of trout stocked to restore wild populations. This program has evolved over the years by utilizing advances in genetics research to improve the stocking program and to protect the genetic integrity of wild Brook Trout populations where they exist. Wild trout are collected and held in-situ in cages for a 6-8-week period during autumn to collect fertilized eggs and then the spawned trout are returned to the stream. Offspring from the wild trout, referred to as F1 trout, are raised in hatcheries and some are stocked into trout streams. Some F1 trout are kept and raised in the hatchery to produce F2 trout to meet the demand for stocking "wild" trout. The "wild" trout stocking program has been successful at improving the survival and longevity of stocked trout (Avery et al. 2001; Mitro 2004),

though a stocking study showed F1 Brook Trout had apparent survival rates 2-3 times greater than F2 Brook Trout in the first year following stocking (Mitro, unpublished data). The DNR has selected different trout streams as broodstock sources for different regions of the state. From 2001 to 2013, a wild Brook Trout population in Ash Creek was the source for F1 Brook Trout stocked in Driftless Area streams in southwestern Wisconsin. Early genetics research suggested Ash Creek Brook Trout genetics were representative of wild Brook Trout in this region. By 2014, however, Ash Creek was no longer a viable broodstock source because of a significant decrease in Brook Trout abundance attributable to infection by the gill parasite *Salmincola edwardsii* (Mitro 2016), and efforts were made to identify new sources of Brook Trout eggs for this region. Potential Brook Trout broodstock source streams were selected based on genetics, population abundance, fish health, and logistics. The DNR began the stream selection process using Brook Trout genetics data from existing studies to determine which streams contained Brook Trout that were genetically representative of wild Brook Trout found in a given region (Fields and Philipp 1998; Hughes 2008). In 2016 the DNR began a new Brook Trout genetics study in collaboration with the University of Wisconsin-Stevens Point (UWSP) using data from multiple states in the Midwest and hatchery sources from the East Coast to better define and understand Brook Trout population genetics throughout Wisconsin (Figure 36).

Results of the genetic analyses determined that Ash Creek Brook Trout, which were thought to have genetics representative of wild Brook Trout in the Driftless Area region of Wisconsin, had genetics indicative of domestication, possibly from early stocking of Brook Trout from East Coast sources in this region. Brook Trout from the South Fork of the Hay River, which has been used as a broodstock source for Brook Trout stocked north of the Driftless Area, were better representative of wild Brook Trout genetics in the Driftless Area region. The DNR used updated information on Brook Trout genetics to aid the selection of new broodstock sources and to revise DNR trout stocking guidance to emphasize the importance of genetics in Brook Trout propagation and stocking. New broodstock sources for the Driftless Area include Melancthon and Lowery creeks, and unlike the past annual use of Ash Creek for Brook Trout egg collection, current egg collection rotates among broodstock source streams, and F2 Brook Trout are created by using F1 Brook Trout from multiple sources.

Additional streams have been added to the genetic analysis of Wisconsin Brook Trout (Erdman et al. in prep). The goal of genetics research on Wisconsin Brook Trout is to further define genetic stock boundaries, to update guidance on stocking, to improve broodstock selection, and to improve hatchery propagation of "wild" trout.

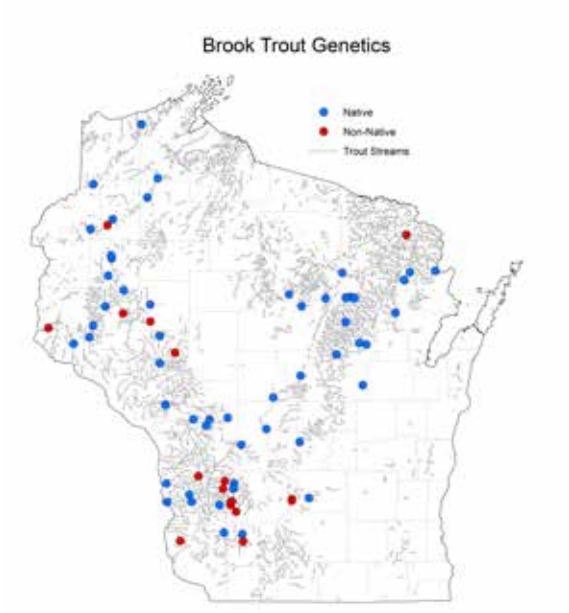


Figure 36. Genetic analysis results showing Brook Trout populations with native and domestic origins.

ANGLERS AND ANGLING

Recruitment, Retention, and Reactivation (R3)

Concern over recent trends in hunting, angling, and trapping participation has prompted the creation of national guidance documents for recruitment, retention, and reactivation (R3) strategies for anglers (Recommendations and Strategic Tools for Effective Angler R3 Efforts), hunters and shooting sports participants (National Hunting and Shooting Sports Action Plan).

Nationally, participation in hunting has been declining since the 1980s. Angling participation has been steady but is likely to decline. The decline in these activities, which sustain a multi-billion dollar industry and provide the primary financial support for state-level fish and wildlife agencies, poses an ever-increasing threat to conservation.

