Brook Trout

Salvelinus fontinalis

Federal Listing	
State Listing	
Global Rank	
State Rank	S5
Regional Status	V. High

Photo by NHFG

Justification (Reason for Concern in NH)

Records suggest that brook trout were once far more abundant in New Hampshire than they are today (Noon 2003). Brook trout are sensitive to habitat alteration. The presence of a healthy brook trout population is generally considered a sign of a healthy stream with good water quality. Habitat degradation may exacerbate the decline of brook trout populations, especially at the southern and eastern edge of their range in New Hampshire. The species is thought to be extirpated in almost half of the watersheds in their native range in the United States (Hudy et al. 2008). In particular, historic self-sustaining, wild populations that once occupied larger river systems and lakes and ponds have been significantly reduced.

Distribution

Brook trout are found in coldwater habitat throughout New Hampshire. The species is native to eastern North America, although it has been introduced into most western states (Hudy et al. 2008). The natural range of the brook trout includes the southern Appalachians, the upper Mississippi, and Great Lakes drainages, all of the northeastern United States, and eastern Canada (Scarola 1987).

Brook trout are more common in northern New Hampshire where inherently cooler summer air temperatures maintain suitable water temperatures. In areas where habitat is not fragmented by dams and perched stream crossings, brook trout will make seasonal migrations in search of quality foraging habitat, suitable spawning areas, refuge from warmer water during the summer, and areas with less ice scour in the winter.

Brook trout become increasingly dependent on groundwater streams as a steady source of cool water in the summer, particularly in southern areas of New Hampshire. Here, warm water temperatures may inhibit seasonal movements throughout the watershed, restricting the population to isolated streams where groundwater maintains cool water temperatures despite the daily air temperature fluctuations typical of midsummer. The handful of wild brook trout populations currently documented in southeastern New Hampshire are entirely dependent on small groundwater fed streams.

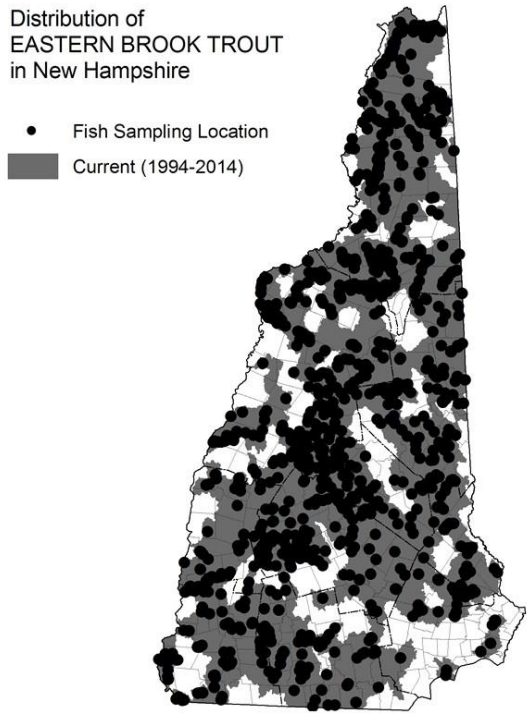
Habitat

Brook trout can survive in almost any clean, cold, well-oxygenated aquatic habitat, though they are unable to tolerate prolonged periods of water temperature over 20C (Scarola 1987). In areas of swift flow, brook trout prefer the shelter of pools created by boulders and woody debris (Curry et al. 2002). Brook trout spawn over gravel substrate in spring-fed headwater tributaries and along lakeshores

with upwelling groundwater (Scarola 1973, Quinn 1995).

NH Wildlife Action Plan Habitats

- Coldwater Rivers and Streams
- Lakes and Ponds with Coldwater Habitat



Distribution Map

Current Species and Habitat Condition in New Hampshire

Healthy brook trout populations are more commonly found in the northern and western parts of New Hampshire. Brook trout populations become restricted to isolated spring fed streams as one moves south of the lakes region and east of the Merrimack River. Although the NHFG has collected extensive data on brook trout distribution and relative abundance throughout the state, there is little information on long term population trends. Although abundance levels of brook trout are thought to have been reduced in some locations, clear evidence of brook trout extirpation from a watershed has yet to be documented in New Hampshire. Anecdotal historical records suggest that both the abundance and the average size of wild brook trout have declined.

