Bridle Shiner

Notropis bifrenatus

Federal Listing	
State Listing	T
Global Rank	
State Rank	S1
Regional Status	V. High

Photo by NHFG

Justification (Reason for Concern in NH)

The bridle shiner is declining over most of its range (Sabo 2000). In Pennsylvania, where the bridle shiner is listed as endangered, its range has been reduced to 1 site out of 31 historical sites (Finger 2001). Bridle shiners have been extirpated from the state of Maryland and from a number of waterbodies in Massachusetts. Despite an extensive survey effort, the New Hampshire Fish and Game Department (NHFG) documented bridle shiners at only 8 of 30 sites where they were recorded as present in 1947 (Harrington 1947).

Distribution

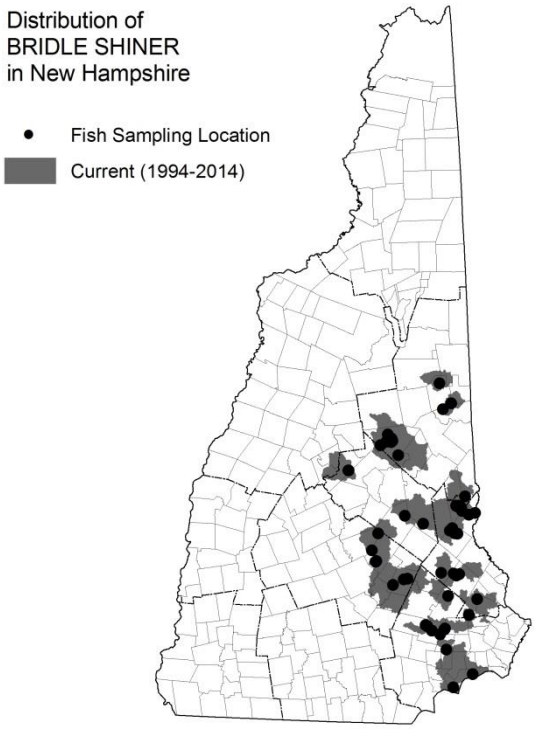
The bridle shiner was once widely distributed throughout the Atlantic coastal plain from North Carolina north to the St. Lawrence River and eastern Ontario (Scott and Crossman 1973). In New Hampshire, bridle shiner populations are scattered throughout the Merrimack River, Saco River, and coastal river watersheds.

Habitat

Bridle shiners depend on dense communities of submerged aquatic vegetation for survival (Harrington 1947). This habitat may be found along the shorelines and coves of lakes and ponds usually associated with adjacent wetlands, the backwaters of larger rivers, and in slow flowing streams.

NH Wildlife Action Plan Habitats

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



Distribution Map

Current Species and Habitat Condition in New Hampshire

Of the 30 sites where bridle shiners were recorded in 1947, 8 sites continue to support bridle shiner populations. Bridle shiners were not found at six of the 30 sites, but the survey effort was not sufficient to be confident that bridle shiners had been extirpated from the area. At 16 of the 30 sites, extirpation was determined to be likely based on an extensive survey of the area or obvious factors, such as habitat loss, that would explain the absence of bridle shiners at the site. Since 2005, NHFG Biologists have documented the presence of bridle shiners at a total of 57 sites, with many new records from previously undocumented locations. Populations appear to be stable at some locations, while they have declined or disappeared from other sites due to changes in habitat. The full extent of occupied bridle shiner habitat in New Hampshire has yet to be determined.

Status of known bridle shiner populations:

Jones Brook Watershed:
All areas of suitable habitat are occupied by abundant bridle shiner populations. The Jones Brook watershed contains one of the best examples of a healthy, intact bridle shiner population.

Coffin Brook Watershed:
All areas of suitable habitat are occupied by abundant bridle shiner populations. The Coffin Brook watershed supports a healthy, intact population in need of protection.

Appendix A: Fish

Trout Pond:
Arguably the most abundant population observed to date, possibly due to the absence of warmwater predator fish species in the pond. The shoreline of the pond is entirely undeveloped.