Fish and wildlife conservation in North America has been accomplished largely through a user-pays system in which hunting and angling license fees and excise taxes on equipment are one critical funding source for scientific management. Participation in hunting has been declining in Wisconsin for the past decade while shooting sports participation has experienced fairly strong growth. The number of anglers has remained stable for at least a decade. The impact of these trends will be a decline of resources available for conservation practices. This plan applies the scientific method to develop tools to effectively reduce or reverse declines and monitor other trends.

Hunting, angling and trapping also have large economic impacts in Wisconsin, supporting over 53,000 jobs annually. Many of these impacts and jobs occur in rural Wisconsin where hunting and fishing are an important part of the fabric of society. Tens of thousands of tons of sustainably raised and harvested meat have defined the Wisconsin way of life since its beginning. First-hand experience with nature, participating in the ecosystem, the camaraderie of family and friends, and the desire to act

positively for conservation are driving motivators and rewards for hunters and anglers.

License fees and excise taxes will continue to provide primary funding for conservation in the future; hence, maintaining positive hunting, angling and trapping brands, and strong participation are top priorities.

Wisconsin DNR's R3 Team is a nationally recognized leader in integrated, effective and accountable R3 programs and our customers strongly believe in our vision. We have a team of 4 FTE and several LTE staff working to integrate our R3 efforts and ensure success at maintaining relevancy. Recruitment, retention, and reactivation (R3) of hunters, anglers, trapper, and target shooters is critical to conservation, conservation funding and our wildlife and way of life in Wisconsin. The R3 Team's vision is to establish and promote a Wisconsin Outdoor Lifestyle and Land Ethic that includes robust hunting and angling participation through strong partnerships and maintaining and supporting strong shooting sports participation. Our Learn to Hunt for Food, and Fishing for dinner programs are very popular amongst the local sustainable food crowd.

Fishing Regulations

Laws to protect trout fisheries were implemented by the Wisconsin Legislature as Wisconsin developed into an agricultural and industrial state, citizens recognized the need for fishing laws and their enforcement to prevent the unrestricted taking of fish and to ensure quality fisheries for current and future generations of anglers.

One of the first laws to protect Brook Trout, enacted in 1858, was a reduction in the open season from 12 months to 8 months, and Brook Trout could only be taken by hook and line and they could no longer be sold. The Brook Trout season was further reduced to 5 months in 1878. In 1905, the first size limit for trout in inland streams was set at 6 inches with a bag limit of not more than ten pounds. For 10-inch Brook Trout of average weight, a ten-pound limit may equate to 30 Brook Trout. Four years later in 1909, the bag limit for trout was changed to 40 trout per day. However, size and bag limits had been enacted earlier for Lake Trout. In 1879 the size limit for Lake Trout was set at three-quarters of a pound, and in 1898 the first bag limit for Lake Trout was set at 25 pounds.

The state legislature continued to be the governing body that set angling regulations until 1933. H. W. MacKenzie was the director of the Wisconsin Conservation Department at that time, and one of his first tasks was to implement a new law that gave the Conservation Commission and the Conservation Department the authority to establish fishing and hunting regulations. The new law also granted the authority to organize advisory committees. MacKenzie, a former chief game warden for the state, was known for having the firm convictions that fish and wildlife belonged to all the people of Wisconsin, and

that the satisfactory enforcement of fish and wildlife laws was predicated on those laws being supported by most hunters and anglers. With these guiding principles, MacKenzie set out to engage all interested citizens to share their opinions and advice on what new regulations should be enacted. This public participatory process in setting angling regulations exists in Wisconsin to this day, in which the public, Conservation Congress, and the DNR work together to revise and set angling regulations for trout and other fish species.

Trout regulations have, with some exceptions, generally become more restrictive over time. The statewide daily bag limit was reduced to 15 trout in 1935, with the size limit increased to 7 inches. By 1990 a category system was established that set different size and bag limits for different categories of streams, along with more restrictive regulations such as catch-and-release only for certain individual streams. Season length also fluctuated over the years, and eventually a catch-and-release season was established to increase angling opportunities outside of the regular harvest season.

Trout angling regulations have periodically been reviewed and revised following the implementation of the category system. All waters or sections of waters, were put into a regulation category (black, yellow, green, blue or red). Red (category 5) regulations were special regulations and varied in bag and size limit. Black, yellow, green and blue categories covered most of the state. In 2003, after a 10-year review of the regulations, a new set of regulation changes went into effect. Category 1 (10 bag, no size limit black) was eliminated, the number of special regulations (Category 5 red) were reduced, and regulation uniformity on the same stream was a goal.

The DNR launched a statewide effort in 2011 to review inland trout fishing regulations last set in 2003. The DNR held a series of public meetings in March 2011 to introduce the trout regulations review process, to update anglers on the status of inland trout populations, and to gather angler and stakeholder input on trout fisheries and management. A written questionnaire was used at the public meetings and made available online to solicit input on participants experiences and perceptions on trout fishing and Wisconsin's inland trout program. There were 201 questionnaires completed at the meetings and 1,704 questionnaires completed online. The public meetings and online questionnaire served to help initiate discussions about the trout program, collect feedback on the trout program, and help focus efforts in developing a more extensive random mail survey (Mitro et al. 2014).

A mail survey of current Wisconsin resident inland trout anglers was sent in February 2012 to 1,000 randomly-selected purchasers of the 2011 inland trout stamp. The survey was based on the 2011 public meeting questionnaire but also included questions on inland trout angling effort, catch, and harvest during the 2011 inland trout season.