Population Management Status

Habitat condition has the greatest influence on wild brook trout populations in New Hampshire and most conservation efforts focus on habitat protection or restoration. Population management strategies for protecting brook trout populations currently include regulations on angling pressure and changes in trout stocking practices intended to reduce impacts to wild brook trout populations. Translocations of brook trout into watersheds with restored habitat may be a potential strategy in the future. Brook trout monitoring efforts and stream restoration projects may create opportunities to expand the brook trout's range into stream reaches that had become uninhabitable due to habitat degradation.

Regulatory Protection (for explanations, see Appendix I)

- Harvest permit - season/take regulations

Quality of Habitat

New Hampshire still contains large expanses of relatively intact brook trout habitat especially in northern New Hampshire, the White Mountains, and the higher elevation areas of western New Hampshire. As one moves south and east, brook trout habitat becomes increasingly impacted by fragmentation from road/stream crossings, dams, and human development.

Habitat Protection Status

Habitat Management Status

Federal, state, and non-government agencies are collaborating on the Eastern Brook Trout Joint Venture, an initiative designed to assess the status of brook trout populations throughout the eastern United States. In New Hampshire, surveys are conducted to assess brook trout status by watershed. The results of these surveys are shared with local and regional conservation organizations and have become incorporated into a number of management plans, restoration projects, and land conservation efforts. For example, surveys conducted by NHFG in the Newfound Lake watershed raised awareness of the high quality brook trout habitat that exists in the rivers and streams which flow into the lake. Once brook trout status has been assessed in a watershed, restoration and protection projects can be targeted more effectively. Restoration projects usually focus on improving connectivity and increasing the extent and quality of the riparian zone. In some cases, wood is added to streams where a history of logging has reduced the number of pools created by trees falling into
the streambed. In other cases, vegetation may be allowed to regrow along the streambank to provide shade and prevent runoff from directly entering the stream. Stream crossing replacements and dam removals increase access to tributary spawning habitat and thermal refuge during the summer. These restoration efforts are most effective when conducted at the watershed scale with a group of engaged local volunteers. Establishing full time project manager positions and providing more consistent funding sources would greatly increase the number of restoration projects that could be completed each year.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a "medium" or "high" score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Disturbance from acid deposition (Threat Rank: High)

Acid rain has extirpated or reduced population densities of brook trout and other species in the northeast, especially in naturally acidic small streams and ponds at high elevations.

Episodic acidification of small streams has been shown to reduce brook trout densities and cause fish to seek refuge downstream in streams with higher pH (Baker et al.1996). Overall, episodes of acid rain are being reduced by tighter regulations on coal plants, but the buffering capacity of watersheds

where calcium has been leached from the soil may not recover on its own (Huggett et al. 2007).

Disturbance from stream crossings that fragment habitat (Threat Rank: Medium)

Undersized stream crossings act as barriers to the movement of aquatic species. Many stream crossings restrict movement at certain flows due to high velocities, insufficient depth within the crossing, or an outlet that is "perched" above the water surface, acting as a small waterfall. These barriers prevent access to critical habitat, reduce gene flow, and result in local extirpations of isolated populations.

A number of studies have demonstrated reductions in fish species richness and abundance upstream of impassable stream crossings (Jackson 2003; Nislow et al. 2011; Pepino et al. 2012).

Habitat degradation due to stream crossings (Threat Rank: Medium)

Poorly sized stream crossings alter the natural sediment transport characteristics of a river or stream, which leads to amplified rates of erosion and aggradation in the stream channel. The cumulative effect of under sized stream crossings can lead to increased sedimentation and turbidity throughout a watershed during storm events. Road fill from washed out stream crossings during flood events accumulates in the stream channel and buries the natural stream bed substrate. Additionally, road drainage is often directed into streams at crossing locations. This enables more contaminants (fine sediments and polluted runoff) to enter streams.