Purity Lake and associated ponds:
Bridle shiners were found in Purity Lake and Long Pond, but not in the more developed Danforth Pond. There are likely more bridle shiner populations in this watershed, which drains into Ossipee Lake.

Winnipesauke Lake:
Bridle shiners are present in vegetated coves along the northern shore of the lake, within the town of Moultonborough. These coves are usually bordered by wetlands and less developed. Some populations, including the bridle shiners documented in Fish Cove in 1938, appear to have been extirpated. Bridle shiner numbers appear to have been greatly reduced after broad scale herbicide treatment to control variable milfoil in Blackey's Cove and Moultonborough Bay.

Wentworth Lake:
Healthy populations of bridle shiners exist in larger wetland coves and tributaries. Milfoil control, shoreline development, and dredging for boats docks have likely extirpated populations in smaller coves.

Northeast Pond:
Bridle shiners are extremely abundant at the north end of the lake, where Branch Brook and the Salmon Falls River enter the lake. They are likely present at other locations in the upper Salmon Falls and Branch Brook watersheds.

Suncook River watershed:
Recorded as abundant in the 1930's, bridle shiners now appear to be rare in the Suncook River watershed. They have been documented in the river upstream of the Suncook Lakes and in a vegetated cove at the north end of Crystal Lake. There is a small population in the Little Suncook River, upstream of the Cass Pond Dam. Bridle shiner populations in the lower river may have been extirpated by the severe flooding and resulting sediment deposition that occurred in May of 2006.

Soucook River watershed:
Bridle shiners are still present at two locations in the mainstem river where they were recorded in the 1930's. No other populations have been discovered in the Soucook River watershed.

Exeter River:
Bridle shiners were relatively common in areas of suitable habitat throughout the river reach between Exeter River Dam and the Hooke Dam in the town of Fremont. Suitable habitat exists in other sections of the Exeter River, but they have yet to be surveyed.

Powwow River:
Bridle shiners were found in the Powwow River during surveys conducted in 2006, but not in Powwow Pond. They may also be present in suitable habitat in neighboring watersheds.

Lamprey River:
Bridle shiners are found in slow flowing, deeper sections of the river with aquatic vegetation, mostly in the town of Raymond. The record of a bridle shiner population below Packer's Falls in the town of Lee has not been confirmed.

Upper Cocheco River:
There are healthy populations in a series of relatively undisturbed wetlands that make up the headwaters of the Cocheco River in Farmington. Bridle shiners have not been confirmed elsewhere in the watershed.

Pemigewasset Lake:
Bridle shiners were found at the outlet of the pond, where habitat appears to be intact.

Isinglass River:
Bridle shiners have only been found at one of two sites with historical records. They continue to occupy a very small patch of suitable habitat upstream of Rt. 202. The habitat at the other site, downstream of Bow Lake, no longer appears to be suitable for bridle shiners.

Garland Pond:
The bridle shiner population appears relatively undisturbed in this pond due to the lack of shoreline development and intensive milfoil control efforts, which have impacted habitats downstream.

Lee's Pond:
Bridle shiners appear to be at very low abundance in Lee's Pond, possibly on the verge of extirpation. The pond has a long history of herbicide treatment for variable milfoil.

Upper Saco watershed:
Bridle shiners were found in Middle Pea Porridge Pond, but not Crystal Lake or Pequawket Pond. More surveys are needed in this area. Populations appear to be patchy in the upper Ossipee and Saco River watersheds, but healthy where they exist.

Bridle shiner extirpations:

Oyster River:
The bridle shiner population in Mill Pond, an impoundment on the Oyster River, was studied extensively by Harrington (1947). The population appears to have been extirpated from the pond, possibly during the construction of a fish ladder, which required draining the impoundment upstream of the dam in the 1970's.