In summary, two-thirds of the respondents went fishing in Wisconsin in 2011. The most cited reason for those who did not go fishing was not finding the time (62% of the 32% who did not fish). About 40% of the anglers overall spent less time trout fishing because the regulations were too numerous, too difficult to understand or too restrictive. Over half of the anglers (55%) often or always used live bait when trout fishing. Over 60% of Brook Trout anglers and Brown Trout anglers sometimes or more frequently kept trout for eating. About 20% of Brook Trout and Brown Trout anglers always kept trout for eating. May was the most popular month for trout fishing during the regular trout season. About one-fourth of the anglers fished the early catch and release season from March 5th through May 1st. Anglers supported the current regular open season. More anglers opposed a year-round open stream season than were in favor of retaining the current season. Extending the open catch and release season to open October first, adding a catch and release season after the regular open season ends and starting the catch and release season earlier all generated opposition. The majority of anglers said that stream regulations were easy to understand and were generally satisfied with them. A final report on the survey results is available at: *http://dnr.wi.gov/topic/fishing/documents/trout/TroutReportJan2014.pdf.*

In 2011, the DNR conducted a survey of lapsed inland trout anglers. Lapsed anglers were defined as those who had not purchased an inland trout stamp for the last three consecutive years (2009-2011) but had purchased the inland trout stamp during each of the five consecutive previous years (2004-2008). The survey was mailed to 800 randomly-selected lapsed trout anglers; useable surveys were returned from 498 lapsed trout anglers yielding a 68% response rate. The results from the lapsed trout angler survey are linked below. The survey included questions to help the DNR understand why former inland trout anglers no longer fished for trout and identify management strategies the DNR could use to draw these anglers back to trout fishing.

In summary, the primary reason lapsed trout anglers have stopped participating in inland trout fishing was how they chose to spend their time. Trout regulations were part of the reason anglers stopped fishing for inland trout but were not the most influential reason. Other reasons that anglers stopped fishing were the quality of the trout fishery on their favorite water and poor access and stream conditions. Many anglers reported that they would return to trout fishing if quality, access or regulations were improved. Three fourths of lapsed anglers stated they would start trout fishing again if they had more time. A full report can be found here:

2011 Survey of Lapsed Wisconsin Inland Trout Anglers [PDF, 341KB]

In early 2013, the DNR formed a Trout Management Task Force to provide input and develop goals for the future of Wisconsin's trout fisheries. The trout management task

Table 2. Regulation stop light concept with special regulations.

Regulation Category	Bag and Length Limit
Green	No Minimum Length Limit, Daily Bag Limit: 5
Yellow	8-inch Minimum Length Limit, Daily Bag Limit: 3
Red	
Special Regulations: Length, Bag and Possession Limits vary by water (including Great Lakes tributaries) Some waters have gear restrictions	10 trout of any size may be kept per day 5 trout may be kept per day, brown and rainbow trout may be any size and Brook Trout must be less than 9 inches 5 trout may be kept per day, Brown and Rainbow Trout may be any size and all Brook Trout shall be immediately released 5 trout may be kept per day, no trout between 10″-16″ with 1 trout over 16″ allowed 5 trout may be kept per day only if they are less than 12 inches 3 trout may be kept per day only if they are less than 12 inches 3 trout may be kept per day, Brown and Rainbow Trout must be at least 12 inches and Brook Trout must be at least 8 inches 3 trout may be kept per day, Brown and Rainbow Trout under 12″ except 1 may be over 18″ and brook trout must be at least 8 inches 2 trout may be kept per day if they are at least 12 inches 1 trout may be kept per day if it is at least 14 inches 1 trout may be kept per day if it is at least 18 inches All trout caught shall be immediately released

force was comprised of about 40 people from around Wisconsin who represent the Conservation Congress, conservation organizations, and businesses and fishing guides with an interest in trout fishing. In general, stakeholders asked for more quality fishing opportunities, less confusing regulations and fewer special regulations.

From March 2013 through October 2013, the DNR Trout Team developed a set of regulations that met all trout stream goals. 1. Provide diverse angling opportunities for trout anglers: a) Increase the number of self-sustaining fisheries; b) Improve catch rates where necessary; c) Increase or maintain quality fishing opportunities; d) Increase the number of early or late season opportunities; e) Maintain or increase harvest opportunities without

jeopardizing quality; f) Maintain special regulation opportunities with and without bait restrictions. 2. Simplify regulations where practical without compromising sport fisheries: a) Create base regulations with area or regional uniformity; b) Provide clear-cut visible boundaries between regulations; c) Reduce the number of types of special regulations; d) Standardize regular seasons on streams, lakes or ponds.

DNR fisheries biologists, in consultation with stakeholder input from the surveys, Task Force meetings, other communications, and neighboring biologists, drafted proposed regulations for trout waters in their local areas based on management goals. Two additional Task Force meetings followed. Regulation proposals were discussed as related to management goals and a process for handling and identifying concerns was developed.

