

Northern Upland Watersheds

Associated Species: American Eel (*Anguilla rostrata*), Atlantic Salmon (*Salmo salar*), Burbot (*Lota lota*), Brook Trout (*Salvelinus fontinalis*), Finescale Dace (*Phoxinus neogaeus*), Lake trout (*Salvelinus namaycush*), Northern Redbelly Dace (*Phoxinus eos*), Rainbow Smelt (*Osmerus mordax*), Round Whitefish (*Prosopium cylindraceum*), Slimy Sculpin (*Cottus cognatus*), Tesselated Darter (*Etheostoma olmstedii*)

Federal Listing: Not listed

State Listing: Not listed

Global Rank: Not ranked

State Rank: Not ranked

Author: New Hampshire Fish and Game and The Nature Conservancy

ELEMENT 1: DISTRIBUTION AND HABITAT

1.1 Habitat Description

The landforms, elevations, and geology of northern upland watersheds are similar to moderate-south watersheds (Figure 3), but moderate-north watersheds are distinct because of their northern terrestrial communities, higher elevations, and separation from watersheds south of the White Mountains. Both the higher elevation and the northern climate result in rivers that support more coldwater fisheries compared to similar southern rivers.

Higher gradient, coldwater stream communities likely dominate this watershed group. Where there are wetlands, there may be some sinuous stream habitats with more stable water flows and warmer waters. There are few long reaches of mature rivers, which would tend to have slower water, deeper pools, and habitats within meanders and laterally varied substrates. The mainstem of the Androscoggin River may have some characteristics of slow and deep rivers, but

it is still fairly high up in the watershed and even the wide sections in New Hampshire have characteristics of faster and colder streams.

Moderate-north watersheds contain the headwater networks that support coldwater ecosystems and fisheries in the New Hampshire portions of the Androscoggin and Connecticut River basins. In addition, this watershed group contains some of the largest impounded reservoirs in New Hampshire. Both the dammed sections of the Ammonoosuc and Connecticut River Lakes provide artificial but unique lake-like habitats.

Moderate-north fine scale systems: 5, 7

Like moderate-south watersheds, the distinction between fine scale systems is subtle. Both fine scale systems 5 and 7 have similar geology, landforms, and elevations, but fine scale system 5 has a greater area above 762 m. Fine scale system 7 has a higher percentage of “big water” features, including large reservoirs, Lake Umbagog, more wetlands, and the large mainstem sections of the Androscoggin River. Fine scale system 5, by contrast, contains more of the highest headwaters and river tributaries.

1.2 Justification

Like northern terrestrial ecosystems, the aquatic systems of the North Country may provide unique ecological and evolutionary contexts for species assemblages. Potentially remote native trout streams, remote lakes and ponds, Lake Umbagog, and the unusually large reservoir systems, managed for industry (hydropower and timber) and recreation, provide settings found nowhere else in New Hampshire. There are slow streams meandering through lowland spruce fir flats and coldwater streams cascading down steep slopes.

1.4 Habitat Distribution

Moderate-north watersheds occupy the northern tier of New Hampshire, north of the major White Mountains drainages. Large tributaries to the upper reaches of the Connecticut and Androscoggin Rivers include the Perry, Nash, Indian Stream, Mohawk, Israel, and Upper Ammonoosuc Rivers to the west, and the Dead Diamond, Swift Diamond, and Magalloway Rivers to the east. Smaller native brook trout streams, such as Gore, Cone, and Smarts Mill Brook (among others) also flow directly into the Connecticut River mainstem in and around Colebrook. This watershed group straddles the Penobscot-Kennebec-Androscoggin and Upper Connecticut Ecological Drainage Units (EDUs). This watershed group is entirely within TNC's Northern Appalachians Ecoregion.