Wheelright Pond:
Noted as present by Harrington (1947), bridle shiners appear to no longer exist in the pond. The cause of extirpation is unknown. Current habitat appears suitable for bridle shiners.

Canobie Lake, Shadow Lake, Pleasant Lake, and Winnisquam Lake:
Extirpated due to loss of habitat from shoreline development.

Merrimack River:
Extirpated from multiple sites. Habitat has been altered due to channelization and flood control. Very little aquatic vegetation left. Water clarity can be poor in the few remaining backwaters with suitable habitat.

Winnipesauke Lake:
Presumed extirpated from Fish Cove. The cove has a long history of herbicide treatments to control variable milfoil.

Heads Pond:
Bridle shiners may have been extirpated from the pond when the dam on the pond was breached, causing the water level to drop significantly. Habitat for bridle shiners appears suitable now that the pond has adjusted its new water level.

Suncook Lakes:
Presumed extirpated. The Suncook Lakes have a long history of intensive milfoil control, drawdowns, and aquatic vegetation loss from shoreline development.

Lower Suncook River (Downstream of the Suncook Lakes):
Bridle shiners were only found at one site in the lower Suncook River despite multiple records from 1938. Much of the suitable bridle shiner habitat in the lower Suncook River, south of the Rt. 4 bridge, was altered by the river avulsion and subsequent sediment deposition caused by flooding in May, 2006.

Lamprey River:
Bridle shiners were extirpated from the impoundment upstream of the Bunker Pond Dam after its removal in 2011. The river channel that formed in the accumulated sediment upstream of the dam was too shallow to support aquatic vegetation. A remnant bridle shiner population exists in a small manmade pond that drains into the river downstream from the old dam.

Warner River:
Recorded as present in 1938, but there is no sign of suitable bridle shiner habitat at the approximate site of the historical record. The population may have been extirpated due to habitat changes caused by a breached dam downstream from the site.

Jones Farm Pond:
Jones Farm pond is a small pond in Canterbury where bridle shiners were recorded in 1938. The pond may have once have been connected to the Merrimack River. It is surrounded by agricultural land and has become extremely eutrophic. There are no longer bridle shiners in the pond.

Population Management Status

There are no current population management efforts focused on bridle shiners. NHFG is considering reintroductions into suitable waterbodies. These waterbodies would meet the following criteria:
1)Bridle shiners were once recorded at the site.
2)Suitable habitat currently exists.
3)Extirpation was likely due to an isolated event (water level draw down or reclaimatio).
Potential reintroduction sites include Head's Pond (Hooksett) and Wheelright Pond (Lee).

Regulatory Protection (for explanations, see Appendix I)

- Endangered Species Conservation Act (RSA 212-A)

Quality of Habitat

Approximately 19,531 acres of bridle shiner habitat have been mapped in New Hampshire. Habitat quantity and quality vary significantly by region and waterbody. In general, the highest quality bridle shiner habitat exists in relatively undeveloped watersheds with natural flow regimes. The best example of intact bridle shiner habitat can be found from the lakes region east to the upper Saco,

Ossipee, and Salmon Falls River drainages. Habitat becomes generally more impacted as you move south and east. The following is a summary of bridle shiner habitat status in New Hampshire:

Jones Brook and Coffin Brook:
The Jones Brook and Coffin Brook watersheds provide the best examples of intact bridle shiner habitat. They are relatively undeveloped watersheds with large expanses of wetland stream habitat in various stages of beaver activity. Protecting these watersheds would help prevent the significant declines in bridle shiner distribution, due to habitat degradation, that have occurred in other states.

Ossipee River, Saco, and upper Salmon Falls River watersheds:
Occupied bridle shiner habitat is patchy, but generally intact throughout this region. These watersheds have been less impacted by development than watersheds to the south. Efforts to protect shoreline habitat in this region will have long term benefits for bridle shiner populations.