The results from the spring hearing advisory questions in 2014 provided guidance in the development of the season proposals. The DNR trout team and fisheries biologists held a series of public meetings in September 2014 to discuss specifics of the trout regulation proposal. The full proposal was voted in favor at the April 2015 spring hearings. Several comments were submitted to the DNR: most in support of the regulation changes. A few comments were directed at specific trout stream regulations. All were discussed by the DNR's Trout Team and a few changes were made to the proposed regulations based on those comments.

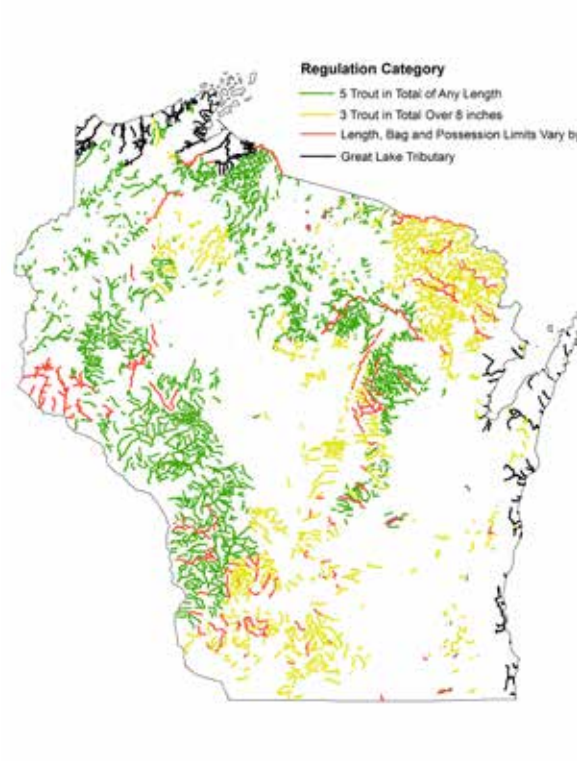


Figure 37. Statewide map showing current trout fishing regulation categories.

A range of regulations from harvest to catch and release were proposed, addressing all types of management goals and angler desires. The regulation categories were reduced from 4 to 3, implementing the category stop light. Category green means go and fish (5 bag, no minimum length), category yellow means caution (3 bag, 8-inch minimum length), and category red means stop and read the regulation pamphlet. The number of special regulations (red category) was reduced from 41 to 12, and they were tied to management goals.

Regulations were implemented with more uniformity and clear boundaries. The early season was extended (where it already existed) beginning the first Saturday in January. More information on the early season can be found here: *https://dnr.wi.gov/topic/fishing/documents/regulations/TroutEarlySeason.pdf*

The fall harvest season was extended to October 15th statewide. The 5-day closure between the catch and release early season and the regular season was eliminated. Trout fishing regulations in lakes are now more consistent and follow the gamefish season (May-March). Rules went into effect in 2016 (Table 2, Figure 37).

FISHERIES MANAGEMENT FUNDING, STAFFING AND ORGANIZATION

Trout management in Wisconsin is generally funded through the Inland Trout Stamp, the Segregated Fish and Wildlife account, grants and gifts. The Segregated Fish and Wildlife (SEG – License Fees) funding comes from the sale of fishing and hunting licenses. In Fisheries, these funds are used to support the majority of FTE salaries and fringe, fisheries assessments and research, propagation and stocking, habitat improvement and protection, public information and education, rules and regulations and program operations costs. Other programs in the DNR that support fishing and hunting in WI (Wildlife, Enforcement, Facilities & Lands, Licensing and Administration) also use these funds. Inland Trout Stamp funds can be used on inland trout streams and spring ponds for activities that directly relate to improving and maintaining trout habitat where there is public access and public ownership or a long-term easement, and for conducting fishery surveys directly related to the inland trout program. Activities that have historically been funded under trout habitat development include FTE positions, in-stream habitat improvement and maintenance, spring pond dredging, beaver control, and administration of the Trout Stamp program. Specialized equipment that directly relates to trout habitat improvement can also be purchased with these funds.

Staffing for Inland Trout Program

The majority of fisheries biologists, technicians, and supervisors across the state spend a portion of their time and resource on managing inland trout. However, the DNR also has several positions devoted primarily toward inland trout management and fish propagation for inland trout stocking. In addition, we hire several Limited Term Employees each year in each of the management districts to assist with survey, habitat improvements, and other management duties. These totals also do not include land management staff who spend time managing Fishery Areas and other Fisheries properties, many aimed at providing trout fishing access and protection.

History of the Inland Waters Trout Stamp Program

The Wisconsin Department of Natural Resources has a long history of successful trout stream habitat management. Work began with the federal work programs in the 1930s and improved as more successful methods were developed over the history of the program. Only limited work could be accomplished due to limited funding ($140,000 annually). In 1977, the inland waters trout stamp (trout stamp) program was created to provide additional funding for improving and restoring trout habitat and to provide increased trout fishing opportunities. In 1978, streams needed to meet the following requirements to be selected for restoration efforts: 1) Public use must be unrestricted, so waters must be situated on public lands or under long-term easement; 2) Water quality must be high. Waters must be free of harmful chemicals or materials, and there should be sufficient groundwater to provide suitable temperatures for natural reproduction of trout during critical times of the year; 3) The stream should have natural reproduction of trout; 4) Waters should be fertile enough to furnish conditions for good trout growth; and 5) The stream should be large enough to furnish a fishable population. Only Class I and II streams meet these requirements. Many of these requirements still exist through guidance. However, there are certain situations in which the DNR may enhance trout habitat on a marginal stream in hopes it will become a class I or II water in the future.