Observations of stream crossings during brook trout surveys in New Hampshire suggest that there are very few streams that do not show some habitat damage from stream crossings (Ben Nugent, NHFG Biologist, personal communication).

Disturbance from dams that cause fragmentation (Threat Rank: Medium)

Dams restrict the movement of aquatic species. Most aquatic species make daily and seasonal movements to access spawning habitat and foraging areas. Movement is also required in response to changes in water level, temperature, or water chemistry. Dispersal and colonization of new habitat is critical for long term population viability.

The effect of dams on diadromous fish species have been well documented (Limburg and Waldman 2009). Freshwater species are also impacted by dams, but the effects have been less studied. Dams have clearly restricted the dispersal of freshwater mussel species (Watters et al. 1996). Brook trout move extensively between habitats throughout the year and are therefore vulnerable to fragmentation by dams in headwater streams (Petty et al. 2012).

Disturbance from impoundments that increase temperature and convert habitat (Threat Rank: Medium)

Surface waters impounded by dams are generally exposed to solar radiation and often exceed the temperature tolerance of brook trout. Dams on coldwater rivers and streams not only fragment brook trout habitat, but increase water temperatures both upstream, in the impoundment, and downstream, as warm surface water flows over the dam.

There are thousands of dams throughout New Hampshire. The total area of coldwater stream habitat in New Hampshire that is under the influence of dams has not been evaluated.

Disturbance from streambank and channel modification (Threat Rank: Medium)

River and streams throughout the northeast have been straightened or armored as a result of flood control efforts, historic logging activity, and streamside development. These activities have impacted the natural channel features to which brook trout have adapted, including meander bends, undercut banks, and large wood in the stream channel.

Signs of channel straightening and bank armoring can be observed throughout the White Mountains where streams were used as sluiceways to move logs to sawmills downstream. Bank armoring is a common practice used to protect infrastructure built within the flood plain of a river or stream. The effects of these physical habitat impacts are difficult to separate from other impacts, such as acid rain.

Species impacts from competion (with introduced species) (Threat Rank: Medium)

Hatchery trout (brook trout, brown trout, and rainbow trout) released into New Hampshire rivers and streams may compete with native brook trout populations.

Trout and other species are stocked throughout the state, but the effects on wild brook trout are difficult to assess in New Hampshire. Studies at Nash Stream, in northern New Hampshire, suggest that there may be less competition between wild and stocked trout than expected (John Magee, NHFG Biologist, personal communication). Stocked rainbow and brown trout have contributed to the decline of brook trout in southern states (Hudy et al. 2008). The acidic water chemistry of New Hampshire rivers and streams prevents rainbow and brown trout reproduction in most watersheds.

Disturbance from stormwater run-off from impervious surfaces (Threat Rank: Medium)

Stormwater runoff from impervious surfaces changes the hydrology of local rivers and streams. Flashier flows cause an increase in erosion and sediment deposition along stream banks and in the stream channel. More surface flow over impermeable surfaces reduces the volume of water able to infiltrate into the ground and recharge groundwater supplies, which results in lower base flows during dry periods. Oil based pollutants, sediment, and road salt are washed from roads and parking lots into surrounding waterbodies which can lead to chronic declines in water quality. NHFG water temperature monitoring data illustrates how runoff from pavement warmed by the sun can also lead to increased temperatures in local streams when stormwater flows directly into surface waters (NHFG unpublished data).

The impacts of impervious land cover on aquatic habitats have been well documented (Wang et al. 2001; Cuffney et al. 2010; Stranko et al. 2008). Impervious surfaces have increased significantly in southern New Hampshire over the past decade.