1.8 Extent and quality of data

Moderate-north watersheds are unique and clearly distinguishable from New Hampshire's other major watershed groups based on aquatic connectivity and geography. The difference between the fine scale systems is more subtle. There are differences in elevation, geology, and landform, but these may not control or influence biological communities. Nevertheless, representing both fine scale systems 5 and 7 in conservation plans will ensure a broader array of environmental settings.

2.1 Scale

Due to the large land area covered by the major watershed groups (Figure 3), a fine scale classification (Figure 4) was used, when possible, to assess the relative condition of aquatic habitats across the state. The types and sources of information were extremely variable and covered many different scales, and so the following sections refer to both the major and fine scale systems. The actual scale at which the natural conditions and processes lead to differences in aquatic communities is uncertain.

Moderate-north watersheds are divided into two conservation planning units (Figure 4). Fine scale system 5 includes 5 watersheds of the Androscoggin and Connecticut Rivers in northern New Hampshire with greater amounts of high elevation features. Fine scale system 7 includes 6 watersheds, also of the An-

droscoggin and Connecticut Rivers, but with more flat landforms and large lakes.

2.4 Relative Quality of Habitat Patches

Fine scale system 5 encompasses 1,709 km² (422,314 ac). Headwater streams (watershed area <77.7 km²) are the most common stream/river type within this system, comprising 75% of the total stream area. Small rivers (watershed area of 77.7-518.0 km²), medium rivers (watershed area of 518.0-2590.0 km²), and large rivers (watershed area >2590.0 km²) comprise 16%, 9%, and 1%, respectively. Moderate elevations (244-518 m) and high elevations (518-762 m) are most dominant, at 44.8% and 42.7%. Very high elevations (762-1371.6 m) comprise 12.5% of this system.

In fine scale system 5, the Connecticut, Mohawk (Colebrook), and Upper Ammonoosuc Rivers provide habitat for several life stages (e.g. spawning, nursery, rearing) of Atlantic salmon (Connecticut River Salmon Commission 1998, USFWS 2005). There is quality wild brook trout habitat in Pond (Stratford/Odell), Long Mountain (Stratford/Odell), Alder (Second College Grant), Lamb Valley (Second College Grant), and Lomis Valley (Second College Grant) Brooks, as well as in the west branch of the Mohawk River and Little Greenough Pond (Wentworths Location) (NHFG, unpublished data).

Fine scale system 7 encompasses 1,611 km² (398,047 ac). Headwater streams are the most common stream or river, comprising 64% of the total stream area. Small rivers, medium rivers, and large rivers comprise 18%, 11%, and 7%. High elevations and moderate elevations dominate at 49.5% and 45.8%. Very high elevations comprise 4.7% of this system.

An Androscoggin River basin study identified Umbagog Lake in Errol as having significant habitat value for waterfowl (USACE 1980). Lake Umbagog provides diverse habitats with relatively low disturbance, making it an important breeding ground for common loons (*Gavia immer*). Lake Umbagog and the adjacent wetland complex also provides ideal habitat for American black ducks (*Anas rubripes*), great blue herons (*Ardea herodias*), ospreys (*Pandion haliaetus*), bald eagles (*Haliaeetus leucocephalus*), and ring-billed gulls (*Larus delawarensis*) (USACE 1980). The lake provides fisheries for warm and coldwater

fish species. Smallmouth bass were illegally introduced into the system in the 1980s (Noon 1999) and expanding populations threaten salmonid populations in tributaries to the lake (Rapid, Magalloway, and Diamond Rivers) (Reardon and Zinc 2004). Clear and Chickwolnepy Streams (tributaries to the Androscoggin River) have ideal spawning and nursery habitat for Atlantic salmon (DeRoche 1967). However, spawning runs by anadromous fish in the Androscoggin River are blocked downstream of the New Hampshire border in Maine (USACE 1980).