The cost of the trout stamp has increased from $2.50 during 1978-1983, to $3.25 during 1984-1991, to $7.25 during 1992-2006, and currently is $10.00 (since 2006).

The number of trout stamps sold averages 142,438 stamps annually from 2012-2016. The total revenue averages $1,563,707 that same time period. In addition, Patron License sales, currently about 46,000, support the trout stamp program (Table 4).

In conjunction with trout stamp funds, general fishing license fees and partner contributions funds trout habitat work. For example, in fiscal years 2016 though 2018 an average of $559,598 was spent on inland trout habitat from general fishing license fees and partner funds (Table 5).

Many of the DNR personnel working on trout habitat projects are not paid by trout stamp funds, representing a significant amount of non-trout stamp dollars supporting trout habitat work that is not shown in Table 5.

Since 1992, trout stamp funds have included maintenance of habitat improvements, which is vital to ensuring the long-term benefits of habitat work. Trout population surveys were added as a viable use in 1998. Surveys are very important for planning habitat improvement projects and evaluating the results of funded projects on trout populations.

DNR biologists and technicians have used these funds to improve and maintain an av-

Table 4. License sales contributing to the inland waters trout stamp account.

Year	Patron Card	Trout Stamp	Total Trout Anglers	Total Revenues
1978	N/A	183,135	183,135	$244,459
1979	N/A	183,447	183,447	$393,912
1980	N/A	187,958	187,958	$420,403
1981	N/A	194,873	194,873	$445,189
1982	N/A	194,658	194,658	$440,949
1983	N/A	190,821	190,821	$424,617
1984	N/A	192,510	192,510	$503,337
1985	218	181,960	182,178	$548,513
1986	264	182,354	182,618	$550,349
1987	398	180,096	180,494	$544,367
1988	254	177,138	177,392	$674,422
1989	449	162,447	162,896	$723,358
1990	756	131,910	132,666	$401,174
1991	539	113,640	114,179	$346,440
1992	847	131,008	131,855	$647,594
1993	13,486	131,308	144,794	$971,516
1994	24,757	135,425	160,182	$1,044,839
1995	34,942	130,701	165,643	$1,066,710
1996	43,370	136,687	180,057	$1,107,057
1997	48,368	127,840	176,208	$986,760
1998	55,579	129,385	184,964	$1,008,113
1999*	89,114	184,526	273,640	$1,553,033
2000	76,175	140,603	216,778	$1,019,645
2001	81,211	142,449	223,660	$1,180,221
2002	82,615	142,633	225,248	$1,157,984
2003	80,851	143,405	224,256	$1,166,441
2004	74,587	137,828	212,415	$1,126,266
2005	69,979	133,441	203,420	$1,147,805
2006	59,974	129,194	189,168	$1,782,603
2007	56,676	130,119	186,795	$1,495,230
2008	55,159	136,836	191,995	$1,504,428
2009	50,752	146,803	197,555	$1,618,053
2010	46,837	140,576	187,413	$1,569,374
2011	44,952	137,731	182,683	$1,498,739
2012	44,049	140,830	184,879	$1,570,291
2013	45,585	141,967	187,552	$1,506,574
2014	46,633	141,729	188,362	$1,549,946
2015	47,965	147,022	194,987	$1,609,090
2016	50,231	140,646	190,877	$1,582,638
2017	51,889	143,392	195,281	$1,591,126

* A spike in sales occurred in FY 99 due to implementation of the Automated License Issuance System (ALIS)

erage of 25 miles of stream and 1 spring pond per year. Specific project details and estimated costs can be found in the Trout Stamp Expenditure Reports. The latest report:

Expenditures of Inland Waters Trout Stamp Revenues FY 2013-2014 [PDF].

Using Inland Waters Trout Stamp Revenues

Wisconsin State Statue 29.2285 (1)(e) states: "The Department shall expend the receipts from the sale under this subsection of inland waters trout stamps on improving and maintaining trout habitat in inland trout waters, conducting trout surveys in inland trout waters and administering this subsection." In addition to specifying trout species, these statues define the geographic and program requirements of the trout stamp program.

Geographical Requirement: Projects that use trout stamp revenues must be geographically focused on Wisconsin's inland trout waters. These revenues may not be used on portions of Great Lakes tributaries that are only accessible to potamodromous trout and salmon.

Program Requirement: Projects funded by trout stamp money must specifically relate to inland trout habitat management (improving and maintaining habitat) or to conduct trout surveys. Expenditures for trout surveys are limited to not more than 10% of the habi-

Table 5. Expenditures of inland waters trout stamp revenue, general license fees and partner funds supporting trout habitat work in fiscal years 2011-2018