Lakes Region:
Habitat quality varies considerably in this region, with examples of both intact and highly degraded sites. Bridle shiners in the more developed lakes, such as Lake Winnipesauke, usually occupy coves surrounded by wetlands, which have prevented shoreline development in the area. Efforts to control variable milfoil have reduced the extent of submerged aquatic vegetation at many locations in the lakes region. Sudden removal of aquatic plants can cause serious declines in local bridle shiner populations by compromising reproductive success and removing protective cover.

Upper Cocheco and Isinglass River watersheds:
A few isolated populations remain in the upper portions of these watersheds. The habitat is relatively intact and conservation efforts should focus on adjacent riparian buffer protection.

Lamprey River watershed:
A number of bridle shiner populations have been identified in the upper Lamprey River mainstem. Aquatic habitat in the Lamprey River has been increasingly degraded by stormwater runoff and increased sediment loads from road stream crossings. Bridle shiner populations in the Lamprey River may be vulnerable to episodes of poor water quality and high turbidity after rainfall events. Bridle shiners were notably absent from an area of apparently suitable habitat downstream of the Raymond town center. Impervious surfaces are unusually high in this area. A recent study has shown a significant decline in freshwater mussel abundance and diversity in the Lamprey River (Nedeau 2011). Freshwater mussels play an important role in maintaining healthy freshwater ecosystems (Strayer et al. 1994).

Exeter River, Powwow River, and other watersheds in southeastern New Hampshire:
The Exeter River contains relatively intact bridle shiner habitat, although populations may be vulnerable to water level fluctuations at dams. Much of the river has yet to be surveyed. The Powwow River also contains bridle shiner habitat, but the total extent of the available habitat has not been mapped. There may be other bridle populations in the small wetland streams and ponds along the southern New Hampshire coastal plain. Aquatic habitat in the southern tributaries of the Merrimack River has been highly degraded and bridle shiners have not been recently documented in the area, including waterbodies with historic records such as Canobie Lake and Shadow Lake, where bridle shiners appear to have been extirpated.

Soucook:
There are two small bridle shiner populations in the Soucook River, which will benefit from efforts to protect riparian buffers and other restoration efforts in the upper Soucook River Watershed.

Suncook River:
Bridle shiner distribution has been greatly reduced in the Suncook River watershed. Populations upstream of dams are vulnerable to water level fluctuations and vegetation removal. Much of the habitat in the lower Suncook River is no longer suitable for bridle shiners due to flood damage in 2006.

Habitat Protection Status

Habitat Management Status

There are no current habitat management projects directed at bridle shiners.

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.

Habitat conversion and degradation due to shoreline development (Threat Rank: High)

Development along the shoreline of lakes, ponds, and larger rivers degrades critical habitat for aquatic species.

Aquatic plant removal, clearing of trees and branches that fall into the water, shoreline armoring, dock construction, tree and shrub thinning, and lawn maintenance are common practices associated with shoreline development. The cumulative effects of shoreline development combine to reduce habitat quality throughout a waterbody (Bryan and Scarnecchia 1992; Hicks and Frost 2010). Bridle shiners have been extirpated from a number of waterbodies where shoreline development has altered or eliminated aquatic plant communities.

Habitat conversion and degradation caused by water level management (Threat Rank: High)

Unnatural water level fluctuation can alter upstream lake and pond habitat. Lake drawdowns, usually during winter, reduce shoreline plant communities and expose aquatic organisms to desiccation. Poor recruitment may be an issue for species that spawn on shallow reefs or along the shoreline, depending on the timing and extent of the drawdown. River and stream habitat below lakes and ponds may also be impacted as flows are shutdown in an attempt to refill lakes or increased rapidly to lower the water level.

Bridle shiners are found in the slow moving sections of rivers and streams where shallow water and slow moving currents allow for the growth of submerged aquatic vegetation. These areas were favorable sites for the construction of mill dams as early colonists settled the region. Over many years, a large quantity of sediment has accumulated above these dams. When the dam eventually fails or is removed, the river or stream carves a new channel through the sediment and becomes a shallow, fast flowing stream type that no longer supports the aquatic vegetation on which bridle shiners depend.