Most lakes and ponds in the northern section of New Hampshire have a surface area less than 4.05 ha (10 ac) (94% of the total number). There are relatively few larger lakes and ponds. There is an average of 1.37 lakes/ponds greater than 4.05 ha per 100 km². The 4 lakes greater than 405 ha (1,000 ac) are First Connecticut Lake (1,243 ha or 3,071 ac), Lake Francis (783 ha or 1,934 ac), Second Connecticut Lake (446 ha or 1,102 ac), and Umbagog Lake (2,456 ha or 6,068 ac). Sixty percent of lakes and ponds are at elevations between 243.84-518.16 m (800-1,700 ft) and 38% are at elevations between 518.16-762 m (1,700-2,500 ft). Only 2% of lakes and ponds have elevations greater than 762 m (2,500 ft).

2.2 Relative Health of Populations

Land Use

Fine scale system 5 has the highest percentage of unfragmented land (94%) and the lowest percentage of developed land (0.8%) in New Hampshire. Low percentages of developed land correspond with the lowest road density in New Hampshire. The density of roads maintained by NHDOT is 0.17 km/km² and the density of private/gravel roads is 0.19 km/km². The estimated population for 2005 is 13,249 people, with a relatively low population density of 6.8 people/km².

Fine scale system 7 also contains large areas of unfragmented land (92%). The amount of developed land is very low compared to other units in New Hampshire (1.1% of total land). The density of NHDOT roads is 0.21 km/km² and the density of private/gravel roads is 0.25 km/km², which are both low. The estimated population for 2005 is 9,677 people, or 3.8 people/km², the lowest population density in the state.

Land uses along the upper Connecticut River

are rural and agricultural, with large areas of forested and undeveloped lands (NHDES 1991). The higher elevations of these areas may inhibit agricultural use. The total area of agricultural land is small compared to other parts of New Hampshire. Agricultural lands in fine scale system 5 and fine scale system 7 comprise 1.9% and 1.2% of the total land area.

Silviculture in northern New Hampshire can be intensive with various levels of regard for significant wildlife habitats and post-harvest effects to stream systems. Forestry management in the Second College Grant is implemented with the “highest standards of forestry practice” with goals of broad wildlife species and age class distributions (Dartmouth Outing Club 2005). Concern is growing as private companies purchase large tracts of land with the intent of heavy logging followed by reselling, without consideration for the subsequent effects on wildlife habitat. Current forestry policies in New Hampshire may encourage out-of-state logging companies to purchase land. Logging regulations in New Hampshire are less stringent than neighboring states, which have more regulations on clear cutting and the sale of woodlots post-cutting (Webster 2005).

Housing increases for census blocks adjacent to lakes and ponds in moderate-north watersheds were estimated using 1990 values and projected 2020 values (see Lake Type Classification for methods). Changes between rural (<0.063 housing units/ha), exurban (0.063 to 0.25 units/ha), and suburban (0.25 to 2.5 units/ha) housing densities could indicate increases in shoreline development, impervious surfaces, and nonpoint source pollution. Housing densities adjacent to lakes are not expected to change in this area by 2020.

Water Quality

The NHDES Volunteer Rivers Assessment Program (VRAP) reported on surface water quality of the Androscoggin River (NHDES 2004). Dissolved oxygen and turbidity levels at all sample sites met state requirements for class B waters. Turbidity levels increased near urban areas. The range of pH values (pH 6.37-6.79) was below state water quality standards for class B waters (standard is pH 6.50-8.0). Acidic precipitation and natural environmental conditions (e.g. soils, geology, wetland drainage) can lower pH values (NHDES 2004). Within the Androscoggin River watershed, there is mercury seepage from contaminated

groundwater and nonpoint source pollution caused by agriculture, stormwater runoff, and poorly managed timber harvests (C. Knox, Androscoggin River Watershed Council, personal communication).