Funding Source	**Expenditures**							
	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18
Trout Stamp								
Permanent Salaries	$354,970	$324,745	$326,652	$332,640	$322,226	$322,200	$322,200	$322,200
LTE Salaries	$211,132	$281,616	$239,671	$246,305	$266,020	$272,070	$283,212	$250,697
Fringe Benefits	$251,260	$245,017	$238,218	$238,877	$240,129	$220,076	$223,546	$221,968
Supplies/Services	$724,070	$667,886	$596,169	$573,756	$819,812	$843,526	$924,711	$866,451
Total Trout Stamp	$1,541,433	$1,519,264	$1,400,709	$1,391,578	$1,648,186	$1,657,872	$1,753,669	$1,661,316
Other Funds								
General License Fees	$341,625	$398,574	$409,159	$233,284	$419,560	$501,767	$431,791	$395,349
Partner Funds/Grants	$233,731	$218,770	$316,007	$199,406	$242,356	$176,963	$127,723	$45,203
Total Other Funds	$575,356	$617,344	$725,166	$432,690	$661,916	$678,730	$559,514	$440,552
Grand Total	$2,116,790	$2,136,608	$2,125,875	$1,824,267	$2,310,101	$2,336,602	$2,313,183	$2,101,868

tat management budget. Surveys authorized must be limited to trout surveys of inland waters. Surveys funded to date include those designed to plan and evaluate habitat improvement projects, wild trout stocking, trout genetics and regulations.

Sources of Revenue for the Inland Trout Stamp Account

All receipts from the sale of trout stamps are placed in the trout stamp account. Trout stamp revenues, sales of patron licenses and collector stamps, general fishing license fees, federal Sport Fishing Restoration (SFR) funding and donations all support the inland trout program.

Currently the cost of each trout stamp is $10.00. The trout stamp account receives about $3.40 from each Patron License sold. A portion of each license also includes a vendor's fee. The vendor's fee is $.75 for the patron license and $.25 for the trout stamp. Calculations and references in this report exclude vendor's fees. Additional revenue comes from collectors who can purchase souvenir trout stamps from previous years. All revenues

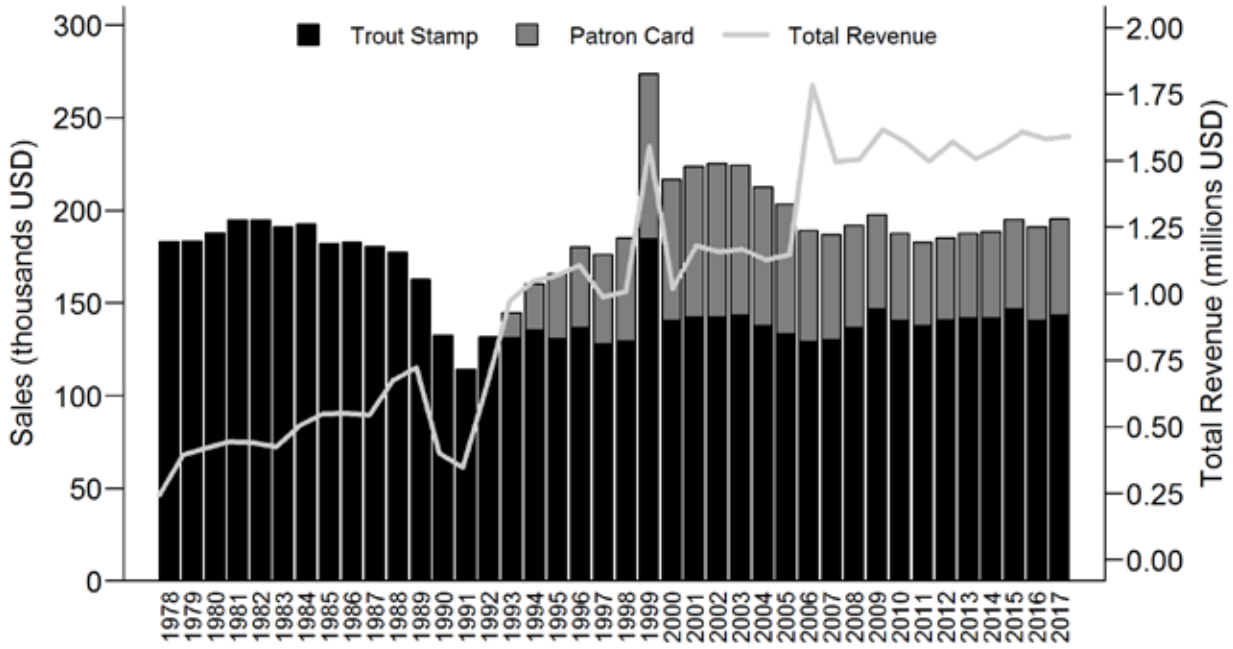


Figure 38. Trout stamp, patron sales and total license revenue from 1978 - 2014. The spike in sales in 1999 was due to implementation of the Automated License Issuing System (ALIS). The spike in revenues in 2006 was due to the fee increase and a rebate from the surplus in the heavy equipment pool.

from these sales contribute to the trout stamp account (Figure 38, Table 6).

The DNR funds 8.09 full time equivalents (FTE) positions from trout stamp revenue. Any additional hours spent on eligible activities are billed to the DNR's 's Fish and Wildlife account which is supported by general fishing and hunting license sales. Table 7 shows Fisheries Program person-hours (FTE = full time equivalents) of time spent on habitat projects in each fiscal year. Per statute, permanent staff hours spent working on non-trout projects cannot be billed to the trout stamp account. Limited Term Employees (LTEs) are not included in this total.

