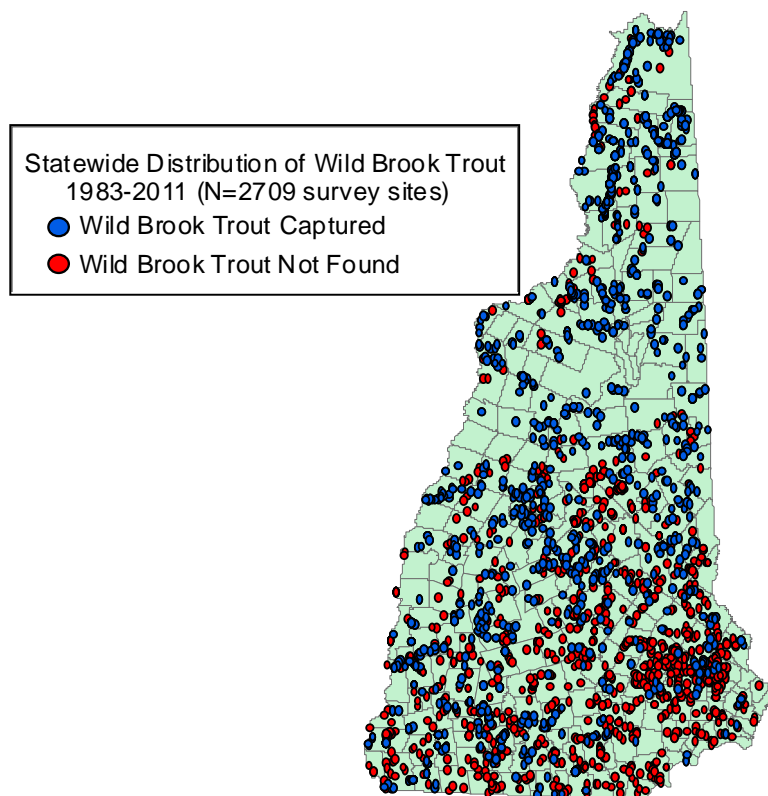


In an effort to evaluate the status of wild brook trout populations in the Mink Brook watershed, the New Hampshire Fish and Game Department with the assistance of the Hanover Conservancy, conducted a watershed wide survey in the summer of 2011. These surveys are part of a statewide effort to quantify the presence of self-sustaining brook trout (*Salvelinus fontinalis*) populations and to gather some preliminary information on their habitat. These surveys also provide some information on the general fish community in the Upper Valley of New Hampshire. An assessment to determine the current status of brook trout within this region of New Hampshire is of particular interest to the overall goal of prioritizing protection and restoration efforts because quantitative information regarding this region of the state, as with most of the tributary watersheds to the Connecticut River, is limited. It is expected that this document could be used as a guidance tool for the protection of both water quality and wild brook trout in the Mink Brook watershed. As the Upper Valley region continues to grow, more pressure is placed on the ability to sustain water quality and habitat for wild brook trout populations.



Background

Brook trout are the only native stream dwelling trout species in New Hampshire, having a historic range that extended from Georgia to eastern Canada. It is believed that wild brook trout were once present throughout all watersheds in New Hampshire. Increased stream temperatures, changes to water chemistry, habitat fragmentation, increased rates of predation and competition, loss of spawning locations, and the loss of stream habitat

complexity have led to reduced and isolated populations of wild brook trout both in New Hampshire and throughout the species' native range in the eastern portions of the United States.

Recognizing the reduction in the distribution of wild brook trout, the Eastern Brook Trout Joint Venture (easternbrooktrout.org/) was established. This public and private partnership of state fish and wildlife agencies, federal natural resource agencies, academic institutions, and local conservation organizations is working to protect existing wild brook trout habitat, enhance and restore impacted habitat, and raise public awareness about their current status. This cooperative effort is one of several regional conservation initiatives under the National Fish Habitat Action Plan. These efforts will also benefit other native stream dwelling species, because brook trout serve as an indicator for healthy aquatic ecosystems. Fortunately, it is believed that New Hampshire has more intact populations of brook trout when compared to the southern portions of the species' eastern U.S. range. However, information to quantitatively describe the status of brook trout populations in central New Hampshire is limited.