List of Lower Ranking Threats:

Disturbance from water withdrawal that causes perennial streams to become intermittent and reduces base flow

Disturbance from reduced area of coldwater habitat

Actions to benefit this Species or Habitat in NH

Dam removal

Primary Threat Addressed: Disturbance from dams that cause fragmentation

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:
Improve habitat connectivity and reduce the impacts of dams on coldwater river and stream habitat.

General Strategy:
Ideally, dam removal projects on coldwater streams should target dams that either fragment large networks of coldwater stream habitat or dams that increase water temperatures and degrade the stream habitat to conditions that no longer support brook trout downstream or within the impoundment. Identifying these dams requires a relatively extensive fish survey effort to identify healthy brook trout populations that would benefit from the habitat restoration and improved access following the dam removal. Once a dam is identified for removal, the process is the same as it is for projects targeting diadromous fish restoration. A dedicated project manager is critical for meeting permitting deadlines and managing the many issues that often arise during dam removal projects, such as the removal of contaminated sediment or documenting the historical value of the site. Despite efforts to prioritize, dam removal projects often come up opportunistically as smaller dams fall into disrepair and become expensive to maintain. Grant funding for dam removal projects is available, but limited, so resources should be directed at projects with the greatest benefit to coldwater stream habitat.

Political Location: **Watershed Location:**

Stormwater Management

Primary Threat Addressed: Disturbance from stormwater run-off from impervious surfaces

Specific Threat (IUCN Threat Levels): Pollution / Domestic & urban waste water / Run-off

Objective:
To reduce the impacts of runoff from impervious surfaces by using Low Impact Development Technology.

General Strategy:
Stormwater runoff from impervious surfaces has been shown to damage aquatic habitats (Wang et al. 2001; Cuffney et al. 2010). Much of this damage can be prevented by stormwater management practices that filter runoff through the ground before it enters surface water. This practice not only removes much of the sediment and toxins that are typically washed into streams, but it also reduces the rapid fluctuation in temperature, as well as the excess erosion and sediment deposition that have become a chronic issue for rivers and streams in developed areas. The University of New Hampshire Stormwater Center is an excellent resource for Low Impact Development (LID) practices for stormwater management.

Political Location: **Watershed Location:**

Riparian Buffer Protection

Primary Threat Addressed: Disturbance from streambank and channel modification

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:
Preserve the water and habitat quality of rivers, streams and the shorelines of lakes and ponds by preventing development in the riparian zone.

General Strategy:
Riparian buffer protection can be achieved through town ordinances, state law (i.e. the Shoreland Water Quality Protection Act), deed restriction, conservation easement, or voluntary land use practices (such as forestry best management practices). In general, the wider the buffer protected, the more ecological benefit. A buffer of at least 10m will provide a minimum level of water quality and habitat benefits. A protected buffer of 100 m or greater provides maximum water quality and habitat benefits while also acting as a migration corridor for larger species of wildlife. Buffer protection is lacking on headwater streams despite the cumulative effect that intact riparian zones in headwater streams have on downstream water quality.

Political Location: **Watershed Location:**

Improve regulations

Primary Threat Addressed: Disturbance from streambank and channel modification

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:
Improve regulatory protection for brook trout and coldwater stream habitat

General Strategy:
Work with NHDES to refine Indexes of Biotic Integrity (IBI's) for coldwater streams to help document habitat alterations and enforce violations of the Clean Water Act. Submit brook trout records to the Natural Heritage Bureau for review under the NHDES Environmental Permitting process. Promote improvements in riparian buffer protection along 1st, 2nd, and 3rd order streams at the town and state level.

Political Location: **Watershed Location:**

Eastern Brook Trout Joint Venture (EBTJV) Surveys

Objective:
Continue to monitor the distribution and status of brook trout in New Hampshire as a partner in the EBTJV

General Strategy:
Conduct backpack electrofishing surveys in suitable habitat using protocols developed under the EBTJV to monitor the status of brook trout populations in New Hampshire. Communicate survey results and recommendations to local and regional conservation organizations. Facilitate projects to with the goal of protecting healthy populations and reducing declines in vulnerable populations according to the objectives of the EBTJV. Develop representative index sites throughout New Hampshire to monitor long term trends in abundance, size, and age class structures.