Bridle shiners are particularly vulnerable to sudden water level drawdowns, especially during the spawning season in late spring and early summer. Their short life span of only one to two years

makes it difficult for the population to recover from the loss of even a single year class. The bridle shiner population documented by Harrington (1947) in the Oyster River in Durham may have been extirpated by a water level drawdown during the construction of a fish ladder in the 1970's. More recently, a dam removal on the Lamprey River in Epping extirpated the bridle shiner population that previously occurred in the pond-like habitat created by the impoundment.

Disturbance from eutrophication (Threat Rank: High)

Nutrients from agricultural sources, sedimentation, lawn fertilizers, and poorly functioning septic systems contribute to increased algal growth in lakes and ponds. This excess productivity causes reductions in water quality and eventually lower dissolved oxygen levels as microorganisms consume the dead algal cells, using up oxygen in the process.

Many lakes and ponds in New England show signs of degraded water quality due to cultural eutrophication (USEPA 2010). Increasing development pressure in southern New Hampshire has led to eutrophication issues with many of the water bodies that support aquatic species of concern, including banded sunfish, bridle shiner, redfin pickerel, swamp darter, and eastern pondmussel. Nutrient loading has been identified as a significant impact to bridle shiners in Quebec (Boucher et al. 2011).

Mortality from subsidized or introduced predators (Threat Rank: Medium)

Fish species including largemouth bass, smallmouth bass, black crappie, and northern pike are often illegally introduced into waterbodies by anglers to create new fishing opportunities. These introductions can significantly alter the species composition of a lake or pond.

Introductions of predator fish species have been implicated in an overall loss of minnow species diversity throughout the northeast (Whittier et al. 1997). Bridle shiners coexist with introduced predators in some waterbodies with relatively intact shorelines and an abundance of aquatic vegetation. When aquatic vegetation becomes sparse, due to shoreline development, water level drawdowns, or invasive plant control, predators like largemouth bass gain an advantage as it becomes easier to locate their prey. Introduced predators may not be a significant threat in waterbodies with healthy aquatic plant communities, but they may exacerbate the decline of bridle shiners as their habitat begins to degrade.

Species disturbance from impervious surface run-off (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 means that less water is able to infiltrate into the ground and recharge groundwater supplies, which results in lower base flow 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. Runoff from pavement warmed by the sun can also lead to increased temperatures in local streams when stormwater flows directly into surface waters.

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). Although declines or extirpations of bridle shiners are difficult to link to water quality issues related to stormwater runoff, populations in southern New Hampshire may be at risk as impervious surface coverage continues to expand in the region. In the Lamprey River, sections of apparently suitable habitat are unoccupied by bridle shiners downstream from an area of high impervious surface coverage in the town of Raymond. As a visual forager, bridle shiners may be particularly sensitive to periods of increased turbidity caused by stormwater runoff from impervious

surfaces.

List of Lower Ranking Threats:

None

Actions to benefit this Species or Habitat in NH

Threat assessment

Objective:
Assess the long term viability of bridle shiner populations in areas with declining habitat quality.

General Strategy:
Some bridle shiners in New Hampshire have shown signs of decline and may be at risk for extirpation. Significant reductions in aquatic vegetation due to herbicide treatments for variable milfoil in Lake Winnipesaukee have resulted in a decrease in the number of bridle shiners observed in the vegetated coves of Moultonborough Bay. It remains to be seen whether the bridle shiner population will recover as vegetation returns. Bridle shiners appear to be absent from sites with suitable habitat in the Lamprey River. Water quality degradation from stormwater runoff may be a factor. Rapid water level fluctuations or dam removals have greatly reduced or extirpated bridle shiners at some locations. An understanding of how threats impact bridle shiner populations and their ability to withstand changing habitat conditions is needed to better protect the species. Causes of extirpation should be documented when possible.