On the upper Connecticut River, there are adequate amounts of dissolved oxygen, low levels of fine particles or organic matter embedded in sediments, and a variety of fish habitats (Francis and Mulligan 1997). The upper Connecticut River system provides a highly prized coldwater fishery. Sedimentation and turbidity are the two highest threats to this area (Francis and Mulligan 1997). Silviculture practices have catalyzed the rates of bank erosion, which introduces sediments and nutrients into the system (Francis and Mulligan 1997). High water temperatures in the summer, coupled with excessive nutrient levels, can significantly lower dissolved oxygen rates (Francis and Mulligan 1997).

Water discharges registered through NHDES are moderate in this area when compared to registered discharges throughout New Hampshire. The number of National Pollution Discharge Elimination System (NPDES) permits issued per river kilometer is 0.013 NPDES permits/river km for fine scale system 5 and 0.027 NPDES permits/river km for fine scale system 7.

Upstream forestry operations that cause sedimentation and increased turbidity can damage downstream fisheries. Siltation from timber harvesting in 1972 covered smelt eggs and decimated the smelt population in First Connecticut Lake (Francis and Mulligan 1997).

Invasive Species

There are no documented infestations of exotic aquatic invasive plants in either fine scale system 5 or fine scale system 7 (Smagula 2004). Several non-native fish populations have become naturalized within the watersheds of the Connecticut and Androscoggin Rivers. Increased water temperatures and altered habitats from the creation of large impoundments facilitate the proliferation of these species. Several non-native species provide sport-fishing opportunities. Largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), northern pike (*Esox lucius*), landlocked Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), and rainbow trout (*Oncorhynchus mykiss*) are examples of species that have naturalized populations (NHFG 2004, Estuarine and Freshwater

Working Group 2005). Landlocked Atlantic salmon, brown trout, and rainbow trout are annually stocked by NHFG. The population of smallmouth bass in Umbagog Lake is perhaps the most infamous naturalized non-native fish population in New Hampshire. The well-established population is expanding into the inlets of the lake and displacing native brook trout populations (Maine Department of Inland Fisheries and Wildlife (MDIFW) 2005).

To assess the likelihood of intentional or accidental introductions of invasive fish and aquatic plants, the degree of remoteness of lakes and ponds was analyzed through GIS. The highest percent of remote lakes and ponds occurs in this area. There are 850 lakes and ponds (69%) within 500 m of a trail or road, 154 lakes and ponds (13%) enclosed by a protective buffer of 500-805 m without a mapped road or trail, 151 lakes and ponds (12%) with a buffer of 805-1609 m, and 74 lakes or ponds (6%) with a buffer greater than 1609 m.

Hydrology

There are approximately 71 active dams/impoundments within fine scale system 5. There are no active impoundments in the mainstem of the Connecticut River in this area. From West Stewartstown to Dalton, there is a 112.65 km stretch of the Connecticut River mainstem that is free flowing (Francis and Mulligan 1997).

There are approximately 51 active dams/impoundments within fine scale system 7, which vary from large river impoundments for hydroelectricity production to small stream impoundments for wildlife habitats. There are five active impoundments along the Connecticut River in this area (Francis and Mulligan 1997). Impoundments in Berlin have a high degree of adjacent industrial development and little natural habitat (USACE 1980). Impassable dams downstream of the New Hampshire border in Maine block spawning runs of anadromous fish in the Androscoggin River (USACE 1980).

The loss of food supplies and spawning or rearing habitat for fish in the upper Connecticut River can occur during low flow periods or after seasonal draw-downs of the Connecticut Lakes and Lake Francis. Modified flow rates further impact limited wintering habitat by influencing ice formation and dissolved oxygen levels (Francis and Mulligan 1997).

2.3 Population Management Status

N/A

2.5 Habitat Patch Protection Status

In fine scale system 5, 35.4% of the total land area is conserved and 37% of unfragmented land is protected through conservation. In fine scale system 7, 11.8% of total land area is conserved. Unfragmented land comprises a significant proportion of this system, but only 12% is protected through land conservation.