Also funded out of the trout stamp fund is the statewide beaver control effort. The primary means of removal of beaver and beaver dams from selected coldwater streams in Northern Wisconsin is through a Cooperative Services Agreement with USDA-APHIS-Wildlife Services (WS). Costs are shared between the agencies. Other agencies, particularly the US Forest Service and several counties, also cost share with WS for beaver and beaver dam removal from streams. These removals allow

Table 6: Annual Inland Waters Trout Stamp account activities, fiscal years 2011-2018.

	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Beginning cash balance	$394,044	$351,350	$402,377	$508,242	$666,611	$627,515	$552,282	$389,738
Revenues	$1,498,739	$1,570,291	$1,506,574	$1,549,946	$1,609,090	$1,582,639	$1,591,126	$1,616,529
Total available funds	$1,892,783	$1,921,641	$1,908,951	$2,058,188	$2,275,701	$2,210,154	$2,143,408	$2,006,267
Total expenditures	$1,541,433	$1,519,264	$1,400,709	$1,391,578	$1,648,186	$1,657,872	$1,753,670	$1,661,315
Cash balance	$351,349	$402,377	$508,242	$666,611	$627,515	$552,282	$389,738	$344,952

the specified streams to remain free-flowing and either protect or rehabilitate naturally the stream channels and hydraulic and physical characteristics maintaining coldwater stream ecosystems.

The cooperative services contract time periods spans two DNR fiscal reporting years. Most of the work is conducted in the North and East Districts although some work is done in the northern portion of the West District and South District. WS maintains complete records of the number of beaver and beaver dams removed from selected streams in each county. These records are reported monthly and summarized annually.

Numbers of beaver and dams removed annually has changed over time as more effective control was achieved on named trout streams, requiring less effort over time. These results are trout stream specific. WS beaver and beaver dam removal operations are seasonal and conducted primarily during the months of April through mid-October on a calendar year basis. Effort is also not consistent across counties, because effort is directed at selected water. Some streams are designated by both the DNR and the US Forest Service, so the agencies coordinate their effort to avoid duplication of effort.

Selected streams are checked at least once for beaver dam presence by WS, DNR Fisheries and/or USFS staff utilizing fixed wing aircraft, foot travel or public complaints.

Table 7. Time coded to Trout Habitat projects by permanent employees by year. FTEs are full-time equivalents or person-years of time (hours/1825).

Year	Permanent FTEs
FY 2011	11.26
FY 2012	12.37
FY 2013	11.15
FY 2014	9.43
FY 2015	11.12
FY 2016	5.57
FY 2017	9.33
FY 2018	8.42

2015 Strategic Alignment

As part of the DNR Strategic Alignment that began in 2015, the DNR pursued an assessment of heavy equipment operations and a reduction in the heavy equipment fleet. To maintain flexibility by retaining some equipment and renting or contracting other equipment. Fisheries is required to finalize its heavy equipment initiative by June 30, 2022. An internal team developed a plan to divest equipment and structure habitat work in the future. The plan was reviewed and approved by the Fisheries Policy Team and the DNR. Fisheries plans to restructure parts of their trout habitat program to maximize effectiveness with the resources we have available. Fisheries will still maintain a dedicated and highly skilled Heavy Equipment crew to conduct projects that require unique skills to work in wetland, river, and lake habitats and funding levels are not expected to change. However, instead of classifying Trout Habitat staff as Heavy Equipment Operators, we will hire Habitat Specialists and Habitat Technicians to better reflect the specialized and highly skilled work these staff perform. The specialists will be hired to coordinate with management biologists to prioritize, plan and implement all habitat work, serve as a lead worker on habitat crews, secure permits, provide technical assistance with project design, work plan and budget. Habitat technicians will be responsible for operating heavy equipment, coordinating maintenance, training operators, and overseeing crews. A new statewide habitat team will be formed to implement the habitat management program and to provide a way for habitat staff to collaborate on issues and projects. Habitat specialists and technicians will be located in various areas of the state and will be supervised by Operations Supervisors in the East or in the South/West.

MANAGEMENT AUTHORITY

Fisheries Management authority is outlined in Wisconsin Administrative Code, NR 1.01-1.04

NR 1.01 Management of fisheries and aquatic resources (summarized)

1. DNR programs shall be based on scientific management principles which emphasize the protection, perpetuation, development, and use of all desirable aquatic species.

2. The goal of fish management is to provide opportunities for the optimum use and enjoyment of Wisconsin's aquatic resources, both sport and commercial. A healthy and diverse environment is essential to meet this goal and shall be promoted through management programs.

3. Aquatic resources include both nongame and game species of fish, other aquatic animals and their habitats (not including endangered and threatened species).

4. Management program shall work with all programs in the DNR, other governmental agencies, federally recognized Indian tribes, and the public. The DNR will keep interested parties informed of policies, plans and management and engage in long-range planning of management programs.

5. The DNR's fish and aquatic resource management program will be financed, in large part, by user fees, particularly license fees and excise taxes on selected equipment purchased by sport and commercial fisheries.

6. Wisconsin law enunciates a trust doctrine which secures the right of all Wisconsin citizens to quality, non-polluted waters and holds that waters are the common property of all citizens. Fish management programs will vigorously uphold the doctrine that citizens have a right to use in common the waters of the state and these waters shall be maintained free of pollution.