Project Justification

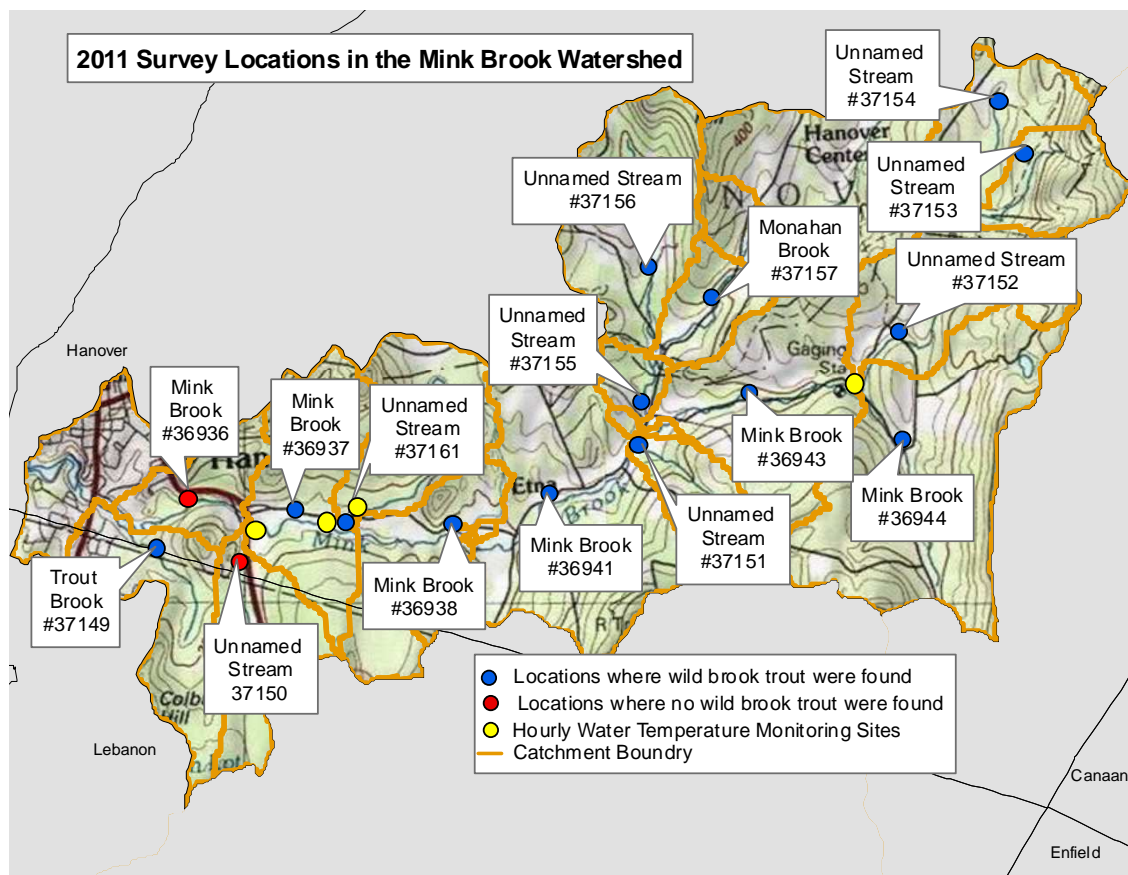
As with several fish and wildlife species found in New Hampshire, the presence or absence of wild brook trout populations can indicate the condition of aquatic habitat and water quality. Brook trout depend on cool, clean, and well oxygenated rivers and streams and can be very sensitive to environmental perturbations which may occur at rates ranging from instantaneous to gradual. Information collected on this species enables us to view the occurrence (or lack of occurrence) of brook trout as a sentinel species that represents the health of aquatic ecosystems, as well as our footprint on the landscape.

Brook trout are susceptible to changes in water chemistry and alterations to their physical habitat. Unfortunately, these changes to water chemistry and aquatic habitats may be difficult to recognize. Unlike a toxic chemical spill that may immediately kill aquatic organisms, the more common attributes that displace brook trout populations occur very slowly with no clear sign of obvious impact. Changes to natural stream substrate can significantly reduce the ability of a wild brook trout population to survive and/or reproduce. Excessive sedimentation from a variety of sources can embed and cover natural stream features in which brook trout have evolved to depend on. When this occurs, spawning locations, stream macroinvertebrates, cover, and holding areas can be lost or impacted negatively. The habitat needs of wild brook trout coincide with our own desires to protect the quality of water supplies and recreational areas.

The brook trout is also an important game fish and symbolic figure in the heritage of New Hampshire. Records illustrating the importance of the species as a food source and sport fish in New Hampshire date back to the 17th century. Even today, the species is consistently one of the most highly pursued fish for freshwater anglers in the state. Additionally, the brook trout has been designated as the state fresh water fish.

Fish Community Assessments

To assess the status of brook trout within the Mink Brook drainage, the New Hampshire Fish and Game Department (NHFGD), in partnership with the Hanover Conservancy conducted electrofishing surveys in July, 2011. The 11,830 acre watershed was divided into smaller drainages, called catchments, so that the collective data from these different survey locations could be assembled to summarize the status of wild brook trout within the Mink Brook watershed. A minimum of 100 meters of stream length was electrofished in each catchment. Information that illustrates the current condition of brook trout habitat as well as length and weight data for each fish captured was collected at each survey location.



Electrofishing and temperature monitoring locations in the Mink Brook Watershed, 2011

Hourly water temperature was monitored at four different locations within the Mink Brook watershed throughout the months of July and August. This information can be a useful tool to help identify locations having the potential to support wild brook trout habitat, areas available for summertime thermal refuge, and areas with water temperatures that would likely preclude wild brook trout from being present. Water temperature monitoring can also be used as a surrogate to evaluate effects of stormwater runoff by observing stream temperatures after rain events.

Relative Abundance

Relative Abundance

A total of nine different fish species were found to inhabit the rivers and streams within the Mink Brook watershed. Informational profiles for these fish species are included in the Appendix. The species observed included: wild brook trout, Atlantic salmon, blacknose dace, creek chub, fallfish, longnose dace, longnose sucker, slimy sculpin, and yellow perch. In terms of overall species relative abundance in the Mink Brook watershed, blacknose dace were most abundant, representing 35.4% of the total number of fish captured. Wild brook trout (32.0%) and creek chub (13.9%) represented the second and third most abundant species, respectively. The other fish species were less abundant, each consisting of less than 10% of the total fish captured during the 2011 surveys.