Political Location: **Watershed Location:**

Reduce nutrient loading

Primary Threat Addressed: Disturbance from eutrophication

Specific Threat (IUCN Threat Levels): Pollution

Objective:
Reduce the impacts of eutrophication by removing excess sources of nutrients.

General Strategy:
The primary sources of excess nutrients are lawn fertilizers in residential and commercial developments, agricultural fertilizers, and poorly functioning septic systems. Reducing nutrient loads can be achieved on two fronts. One is through outreach, which includes creating awareness about the effects of fertilizers on water quality and offering alternatives to fertilization practices that lead to the greatest amount of nutrient loading in nearby waterbodies. Best management practices can be developed for property owners with a focus on reducing runoff, minimizing or eliminating fertilizer use, and landscaping in a way that reduces the need for fertilization. In the case of septic failure, shoreline property owners with older septic systems can be targeted with incentives for upgrading. The second front is legislative. Laws that set limits on fertilizer use and require upgrades to septic systems will have long term benefits on water quality throughout the developed watersheds of southern New Hampshire. Requirements for new septic systems have greatly improved in recent years. The challenge is identifying and upgrading older systems that were constructed before septic systems were required to meet modern standards.

Political Location: **Watershed Location:**

Reintroduction

Primary Threat Addressed: Habitat conversion and degradation caused by water level management

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:
Reintroduce populations into suitable habitat within the species' former range.

General Strategy:
Bridle shiner extirpations have been documented in a number of waterbodies. In most cases, these waterbodies will no longer support bridle shiner populations due to habitat degradation. However, in some instances, extirpation was likely caused by an isolated incident such as a dam removal, a flood, or an extreme water level drawdown. In this case, habitat in the waterbody, which previously supported bridle shiners, may have recovered to a point that it would support a population of bridle shiners again. Bridle shiners could be introduced into these waterbodies from neighboring watersheds with healthy populations. This would help expand the current range of the species, which has suffered range wide declines (Sabo 2000). Two potential locations for reintroduction are Wheelright Pond in Lee and Heads Pond in Hooksett. Bridle shiners were documented in both waterbodies by Harrington (1947). Both waterbodies appear to have appropriate habitat for bridle shiners. The cause of extirpation in Heads Pond was likely a sudden water level drop due to a failed dam, which is currently in ruin. The cause of extirpation in Wheelright Pond is unknown.

Political Location: **Watershed Location:**

Distribution surveys

Objective:
Map the distribution of fish species of conservation concern.

General Strategy:
The bridle shiner distribution map is incomplete. New populations continue to be discovered each year. Areas that require more focus are the lakes, ponds, and low gradient streams of the Saco and Ossipee watersheds, the upper Salmon Falls and Cocheco River watersheds, the northern lakes region, and southeastern NH in the area of the Exeter and Powwow River watersheds.

Political Location: **Watershed Location:**

Reintroduction pilot study

Objective:
Assess the feasibility of reintroduction as a conservation strategy for bridle shiners.

General Strategy:
Bridle shiner reintroduction sites should be carefully monitored for factors that may limit successful recruitment. The long term viability of bridle shiner reintroductions at a limited number of pilot sites should be established before the strategy is expanded into additional waterbodies. An appropriate source of bridle shiners to be used for reintroductions remains to be identified. The efficacy of

culturing the species has not been evaluated.

Political Location: **Watershed Location:**

Water level management

Primary Threat Addressed: Habitat conversion and degradation caused by water level management

Specific Threat (IUCN Threat Levels): Natural system modifications

Objective:
Reduce the aquatic habitat impacts associated with artificial water level fluctuation at dams.

General Strategy:
Work with dam managers to achieve water level fluctuations that mimic natural flow regimes. Practices such as rapid changes in water level, excessive winter drawdown, and shutting off downstream flow to refill a waterbody should be avoided. Engaging stakeholders, including shorefront property owners, boaters, anglers, and hydropower project owners is critical to changing long established water level management traditions. The NHDES Dam Bureau is the lead on dam management issues in New Hampshire. The best strategy for improving water level management practices for fish and wildlife is to work with the Dam Bureau to identify opportunities to create more natural water level fluctuations at a certain dams and then make slow incremental changes. This allows stakeholders to adjust to the changes and make comments when conflicts arise.