The Connecticut River is designated in the New Hampshire River Management and Protection Program (RMPP)(NHDES 2004). The RMPP regulates dam construction, instream water flow levels, channel modification, water quality, solid waste and hazardous waste storage/treatment facilities, and motorized boating traffic.

2.6 Habitat Management Status

It is difficult to assess efforts to restore and manage habitats at such a broad level. A database of conservation groups may enhance cooperative efforts and eliminate repetitive or redundant projects.

There is a conservation and management plan for the Connecticut River. The plan identifies ecologically significant areas and guides the human use and management (Francis and Mulligan 1997). Public outreach and education are identified as useful tools for conserving and restoring this watershed. The plan provides highly detailed information at local levels and should be used to help identify sensitive areas, local impacts, and management actions. The Connecticut River Management Plan (1997) is currently being revised. The Coldwater Fisheries Coalition has created a management plan for coldwater fisheries in the upper Connecticut River (Coldwater Fisheries Coalition 1998).

Several agencies are actively involved in habitat restoration and identifying potential areas of habitat enhancement or improvement. Ongoing or recently completed projects include riparian buffer stabilization, stream bank erosion inventories, creating a task force for dam removal, landowner education, annual river clean ups, NHDES fish biomonitoring, and other studies. There are targeted restoration efforts for Atlantic salmon and brook trout.

The United States Forest Service (USFS) has

initiated several watershed restoration projects to address the negative effects of historical silviculture practices on riverine habitats. Two segments along the west branch of the Upper Ammonosuc River in Berlin now have improved bank stability, channel depth, fish and invertebrate habitat, and habitat structure with large woody debris (Jay Milot, United States Forest Service, personal communication).

In Lake Umbagog, the MDIFW is working to minimize the effects of an increasing smallmouth bass population that is expanding and displacing native brook trout populations. The MDIFW is continuing research on the habitats, movements, and foraging of smallmouth bass, brook trout, and land-locked salmon. Passage barriers have been repaired and smallmouth bass fishing regulations have been amended to provide further protection to brook trout populations (MDIFW 2005).

2.7 Sources of Information

A watershed classification based on geological, topographical, climactic, and connectivity attributes, developed by TNC, was used to define scale and habitat condition. Watershed management plans, GIS analyses, and anadromous fish restoration plans were used to identify significant habitats, relative condition, quality, and ongoing management and restoration efforts.

2.8 Extent and Quality of Data

Information on current habitat quality and restoration efforts was highly concentrated on larger rivers. Smaller rivers within this habitat were not well represented. Information obtained from GIS analyses may not accurately represent all physical features.

2.9 Condition Assessment Research

Surveys in moderate-north watersheds should focus on identifying high quality areas or unique aquatic habitats representative of the region. Sites with degraded habitats, such as eroded banks or poor water quality, should be identified and monitored to help target future restoration work.

ELEMENT 3: SPECIES AND HABITAT THREAT ASSESSMENT

Existing river management plans, local watershed associations, and GIS analyses indicate that the primary threats to this area are fragmentation, development, sprawl, and non-point source pollution, especially sedimentation and runoff from poorly managed logging operations, agricultural fields, and impervious surfaces in population centers like Berlin. Refer to the general threats section for: Transportation Infrastructure, Development (Fragmentation and indirect effects), Non-Point Source Pollution (Runoff and Sedimentation, Nutrients (Eutrophication)), Acid Deposition, Introduced Species, Altered Hydrology, Recreation, Unsustainable Harvest (Forestry Operations and Management), and Agriculture.

ELEMENT 4: CONSERVATION ACTIONS

Watersheds within high percentages of unfragmented land are unique to northern New Hampshire. Strategies to preserve connectivity must be developed to protect these large unfragmented land tracts. Fortunately, there is an opportunity for protection rather than restoration in this area. Several strategies for conservation action for this area can be found in the Connecticut River Management Plan. Refer to the general strategies for Transportation Infrastructure, Development (indirect effects), Fragmentation, Population Isolation, Pollutants (Pesticides/Fertilizers), Pollutants (stormwater runoff), Pollution (acid deposition), Sedimentation, Forestry, and Agriculture.