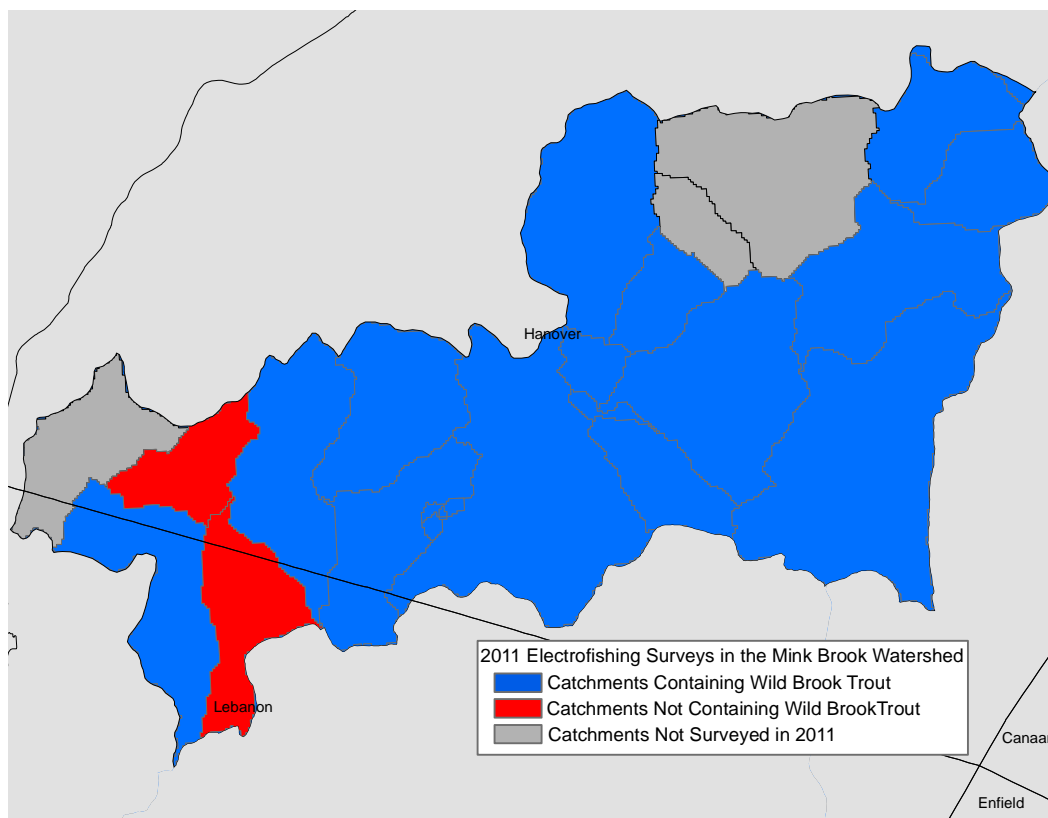
Survey Site	Atlantic Salmon	Blacknose Dace	Creek Chub	Brook Trout	Fallfish	Longnose Dace	Longnose Sucker	Slimy Sculpin	Yellow Perch
Mink Brook-36944		3		19		4	6		
Unnamed Stream-37152				22					
Unnamed Stream-37154				38					
Mink Brook-36943	12	42		21			1		
Unnamed Stream-37153				23					
Unnamed Stream-37156		2		9					
Mink Brook-36941	15	21	2	8		7	3		
Monahan Brook-37157		16	1	6					1
Unnamed Stream-37155		7	27	1					2
Unnamed Stream-37151				14					
Mink Brook-36938	5	19	18	4	1	7	3		2
Unnamed Stream-37161		6	13	2			2		
Mink Brook-36936	17	75				13	1		
Unnamed Stream-37150		11	4						
Mink Brook-36937	6	35	28	6	10	3	3		
Trout Brook-37149				41				1	
Total Number of Each Species Captured	55	237	93	214	11	34	19	1	5
Watershed Wide Relative Abundance of Each Species	8.2%	35.4%	13.9%	32.0%	1.6%	5.1%	2.8%	0.1%	0.7%
The Occurrence of Each Species at Different Sites	5	11	7	14	2	5	7	1	3
Summary of total captures, relative abundance, and occurrence by species and location									

Fish Species Occurrence

The occurrence of fish species at different survey sites can be a reflection of aquatic habitat, current and historical adjacent land uses, and micro watershed characteristics. During the sixteen different survey locations within the Mink Brook mainstem and tributaries, wild brook trout were found at 14 different locations making it the most widespread species. Blacknose dace were found to be present at 11 locations while creek chub and longnose suckers were each found at 7 different locations. The slimy sculpin, a species with similar habitat requirements as wild brook trout was only encountered at one location (Trout Brook).

Brook Trout Presence/Absence Information

Since the roughly 38 kilometers (23.6 miles) of stream within the Mink Brook watershed could not be completely surveyed, the assembled fish data was used to illustrate a representative description of the entire watershed. Wild brook trout were found at 14 of the 16 surveys locations (87.5%). Unfortunately, three catchments within the Mink Brook watershed were not surveyed in 2011. Access, time limitations and depths prevented these catchments from being surveyed.



A summary of wild brook trout presence in the Mink Brook Watershed, 2011

Surveys were focused at the approximate midpoint of each catchment. There are several advantages of using the scale of catchments for survey locations. The catchment model divides larger watersheds (Mink Brook) into smaller stream reaches based on localized drainages. An appropriate electrofishing survey length (minimum 100 meters) assumes

that all different fish species residing in the catchment will be captured. Within each of these units, information has already been developed to describe several features related to effects on water quality. Land-use (% developed, % agriculture, % forested), atmospheric deposition, physical characteristics (size, slope, % wetland), and other variable data are available to quantify estimated nutrient loading. Eventually, it is expected that a regional model will be developed to predict fish species presence or absence in areas with no survey information based on catchment data attributes and fish survey data from other locations.



Volunteers and Staff Electrofish a portion of Mink Brook, 2011.

