Natural System Modifications

The 'natural system modifications' threat category (IUCN 7) covers a wide range of activities that convert or degrade habitats largely as a result of human management. Often the goal of such management is to improve conditions for human activities, including recreation, energy generation, navigation, and general safety. Also included here are threats resulting from the lack of management in habitats that historically rely on disturbance to persist on the landscape. Most threats in the latter category apply to terrestrial systems, in particular the suppression of fire in pine barrens and cessation of management in grasslands and shrublands. In aquatic systems, the dominant threat in this category is dams, which fragment river systems, alter flows and sedimentation patterns, and cause mortality in aquatic organisms. Other natural systems modifications identified as important in New Hampshire include water withdrawals (both surface and subsurface), bank stabilization along rivers, and ditching and tidal restrictions in coastal habitats.

Risk Assessment Summary

In New Hampshire, this threat category was used for 242 threat-target combinations, with 99 of these ranked as high or medium threats (41%, with 38 high and 61 medium – see table 4-18). The high and medium threats are evenly divided between two broad pathways (see below): "absent or inappropriate habitat management" (47 targets, primarily in terrestrial systems) and "altered hydrology" (43 targets, aquatic and wetland systems).

The management category includes fire suppression (19 targets, primarily in pine barrens), lack of management in early successional habitats (22 targets, grasslands and shrublands), and natural succession in wetlands and dunes (5 targets). A higher proportion of threats in this pathway are ranked medium (55% of all M/H threats) than high (31%). The effects of dams were ranked as medium or high threats for 32 targets (17 high, 15 medium), with these targets including most aquatic habitats and the fish and mussels that live in them. Water withdrawals were identified as a medium threat for four aquatic habitats, and tidal restrictions for two coastal habitats and four salt marsh bird species. Channelization or stabilization of river banks was identified as a threat to five species that depend on these habitats.

Known Wildlife Exposure Pathways

Fire and Fire Suppression

Fire suppression alters the vegetative structure of habitats by inhibiting the establishment of fire tolerant plant species (e.g., pitch pine, scrub oak, and a variety of grasses and forbs, among others). In the absence of fire, habitats eventually succeed to dense canopied forest dominated by white pine and/or hardwoods (e.g., oak, red maple, and/aspen) with little or no grass and forb cover. This renders the habitat unusable by a number of rare and declining wildlife species, particularly those specialized in pine barrens habitats. Of particular concern are several Lepidoptera with specialized host plant requirements, including the Karner blue butterfly, frosted elfin, wild indigo duskywing, and others (Grundel et al. 1998, VanLuven 1994).

For instance, a lack of fire in the Concord pine barrens has caused the characteristic mosaic of grassy openings, heath barrens, scrub oak thickets, and pitch pine woodlands to be replaced by white pine and

hardwood forest (VanLuven 1994). Similar shifts in vegetation structure and composition have been implicated in the decline of Karner blue butterflies at many locales (Grundel et al. 1998). Similarly, white pine and fire-intolerant hardwoods have substantially increased over the last 50 years in the Ossipee Pine Barrens and are predicted to soon be the dominant canopy species (Howard et al 2005).

Although not solely dependent on fire to provide suitable habitat, many species of wildlife typical of early successional forests and shrublands often reach their highest densities in fire-adapted habitats. Historically, New England Cottontails likely occupied native shrublands that were created and maintained via fire and other means (Litvaitis 2001). Similarly, the highest known densities of Eastern Whip-poor-wills and Eastern Towhees in New Hampshire occur in the remaining patches of pine barrens in the towns of Concord and Ossipee (Hunt 2013a, b).

Fire suppression also leads to an accumulation of highly flammable fuels (pine needles, leaf litter, and dead wood). As such, the potential increases for a catastrophic wildfire that would severely impact remaining patches of pine barrens habitat and populations of associated wildlife species. Wildlife mortality rates under this scenario may be too high to sustain wildlife populations in the long term (Howard et al. 2005).

Lack of Management

Like fire-adapted systems, grasslands and shrublands require periodic disturbance if they are to persist on the landscape. In the absence of management (e.g., mowing, selective harvest, herbicide), these habitats will revert to a forested condition in relatively short time spans, and are no longer suitable for most early successional wildlife species.