Political Location: **Watershed Location:**

Shoreline Buffer Protection

Primary Threat Addressed: Habitat conversion and degradation due to shoreline development

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:
Protect important habitat features along the shorelines of lakes, ponds, and larger rivers.

General Strategy:
The NH Shoreland Water Quality Protection Act provides a minimum level of protection for shoreline habitat along New Hampshire's lakes, ponds, and rivers (third order and larger). While the Shoreland Water Quality Protection Act focuses on protecting natural vegetation along the shoreline, it falls short of protecting other important habitat features such as submerged aquatic vegetation and trees that fall into the water. Landowners often remove plants and trees from the water to improve access for swimming and boating. These trees and submerged aquatic plants offer important structure for spawning, foraging, and evading predators. Increasing the percentage of natural or undeveloped shoreline will improve the overall habitat quality in a lake or pond. Conservation easements, changes in zoning, legislative acts, or landowner outreach programs may be used to restore natural shoreline features to New Hampshire lakes and ponds, many of which have little remaining undeveloped shoreline. Landowners often remove plants and trees from the water to improve access for swimming and boating. These trees and submerged aquatic plants offer important structure for spawning, foraging, and evading predators. Increasing the percentage of natural or undeveloped shoreline will improve the overall habitat quality in a lake or pond. Conservation easements, changes in zoning,

legislative acts, or landowner outreach programs may be used to restore natural shoreline features to New Hampshire lakes and ponds, many of which have little remaining undeveloped shoreline.

Political Location: **Watershed Location:**

Land Protection

Primary Threat Addressed: Habitat conversion and degradation due to shoreline development

Specific Threat (IUCN Threat Levels): Residential & commercial development

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, land protection will be part of a greater restoration strategy. Although land protection is not a feasible strategy for some water bodies where bridle shiners have been documented, it will be an effective tool for protecting watersheds known to contain large expanses of intact bridle shiner habitat, such as the Jones Brook and Coffin Brook watersheds. 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:**

Stormwater Management

Primary Threat Addressed: Species disturbance from impervious surface run-off

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 waters. 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:**

Life history research

Objective:
Study the life histories of fish species of conservation concern in New Hampshire.

General Strategy:
There is a lack of basic information on the reproductive behavior, foraging habits, habitat requirements, seasonal movement patterns and other aspects of the life history of many lesser known fish species of concern in New Hampshire. A better understanding of these species would aid in the assessment of potential threats and the development of appropriate management actions.
Also of interest is their ecological role in aquatic communities and their potential use as indicators for water quality or intact habitat.

Political Location: **Watershed Location:**

References, Data Sources and Authors

Data Sources
NHFG biologists with the Fish Conservation Program of the Inland Fisheries Division have been conducting targeted surveys for bridle shiners since 2005. Historical bridle shiner distribution is based on the work of Harrington (1947) and NHFG survey records (1937-1939).

Data Quality
All sites with historical bridle shiner records have been resurveyed. Bridle shiner habitat has been mapped at most locations with known records. New bridle shiner populations continue to be discovered by evaluating similar habitats within watersheds where the species has been documented. NHFG biologists have been conducting surveys for bridle shiners since 2006. After identifying a number of likely extirpations during an initial status assessment of sites with historical bridle shiner records, NHFG biologists focused on identifying and mapping the distribution of the remaining bridle shiner populations throughout the state. Although there are gaps in the distribution map in northwestern and southeastern regions, distribution maps for a number of watersheds, including the Lamprey River, Jones Brook, Coffin Brook, and the Soucook River, have been completed.

2015 Authors:
Matthew Carpenter, NHFG, Benjamin Nugent, NHFG

2005 Authors:

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