The surveys show habitat quality for wild brook trout can vary throughout the Mink Brook drainage. But generally, the assemblage of collected data suggests at the watershed level, the Mink Brook drainage currently offers suitable intact habitat for wild brook trout. The two locations within the watershed that did not contain brook trout were both downstream of Rt. 120. These locations consisted of a smaller tributary and a section of the mainstem Mink Brook. Water temperature was likely a factor that precluded wild brook trout presence.

Wild Brook Trout Density and Recruitment

An additional analysis that illustrates the health of wild brook trout populations is population density. In streams where wild brook trout were found, density calculations were performed. The results ranged between 0.7 brook trout/100m² (Unnamed Stream-37155, near Partridge Rd) to 30.3 brook trout/100m² (Unnamed Stream-37153, near Three Mile Rd).

The ability for wild brook trout to reproduce is imperative for a population to be self-sustainable. A population consisting of various age and size classes is an indicator of good habitat condition. Water quality and habitat types must be suitable to support all life stages of fish to sustain the population. Sustainable populations show the habitat present provides ample amounts of forage, thermal refuge, spawning gravel, and protective areas to avoid predation and various weather impacts (flooding, frazil ice, etc.). Flows that have been amplified by impervious surface and constriction during stormwater runoff events can scour areas where eggs have been deposited. This impact can also compromise reproductive success by increasing sediment and silt (associated with upstream erosion) depositing on eggs, causing suffocation.

Scale samples can be taken and analyzed to determine the age class structure of brook trout in a stream. This analysis goes beyond the scope of our assessments but the collected data can provide some indication on the population's ability to reproduce. As a surrogate to scale samples, a length metric can be used to identify presence of juvenile fish hatched earlier in the year of the electrofishing surveys. A brook trout less than 90 millimeters is routinely expected to be a young of the year fish. Of the 14 streams where wild brook trout were detected, 12 of them contained young of the year brook trout (YOY brook trout) (having at least one brook trout with a length <90mm). Where present, the density of young of the year brook trout varied between 0.3 young of the year brook trout/100m² (Mink Brook-36938) to 18.0 young of the year brook trout/100m² (Unnamed Stream-37154).

Survey Site	Total # Brook Trout	Brook Trout Density (#/100m ²)	Total # YOY Brook Trout	Brook Trout YOY Density (#/100m ²)
Mink Brook-36944	19	12.7	11	7.3
Unnamed Stream-37152	38	10.9	12	3.4
Unnamed Stream-37154	22	22.0	18	18.0
Mink Brook-36943	21	4.2	9	1.8
Unnamed Stream-37153	23	30.3	12	15.8
Unnamed Stream-37156	9	8.2	9	8.2
Mink Brook-36941	8	1.5	2	0.4
Monahan Brook-37157	6	4.0	0	0.0
Unnamed Stream-37155	1	0.7	0	0.0
Unnamed Stream-37151	14	23.3	7	11.7
Mink Brook-36938	4	1.3	1	0.3
Unnamed Stream-37161	2	2.0	2	2.0
Mink Brook-36936	0	0.0	0	0.0
Unnamed Stream-37150	0	0.0	0	0.0
Mink Brook-36937	6	0.7	5	0.6
Trout Brook-37149	41	17.1	17	7.1

Density of wild brook trout and young of the year brook trout by survey location.

Water Temperature Monitoring

In 2011, four water temperature thermographs were deployed in the Mink Brook watershed. Three sections of the mainstem Mink Brook were monitored as well as a small tributary near Hollenbeck Lane. These thermographs recorded hourly water temperature for the Months of July and August. The thermographs were removed early, prior to the end of August (August 25) due to the potential of losing them during high flows associated with Hurricane Irene. An evaluation of summer water temperature can help explain the occurrence of fish species having variable tolerances to different water temperatures. Being a species dependent on cool water, wild brook trout are seldom found in streams with water temperatures that routinely exceed 70°F.

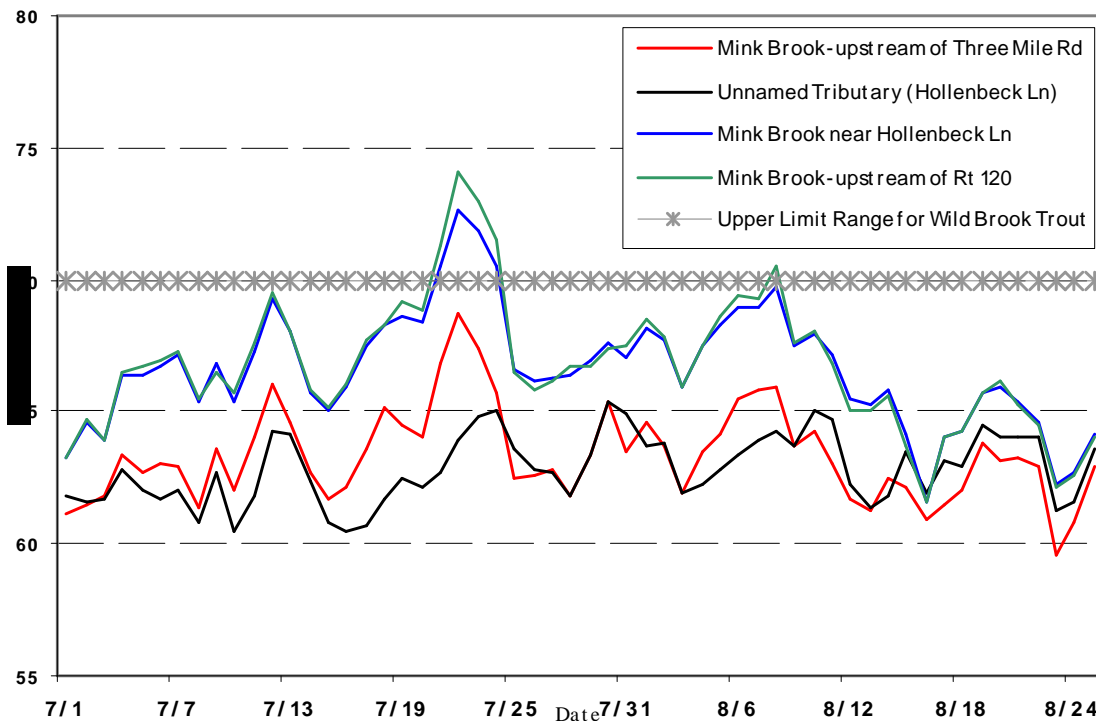
All four monitoring sites indicated that the average July water temperature was below 70°F in 2012. This suggests water temperature in 2011 was not a variable that limited wild brook trout presence for at least most of the Mink Brook watershed. While the two lower monitoring locations in Mink Brook did exceed 70°F, the duration may have been short enough for brook trout to exist in these warmer temperatures or the brook trout may have migrated to cooler upstream areas or where cooler tributary streams enter the mainstem. This illustrates the importance of habitat connectivity. If brook trout are unable to migrate to more desirable locations because of perched crossings and impoundments, they may not survive the summer. Water temperatures appear to increase as the drainage size of the Mink Brook watershed gets larger (as the brook flows toward the Connecticut River). This may explain why no wild brook trout were found at the mainstem site (Mink Brook-36936) well below our temperature monitoring locations. While hourly water temperature data is not available for the other survey location where no wild brook trout were captured (unnamed stream-37150), the water temperature recorded the day of the electrofishing survey occurred (78.4°F) is a good indicator that the conditions are not suitable for wild brook trout. This stream flows from a large wetland detention pond near Medical Center Drive.