Political Location: **Watershed Location:**

Stream crossing restoration

Primary Threat Addressed: Habitat degradation due to stream crossings

Specific Threat (IUCN Threat Levels): Transportation & service corridors

Objective:
Increase connectivity and reduce habitat degradation caused by stream crossings.

General Strategy:
There are two phases to stream crossing restoration. The first phase is assessment. Stream crossing surveys are currently being completed in watersheds throughout the state. It is important that these surveys follow the standardized methods and protocols outlined by the New Hampshire Geological Survey (NHGS). NHGS maintains a statewide database of stream crossing survey data. Once the data is collected, stream crossing restoration projects can be prioritized to achieve the greatest benefits to aquatic organism passage, along with reductions in flood damage and habitat degradation. Prioritization may take place within small watersheds or across a large region. The second phase is implementation. Once a stream crossing is identified as a good candidate for restoration there are many obstacles to a completed project, including permitting and cost. Streamlining the permitting process for crossing restoration, increasing available funding sources, and developing innovative stream crossing design and construction techniques that significantly reduce cost would greatly increase the number of stream crossing restoration projects in New Hampshire.

Political Location: **Watershed Location:**

Land Protection

Primary Threat Addressed: Disturbance from stormwater run-off from impervious surfaces

Specific Threat (IUCN Threat Levels): Pollution / Domestic & urban waste water / Run-off

Objective:
Preserve the natural ecological functions of an area by protecting land from development.

General Strategy:
Land protection is a strategy that can be used to ensure a level of habitat quality that is necessary to support certain species and habitats of conservation concern. For aquatic species, land protection prevents many of the impacts caused by sprawling development. Groundwater recharge, intact riparian zones, and unrestricted migration corridors are some of the benefits. Species with limited ranges and mobility may be protected almost entirely through land conservation. For wider ranging species, such as brook trout, land protection will be part of a greater restoration strategy. Land protection projects in New Hampshire usually require the coordination of a variety of funding sources, with involvement from town conservation commissions, local land trusts and watershed associations, government agencies, and state or national NGO's. Since 2005, the NH Wildlife Action Plan has helped direct land protection efforts toward conserving habitat for species and habitats of concern. The effectiveness of land conservation could be improved by identifying and addressing barriers to land conservation in New Hampshire and increasing outreach to help prioritize projects that benefit species and habitats of concern.

Political Location: **Watershed Location:**

Wood addition

Primary Threat Addressed: Disturbance from streambank and channel modification

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:
Increase the amount of wood in coldwater stream habitat to improve habitat for brook trout.

General Strategy:
The logging history of forests in the northeast has resulted in channelized streams surrounded by relatively young forests. Streams surrounded by old growth forests contain large quantities of fallen wood. Much of this wood becomes lodged in the stream channel where it alters stream flow in a manner that traps sediment and scours deeper pools. These deep pools and gravel spawning substrate make ideal brook trout habitat. Some streams with extensive logging histories are characterized by long stretches of homogenous riffle habitat with very few pools and a lack of appropriate gravel spawning substrate. Adding wood to a stream is a technique used to simulate a stream surrounded by older forest and to restore some of the stream habitat features that brook trout had adapted to before large scale logging operations altered the age composition of northeastern forests. Wood additions also reengage floodplains. This allows high flow events to be dissipated away from the stream channel, reducing scour rates.

Political Location: **Watershed Location:**

References, Data Sources and Authors

Data Sources
NHFG biologists conduct surveys to establish the distribution and status of brook trout populations

in watersheds throughout the state.

Data Quality
NHFG maintains a fish database with over 4000 survey records from the early 1980's to the present. Since 2007, NHFG has partnered with local conservation groups to assess and summarize the status of wild brook trout throughout New Hampshire. Although there are still many gaps in the data, more distribution and status information is available for brook trout than for most other fish species of concern in New Hampshire.

2015 Authors:
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2005 Authors:

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