7. Access to Wisconsin's lakes and streams is a prerequisite for their use by the public. The acquisition and development of public access to waters should be accelerated, especially in the more populous areas of the state.

8. Wild and wilderness lakes and streams are a special and limited resource providing unique settings for enjoyment of fishing and other outdoor activities. Special management methods that increase fishing quality shall be encouraged on these waters.

9. Sport fishing shall be managed in such a way that all have an equal opportunity to safely enjoy the aquatic resources, regulated to the extent that:

(a) Fish and other aquatic resources are protected and enhanced;

(b) Fishing effort does not exceed the capabilities of the resource to sustain desirable, quality fish populations;

(c) The social, biological and economic values associated with all recreational fishing, competitive and non-competitive, are recognized;
(d) A sense of responsibility for the resource is inherent in all who participate and enjoy fishing;
(e) User conflicts are minimized; and
(f) Aesthetic and cultural values associated with fishing are held in trust for future generations.
NR 1.02 Inland fisheries management (summarized)

The following actions are essential to carry out an effective fish management program.

1. LAND ACQUISITION AND DEVELOPMENT. The DNR shall provide for the protection of habitat essential to the maintenance of fish populations and for providing quality fishing opportunities through the acquisition of lands by gift or purchase. These lands shall be developed to provide access or be maintained as wilderness areas according to their potential.

2. HABITAT PROTECTION AND IMPROVEMENT. The DNR shall actively protect and maintain habitat capable of supporting aquatic species. Management efforts include deterring point and nonpoint pollution , vegetation control, rough fish control, water level manipulation and limiting shoreline development. Habitat shall be improved where fish populations can be increased, and such improvements are economically and ecologically feasible. Improvements include in-stream devices, wing deflectors, bank riprap, stream bank fencing, fish shelters, dredging and streamside brushing.

3. SURVEYS AND RESEARCH. Programs shall be based on sound surveys and research. The DNR shall survey lakes and streams to obtain information needed to develop and implement management programs. Research shall be conducted to evaluate and resolve problems that have been defined.

4. PROPAGATION, REARING AND DISTRIBUTION. The DNR shall rear fish for stocking in waters lacking adequate natural reproduction and where reasonable returns are demonstrated by surveys. Stocking priorities will be based on use opportunities, hatchery production capabilities, cost and habitat potential. Stocking of exotic species shall be thoroughly evaluated.

5. POPULATION MANIPULATION. The DNR may, where feasible, control fish populations that are stunted or harmful to more desirable fish species. Control measures include mechanical removal, predator stocking, commercial harvest and chemical treatment.

6. RULES. The DNR shall regulate the sport and commercial harvest of aquatic resources to achieve optimum sustained yields. Pollution and habitat destruction shall be stringently opposed through the strict enforcement of all laws and administrative rules. Special regulations shall be used to provide diverse angling opportunities and to distribute use in heavily fished areas.

7. TROUT STREAM CLASSIFICATION. The DNR shall identify and classify trout streams as follows to ensure adequate protection and proper management of this unique resource.

Administrative Code: http://docs.legis.wisconsin.gov/code/admin_code/nr

State statutes: http://docs.legis.wisconsin.gov/statutes/prefaces/toc

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GLOSSARY

Benthic – relating to or occurring at the bottom of a body of water

Brook Trout reserves -a selection of places where brook trout have the best chance enduring the effects of climate change. The designation of reserves enables partners to rally with their specific tools to collectively ensure brook trout.

Broodstock – a group of mature individuals used in aquaculture for breeding purposes

Chronic (incipient) upper lethal thermal limits - continuous exposure to constant lethal temperatures for a long time period and eventual mortality.

Creel surveys - collect data on angler effort, catch, and harvest.

Extirpated – To destroy completely or wipe out in a local area, though it still exists elsewhere

Fecundity – The fecundity of fish is the seasonal spawning potential or number of eggs ripening between spawning periods (e.g. annually).

Fisheries Management Handbook -Wisconsin Department of Natural Resources Fisheries Management Bureau internal guidance document.

Master planning – A master plan is also called a property plan. It establishes the level and types of public uses and what development may take place on the property.

Native trout – population or individual that has not been introduced or descended from introductions from another location. Brook trout and Lake Trout are the only native trout species in Wisconsin. Because of past stocking practices not all populations of brook trout may be native to Wisconsin.

Nonpoint source – Nonpoint Source pollution is caused by rainfall or snowmelt moving over and through the ground. Runoff moves and deposits pollutants into waterbodies and groundwater.

Nutrification – a process in which waterbodies receive excess nutrients from a variety of sources.

Oligotrophic waters -waters with low primary productivity (low in plant nutrients) and therefore may have very clear water. This is usually accompanied by an abundance of dissolved oxygen.

Piscivorous – an animal that eats primarily fish

Refugia – an area in which a population of organisms can survive through a period of unfavorable conditions

Siltation - a process in which water becomes dirty due to fine mineral particles in the water.

Two-story lakes – lakes that support warmwater and coldwater species.

Wild fish transfer -an effective management technique. However, since 2007 and the detection of VHS in Wisconsin waters, rules were developed to limit this practice.

Wild trout – population or individual that is from natural reproduction and recruitment and is not result of hatchery stocking, may be native or naturalized.

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