The Mean Value of July and August Combined Water Temperature (MJAWT), Mean Value of July Water Temperatures (MJWT), and Mean Value of August Water Temperature (MAWT)* and ranges observed in the Mink Brook Watershed in 2011.

Site Name	Year	MJAWT (SD) Range	MJWT (SD) Range	MAWT (SD) Range
Mainstem Headwaters	2011	63.3 (±1.8) 59.6-68.6	63.6 (±1.9) 61.1-68.8	63.0 (±1.6) 59.6-65.6
Tributary near Hollenbeck Ln		62.8 (±1.3) 60.4-65.4	62.6 (±1.4) 60.4-65.4	63.2 (±1.1) 61.3-65.1
Mainstem near Hollenbeck Ln		66.6 (±2.2) 61.6-72.7	67.2 (±2.1) 63.2-72.7	66.0 (±2.2) 61.6-69.7
Mainstem above Rt. 120		66.8 (±2.5) 61.6-74.1	67.4 (±2.4) 63.2-74.1	66.0 (±2.4) 61.6-70.5

*MAWT includes records between 8/1/11 and 8/25/11. Thermographs removed before predicted flooding event.

Average Daily Summer Water Temperature at Four Locations within the Mink Brook Watershed, 2011



Observed Impacts to Water Quality and Brook Trout Habitat

Some attributes that describe current aquatic habitat conditions can be evaluated with modern day mapping software, but on the ground survey work is imperative to obtain a more complete sense of the health of aquatic systems. Survey crews have documented several alterations to the habitat and water quality that exists within the surveyed locations of the Mink Brook drainage. These alterations range from clearly visible current impacts, to historic land use practices that have altered the landscape and its drainage for an incalculable period of time. Potential impacts to wild brook trout were recorded at every survey location.

The lack of riparian vegetation, as a result of logging, lawns or adjacent road proximity, was the most common impact recorded. Impacts associated with erosion (scouring, sediment deposition, etc.) were routinely observed at these locations. Here, it was common to observe finer materials (silt and sand) embedding larger substrate. This can have an impact on stream macroinvertebrate communities and brook trout spawning locations. Excessive sedimentation and the subsequent increase of substrate embeddedness can also lead to an increase in stream width and a decrease in stream depth. When a riparian buffer is removed, the cooling ability from shading can also be reduced. As a stream flows through a watershed, the accumulation of sun exposed areas may increase stream temperatures to a point undesirable for wild brook trout. Other

observations noted were perched culverts, extensive stream bank armoring using riprap, stormwater drainage entering streams and litter.



Locations along Mink Brook (left) and a tributary to Mink Brook (right) where riparian areas have been removed. The natural stream bank stability, filtering ability and shading of a stream has been reduced.

Bank armoring to protect impacts to shorelines often goes hand in hand with the lack of a well established riparian buffer. When a well established vegetated riparian buffer is removed, the natural armoring ability found from rooted material is lost. The shorelines then become much more mobile and easier to move during higher flows. Often, heavy rock material is placed adjacent to or upstream of lawns, fields, crossing structures (culverts and bridges) and areas where streams flow close to roads. This armoring deflects erosive flows away from the shoreline protecting nearby areas from scouring away. Unfortunately, armoring usually prevents the stream from accessing its floodplain where some erosive flow can be dissipated. Instead, the erosive flow is passed further downstream to other shoreline areas. This impact can be amplified if armoring has resulted in a reduction of the stream channel width during flood flows.



An example of shoreline bank armoring on Mink Brook. During high flows, the stream is precluded from accessing its floodplain where the velocity of flows could be naturally reduced. Instead, erosive flows continue to downstream areas.