Long term timber harvesting in New England has resulted in a forest with altered size and age class distributions. When adequate structural conditions associated with different seral stages of forest development are not represented on the landscape, associated wildlife species cannot find the structure needed to reproduce and occupy the landscape. For example, lynx are dependent on large areas with high snowshoe hare densities. Clearcutting and other silvicultural methods that produce high snowshoe hare densities are important to consider in forest management.

Dams and Water Management/Use

Impoundments above dams cause changes in water temperature, turbidity, substrate composition, and flow, all of which influence biological communities. Increased flows below impoundments result in high sediment loads, suffocating fish and invertebrates and altering fish spawning substrates (Baxter and Glaude 1980, Moser 1993). The leaching of plant nutrients and toxic substances (e.g. mercury) from flooded soils upstream of impoundments can lead to algal blooms and accumulated toxins in fish tissue (Baxter and Glaude 1980). Increased biological oxygen demand from the decomposition of flooded soil and vegetation may cause lower dissolved oxygen levels, typically in the deep water adjacent to the dam (Baxter and Glaude 1980). Periodic flooding of shoreline and wetland habitats has been shown to increase mercury methylation in lakes and ponds with water levels controlled by a dam (Simonin et al. 2008). Fluctuating water levels upstream and downstream from dams pose a threat to Cobblestone Tiger Beetles by potentially inundating their habitat more frequently than natural flooding events (Nothnagle 1993). Water level management for hydropower or flood control may decrease the frequency and intensity of flooding events needed to maintain floodplain forest communities (Bornette and Amoros 1996). Water level drawdowns, especially during the winter months, impact invertebrate and plant

communities in the littoral zone and may influence nutrient cycling in a waterbody (Zohary and Ostrovsky 2011). Changes in fish communities that result from artificial flow manipulation involve a shift to habitat generalist fish species (Kanno and Vokoun 2010).

Dams restrict the movements of aquatic species, especially diadromous fish, which migrate upstream to spawn, and freshwater mussels, which depend on larval transport by host fish for dispersal (Waters 1996). Widespread dam construction throughout the northeast has resulted in dramatic declines in migratory fish populations (Limburg and Waldman 2009). Fish passage construction has improved access to spawning habitat in some rivers, but migratory delays and mortality during downstream migration continue to limit the recovery of diadromous fish populations (Castro-Santos and Letcher 2010).

Although not always directly related to water management, alteration of stream banks through channelization can impact flows, sedimentation, and the species that depend on them.
River bank stabilization restricts the dynamic nature of a river and often causes erosion problems downstream, and eliminates habitats used by Bank Swallows and emerging dragonflies. Bank stabilization removes habitat features, including undercut banks and fallen trees, which are important to native fish species such as Brook Trout. Dams, ditches, and road crossings in tidal systems have hydrologic effects on estuaries and salt marshes, usually through reductions in tidal flooding. Without tidal influence, typical salt marsh vegetation is replaced with invasive reeds and grasses (Sinicrope et al. 1990).
Water withdrawal for irrigation, municipal water supplies, snow making, or industrial uses can decrease water levels and flows in aquatic habitats. An estimated 320 million gallons of water is withdrawn daily from the Merrimack River during the summer (Merrimack River Watershed Council 2001). In addition to impeding the movements of aquatic species, low flows can create higher water temperatures and stagnant conditions that encourage algal blooms. Water withdrawn for irrigation may re-enter aquatic systems, containing increased nutrient levels (Baxter and Glaude 1980). Low summer flows modify invertebrate and fish communities, favoring generalist species. A study of streams impacted by water withdrawal in Connecticut documented a significant decrease in fluvial dependent fish species (Kanno and Vokoun 2010). Unusually low summer flows due to groundwater withdrawal in the Ipswich River (Massachusetts) resulted in a significant decrease in fluvial dependent fish species the species composition (Armstrong et al. 2001).

Research Needs

- Research the impacts of water level fluctuation on natural communities.
- Expand the impervious surfaces assessment done in the coastal watershed to other watersheds in New Hampshire.
- Continue to monitor the results of salt marsh restoration projects on the coast.
- Investigate the quantitative effects of seasonal draw-downs on species diversity in aquatic habitats.
- Compare vegetation composition and structure, nutrient loading, and soil chemistry along impounded and free-flowing rivers in New Hampshire.
- Assess interactive impacts of fire suppression, land use history, ecological history, microclimate alterations, and habitat patch isolation on vegetation structure and composition of pine barrens, grasslands, and shrublands.