5.1 LITERATURE

Coldwater Fisheries Coalition. 1998. Upper Connecticut River Strategic Fisheries Management Plan. Available <http://www.nhcf.org/conn.html#Connecticut%20River%20Fisheries%20Plan> (Accessed March 2005).

Connect River Atlantic Salmon Commission. 1998. Strategic Plan for the Restoration of Atlantic Salmon to the Connecticut River. Available <http://www.fws.gov/r5crc/documents/strplan.pdf> (Accessed March 2005).

Dartmouth Outing Club. Management. Available <http://www.dartmouth.edu/~doc/secondcollegegrant/management/?DOC=7170221>

[af07fb5fdbab33a1b7feaa56a](http://www.fws.gov/r5crc/documents/strplan.pdf). (Accessed May 2005).

DeRoche S. 1967. Fishery Management in the Androscoggin River. Maine Department of Inland Fisheries and Game. No. 52. Augusta, Maine, USA.

Estuarine and Freshwater Working Group. 2005. State of New Hampshire Comprehensive Management Plan for the Prevention and Control of Aquatic Nuisance Species-Draft. Concord, New Hampshire, USA.

Francis F, Mulligan A. 1997. Connecticut River Corridor Management Plan. Connecticut River Joint Commission. Charlestown, New Hampshire, USA.

Maine Department of Inland Fisheries and Wildlife. 2005. Rapid River/Pond in the River Fact Sheet. Available <http://www.maine.gov/ifw/fishing/fishreports/rapidriverfactsheet.htm>. (Accessed April 2005).

New Hampshire Department of Environmental Services. 1991. The Connecticut River. Available <http://www.des.state.nh.us/Rivers/connect.htm#Intro> (Accessed March 2005).

New Hampshire Department of Environmental Services. 2004. Androscoggin River Water Quality Report. Volunteer River Assessment Program. Concord, New Hampshire, USA.

New Hampshire Department of Environmental Services. 2002. Rivers Management and Protection Program (RMPP). Available <http://www.des.state.nh.us/Rivers/rsa483.htm> (Accessed March 2005).

New Hampshire Department of Environmental Services. 2004. Designated Rivers. Available <http://www.des.state.nh.us/Rivers/designriv.htm> (Accessed March 2005).

New Hampshire Fish and Game Department. Freshwater Fishing Guide. 2004. Available http://www.wildlife.state.nh.us/Fishing/Fishing_PDFs/FW_Fishing_Guide.pdf (Accessed April 2005).

Noon J. 1999. The Bassing of New Hampshire. Moose Country Press. Warner, New Hampshire, USA.

Reardon J., Zinc T. 2004. The New England Brook Trout: Protecting a Fish, Restoring a Region. Trout Unlimited. Arlington, Virginia, USA.

Smagula A. 2004. Report of the New Hampshire Exotic Aquatic Species Program. New Hampshire Department of Environmental Services. Concord,

New Hampshire, USA.

United States Army Corps of Engineers. 1980. Water Resource Study Androscoggin River Basin Maine. New England Division. Volume 2. Concord, Massachusetts, USA.

United States Fish and Wildlife Service (USFWS) webpage. Land Protection Plan. Available <http://www.fws.gov/r5soc/landprot.htm#38> (Accessed March 2005).

Webster K. 2005. New Hampshire Now Considers Logging Regulations. Associated Press. The Barre Montpelier Times Argus. Available (<http://www.timesargus.com/apps/pbcs.dll/article?AID=/20050419/SERVICES02/50419001>). (Accessed May 2005).

**Watershed Groupings:
NORTHERN
UPLAND**