As with most of New Hampshire, much of the land within the upper valley was cleared for cropland and livestock grazing. In as early as the 17th century, the water retaining ability of old growth forests with thick layers of moss and detritus was becoming altered by the hand of man. The once slow absorption of water from rain and snowmelt which kept water tables high throughout the year was replaced by readily drained plowed fields carrying sediment laden runoff to aquatic systems. It is likely these rivers and streams were afforded minimal riparian buffers. The loss of recharge to water tables caused stream flow rates to drop in the summer months. Countless streams were reconfigured to generate water powered mills, creating impoundments that resulted in warmer water temperatures and fragmentation of aquatic habitats. Signs of these historical practices were observed at several of the surveyed locations. Stonewalls, barbed wire, and mill structures were frequently documented.

The impacts on aquatic systems associated with modern day activities can be very similar to those which occurred centuries ago. Increased concentrations of impervious surfaces prohibit rain and snowmelt to infiltrate soils and recharge ground waters. Instead, streams become flashy; significantly increasing in flow rate directly after storms or

melting events and then quickly returning to low flow levels. These large flushes of high water can increase erosion and sedimentation rates on streams. Additionally, runoff from impervious surfaces can introduce quick bursts of nutrients, petroleum hydrocarbons, warmer water temperatures, sand, chlorides, etc., into aquatic systems. Even low percentages of impervious surfaces (as low as 4% of watersheds) can significantly influence the presence or absence of wild brook trout. Stormwater drainage systems that convey runoff directly into streams were routinely observed during surveys within the some parts of the Mink Brook drainage. These were often associated with road/stream crossings or areas where development left minimal riparian buffer. Drainage from impervious surfaces should be directed away from aquatic systems to reduce the negative impact on aquatic communities.

There is a wide variety of stream crossing structures throughout the Mink Brook drainage. In some instances, stream crossings that were designed only to incorporate the passage of water flow can alter both stream habitat and aquatic communities. In addition to the ability for a crossing to facilitate the passage of a certain rate of flow, stream crossing design should also consider the specific geomorphic properties of the stream in question. Natural stream systems are in states of evolution or adjustment. Beyond water, streams are employed to convey organic (wood, leaves) and inorganic (sand) material. Several impacts related to crossing designs that do not incorporate the geomorphology of a stream include: culvert perching, scouring and sedimentation, blockage, undermining, road overtopping, and failure. Although the capital costs associated with a geomorphic design are expected to be larger, it is expected that costs related to maintenance overtime and replacement would be much less.



An example of a perched culvert on a tributary to Mink Brook. Crossings not designed with the accommodation of fish passage make it difficult for fish to access more desirable habitats.

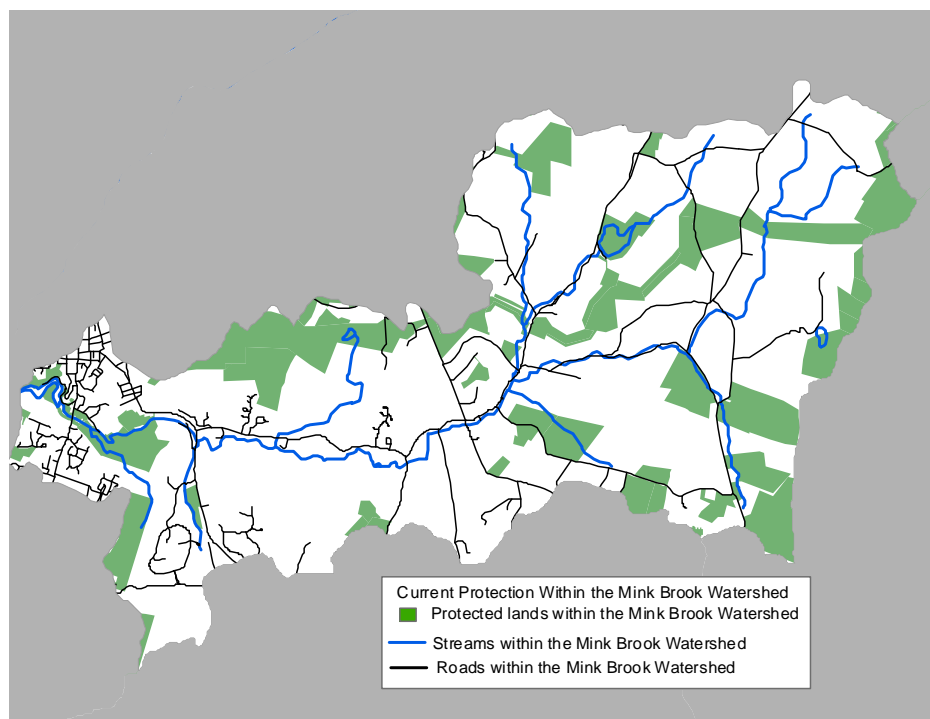
The most suitable stream crossing for fish is one that does not exist. Road design should first consider ways to avoid streams. If a stream crossing is unavoidable, designs should

attempt to make the crossing invisible to the stream. Flow rate, sediment transport, gradient, water temperature, and substrate should be identical within the crossing structure to the reference condition of the stream. Impacts to fish communities and habitat result when these conditions become altered. Undersized culverts that constrict streams and increase flow rates (particularly during storm flow events) often create scour pools (or perching) at the culvert outlet. Overtime, these can become barriers to fish movement. This scenario was observed at some of the locations surveyed. If a fish manages to access the culvert, flows may be too overwhelming for the fish to navigate through it. The creation of barriers can lead to wild brook trout not being able to access more desirable habitats for spawning, refuge from warm water temperatures, forage areas, etc. As a result, the population could become extirpated.

Wild brook trout are not often thought of as migratory fish and subsequently not often considered during roads design. However, radio telemetry studies in New Hampshire have shown larger wild trout can move over 20 miles in a single year. When a population becomes isolated, concerns regarding gene flow are also present. If a catastrophic event (acid flush event from snowmelt, extreme drought year, large plumes of sediment) occurred upstream of an impassable barrier (i.e. dam, perched stream crossing) that decimated a wild brook trout population, fish may not be able to repopulate the area.

Local Strategies for the Conservation of Wild Brook Trout

Land conservation and guidance on land use practices are essential to protecting brook trout habitat. Wild brook trout populations and humans can coexist, but concerted efforts must be made to limit impacts to the brook trout habitat. Land and water use guidance should be given for streams of all sizes within a watershed. Presumably, minor human impacts to smaller streams can be additive throughout the watershed and create problems that are not readily apparent until further downstream. Land use practices have to occur in ways that minimize their impacts on brook trout and their habitats. The cost to restore a population of any species is always higher than the cost to protect them. Restoration actions require a great deal of effort and may not always guarantee self-sustaining populations would return.



Headwater Stream Protection

The level of protection for headwater streams varies by town and is usually accomplished through zoning ordinances. Local zoning ordinances should be reviewed to determine whether they provide sufficient protection. Best management practices for agriculture and silviculture should also be promoted among landowners who abut headwater streams. Local environmental stewards need to be attentive and vocal when projects are proposed within the watershed that could impact aquatic systems. The Comprehensive Shoreline Protection Act (RSA 483-B) already offers some regulatory protection for a portion of Mink Brook when it becomes a fourth order stream (near Ruddsboro Rd). At a minimum, 100 feet (30 meters) of naturally vegetated buffers along all streams should be maintained. Preferably, vegetated buffers should be 300 feet (~100 meters). As buffer widths increase, more terrestrial species will use the wooded area as a travel corridor.

Additionally, riparian vegetation slows sediment and pollutant laden stormwater before it enters an aquatic system. Stormwater drainage designs that discharge directly into the stream should be avoided in favor of systems that filter stormwater into the ground (i.e. rain gardens, properly designed catch basins). Maintaining larger riparian areas also allow the ability for trees to fall into streams. The presence of large woody debris creates pools, cover, stream bank stability and complex habitat for fish species. When wood cover is allowed to persist in streams it may also slow and retain nutrient particulates. Taking steps to protect headwater streams will prevent irreversible losses to New Hampshire's biodiversity, as well as save countless dollars by protecting water quality and preventing flood damage. Therefore, communicating these protective measures to local policy makers is imperative.

Restoration

Efforts should also be implemented to restore riparian buffers and stabilize banks. These restoration efforts will protect both aquatic habitat and water quality. Since the demand for more development and land alteration and their subsequent strains put on aquatic systems is expected to continue throughout the upper valley, the need to provide systems that slow, stabilize, and infiltrate flows will always be needed. There are several different options and resources available to help guide the reestablishment of riparian areas and bank stabilization. As fisheries resource managers, we believe prioritization should be given to those streams where wild brook trout and/or species found on the state's threatened and endangered list exist.

Stream Crossing Inventories

Stream crossings should be evaluated within the Mink Brook drainage to determine if they are degrading habitat and/or obstructing fish passage. In some instances, stream crossings can be found that are no longer being used. For example, an abandoned crossing structure that likely precluded free movement was noted at the survey site for Unnamed Stream-37161. Stream crossing inventories used in conjunction with fish survey data can be used to determine the level of degradation of aquatic habitat as well as provide restoration focus priority areas. This should be communicated to local road agents and the New Hampshire Department of Transportation so that stream crossing upgrade projects can be developed, prioritized, and implemented.

Public Outreach and Education

Educational programs should be developed that inform both children and adults about the importance of the link between wild brook trout presence and good water quality.

Educators should emphasize the realization that environmental impacts caused by one person or one family in the Mink Brook drainage could have a lasting effect on them and their neighbors downstream. The key is to stress the needs of the wild brook trout, a focal species that is the essence of New Hampshire's rich heritage.

For More Information

Interested individuals and groups are encouraged to request site specific information by contacting the Inland Fisheries Division at New Hampshire Fish and Game (phone (603) 271-2501 or email benjamin.nugent@wildlife.nh.gov).

Useful Information:

- New Hampshire Stream Crossing Guidelines:
http://www.unh.edu/erg/stream_restoration/nh_stream_crossing_guidelines_unh_web_rev_2.pdf
- Importance of Shoreline Protection and Buffers, The NH Department of Environmental Services:
http://des.nh.gov/organization/divisions/water/wmb/repp/documents/ilupt_chpt_2_6.pdf
- Buffers for Wetlands and Surface Waters, A Guidebook for NH Municipalities:
<http://www.nh.gov/oep/resourcelibrary/referencelibrary/b/buffers/documents/handbook.pdf>
- New Hampshire Strategies for the Conservation of Wild Brook Trout Habitat:
http://www.easternbrooktrout.org/docs/EBTJV_NewHampshire_CS.pdf

Appendix. Profiles of fish species found in the Mink Brook Watershed.

Atlantic salmon parr



Atlantic salmon fry have been stocked in several tributaries to the mainstem Connecticut River as part of the effort to restore the species. Juvenile salmon were once prolific throughout the Connecticut River watershed but impoundments and impacts to water quality and aquatic habitat have limited the ability for adult salmon to return and successfully spawn. Fry, the life stage just after hatching, are stocked at rates dependent on identified habitat quality. The salmon will spend two to three years in riffles, rapid, and pool habitats associated with cooler water temperatures before attempting to return to the Atlantic Ocean. All salmon captured within the Mink Brook watershed were found within the mainstem section. The restoration strategy for the species in the Connecticut River is currently undergoing an adjustment. It is unclear if

Blacknose Dace



Blacknose dace are found in rocky streams with moderate to swift current. Less streamlined than their relative, the longnose dace, they take advantage of small pools and slower flowing water along the margins of streams with swift current. They feed on a variety of invertebrates and algae. They are more common in small headwater streams than in larger rivers. Often found associated with brook trout, their higher temperature tolerance gives them a wider distribution throughout New Hampshire. They are

considered tolerant of pollution and habitat alteration and may be found in both disturbed and undisturbed habitats.

Creek Chub



The creek chub is a commonly encountered fish species within the Connecticut River watershed. They seldom reach lengths in excess of five inches and tend to inhabit areas with both moderate and minimal flow. They can be differentiated from the fallfish by their dark spot present at the base of their dorsal fin. Similar to the fallfish, creek chubs deposit their fertilized eggs in constructed gravel nests in the spring. The widespread distribution of the species through the Connecticut River drainage makes the creek chub an important forage species for larger fish, birds, and piscivorous mammals.

Brook Trout



Adapted to coldwater streams, brook trout are rarely found in waters that exceed an average monthly temperature of 20°C (68°F) in July or August. Brook trout are powerful

swimmers and are often found in steep, cascading mountain streams where no other fish are present. Though some individuals may live their entire lives in one small stream, surveys using radio tags have shown brook can move many miles in search of thermal refuge, spawning habitat, or quality foraging areas. Brook trout are “sit and wait” predators, usually taking up residence in a pool and riffles where they feed on both aquatic and terrestrial invertebrates. Spiders, beetles, and other terrestrial invertebrates that fall into streams are a very important part of brook trout diets, especially in the spring. Brook trout seek out gravel beds with upwelling groundwater, often in small headwater streams, for spawning. Eggs are laid in small excavated nests in gravel, called redds, where they incubate through the winter and hatch in the early spring. Brook trout are more common in northern New Hampshire where cooler summer air temperatures maintain suitable summer water temperatures.

Brook trout are sensitive to habitat disturbance. An intact riparian zone provides both shade and prey in the form of terrestrial invertebrates. Removal of streamside vegetation may cause a stream to become too warm to support brook trout. Impervious surfaces and undersized culvers increase peak flows and cause erosion and sediment deposition, which may fill pool habitat and bury spawning gravel. Fragmentation is an important limiting factor when it comes to maintaining healthy brook trout populations because impassable stream crossings prevent brook trout from accessing critical habitat, like a cold stream in the summer or spawning habitat in the fall. Promoting groundwater recharge by limiting impervious surfaces and using low impact designed stormwater practices is critical for protecting brook trout populations.

Fallfish



The fallfish is New Hampshire's largest minnow species and one of the most common fish species in the state. It can grow to 255 mm (10") in length and reach ages over 10 years. It can be found in nearly any river or stream, but it is most abundant in medium sized rivers with a mix of rocky and gravel substrate. Fallfish males build nest mounds out of pebbles, one stone at a time. Spawning is communal, although usually initiated by the nest builder, with a number of females and surrounding males using a single nest. Larger individuals may move into smaller streams to spawn. Fallfish are generally considered indicators of river and stream habitat with year round flow.

Longnose Dace



Longnose dace inhabit swift flowing riffle sections of rivers and streams with boulder, cobble, and gravel substrate. Their streamlined shape and small air bladders make them well adapted to living along the bottom in flowing water. They feed on invertebrates in the crevasses between rocks and boulders. During spawning in late May, early June, males defend territories where females lay adhesive eggs in protected cavities between rocks. Longnose dace generally prefer flows greater than 45 cm/sec and temperatures that below 23⁰C.

Longnose Sucker



Longnose suckers inhabit medium and small sized streams with moderate flow and rocky substrates. They are differentiated by the common white sucker by their smaller scales, more pronounced snout and backward flaring lower lip. The species is found in most parts of the Connecticut River drainage in New Hampshire as well as the Androscoggin and Pemigewasset watersheds. Common white suckers have a greater distribution in the state and grow to larger sizes than the longnose sucker. Like the white sucker, the longnose sucker feeds on larval insects, snails, crustaceans, worms and algae. Both species spawn in the spring by depositing their fertilized eggs in shallow riffles with moderate flow.

Slimy Sculpin



The unique appearance of the slimy sculpin makes it very easy to identify the species in New Hampshire. The species has large wing-like pectoral fins and a long dorsal fin that extends for most of the body. Similar to the brook trout, sculpin inhabit cooler streams that have high to moderate flow. The species can also be found in deep cool water lakes and ponds. Slimy sculpin are found in all major watersheds in New Hampshire with the exception of the coastal drainage. The only location within the Mink Brook watershed where slimy sculpin were captured was Trout Brook. Slimy sculpin consume smaller fish, aquatic macroinvertebrates and vegetation. Like the brook trout, the species is particularly sensitive to adjacent land use that alters natural flows and increases sedimentation and substrate embeddedness.

Yellow Perch



The yellow perch is native to ponds, lakes, and slow flowing rivers throughout New Hampshire. It is usually abundant in stands of aquatic vegetation along shorelines in the summer. Yellow perch consume a wide variety of invertebrates and small fish species. Spawning takes place in the spring as water temperatures warm along the shorelines. Eggs are strewn in long ribbons over dead vegetation and the branches of fallen trees. Each female is followed by a group of males, attempting to fertilize the eggs as they are extruded. The abundance of yellow perch in most waters makes them an important forage species for many predators, including loons, otters, and largemouth bass. Often, yellow perch are encountered in uncharacteristic habitat such as shallow streams. These streams are usually downstream from lakes and ponds with abundant perch populations.