- Investigate impacts of beaver population changes on natural communities and habitat distribution.
- Monitor the response of diadromous fish populations to improvements in fish passage and dam removals.
- Research the influence of diadromous fish populations on freshwater and marine food webs.

Table 4-18. Habitats and species at highest risk from the effects of natural system modifications (threats ranked as *Low* not included here). IUCN Level 2 provided if evaluated to that level (if not evaluated to level 2, text reads *not specified*). Some habitats and species were evaluated for multiple specific threats separately and therefore listed multiple times below. See Appendix E for additional information on specific threats and rankings.

Habitat	IUCN Level 2	Overall Threat Score
Coldwater rivers and streams	Dams & water management/use	M
Coldwater rivers and streams	Not Specified	M
Estuarine	Other ecosystem modifications	M
Floodplain Forests	Dams & water management/use	H
Grasslands	Other ecosystem modifications	M
Hemlock-Hardwood-Pine Forest	Not Specified	M
Lakes and ponds with coldwater habitat	Dams & water management/use	H
Large warmwater rivers	Dams & water management/use	H
Lowland Spruce-Fir Forest	Not Specified	H
Peatlands	Not Specified	M
Pine Barrens	Not Specified	M
Salt Marsh	Not Specified	M
Salt Marsh	Other ecosystem modifications	H
Shrublands	Not Specified	M
Shrublands	Other ecosystem modifications	H
Warmwater lakes and ponds	Dams & water management/use	H
Warmwater lakes and ponds	Not Specified	M
Warmwater rivers and streams	Dams & water management/use	H
Warmwater rivers and streams	Not Specified	M

Common Name	IUCN Level 2	Overall Threat Score
Alewife	Dams & water management/use	H
Alewife Floater	Dams & water management/use	H
Alewife Floater	Other ecosystem modifications	H
American Brook Lamprey	Dams & water management/use	M
American Eel	Dams & water management/use	H
American Kestrel	Not Specified	H
American Shad	Dams & water management/use	H
American Shad	Dams & water management/use	M
American Woodcock	Not Specified	M

Banded Sunfish	Dams & water management/use	M
Bank Swallow	Not Specified	H
Black-billed Cuckoo	Not Specified	M
Black-billed Cuckoo	Other ecosystem modifications	H
Blandings Turtle	Dams & water management/use	M
Blueback Herring	Dams & water management/use	H
Blue-winged Warbler	Not Specified	M
Blue-winged Warbler	Other ecosystem modifications	H
Bobolink	Other ecosystem modifications	M
Bridle Shiner	Dams & water management/use	H
Brook Floater	Dams & water management/use	H
Brook Floater	Other ecosystem modifications	M
Brook Trout	Dams & water management/use	M
Brook Trout	Other ecosystem modifications	M
Brown Thrasher	Fire & fire suppression	M
Brown Thrasher	Not Specified	M
Brown Thrasher	Other ecosystem modifications	H
Common Gallinule	Not Specified	M
Common Nighthawk	Fire & fire suppression	M
Common Nighthawk	Other ecosystem modifications	M
Creeper (Mussel)	Dams & water management/use	M
Dwarf Wedgemussel	Dams & water management/use	H
Dwarf Wedgemussel	Other ecosystem modifications	H
Eastern Meadowlark	Other ecosystem modifications	M
Eastern Pondmussel	Dams & water management/use	H
Eastern Towhee	Fire & fire suppression	M
Eastern Towhee	Not Specified	M
Eastern Towhee	Other ecosystem modifications	H
Eastern Whip-poor Will	Fire & fire suppression	M
Eastern Whip-poor Will	Other ecosystem modifications	M
Field Sparrow	Fire & fire suppression	M
Field Sparrow	Not Specified	M
Field Sparrow	Other ecosystem modifications	H
Frosted Elfin	Not Specified	H
Golden-winged Warbler	Not Specified	M
Golden-winged Warbler	Other ecosystem modifications	H
Grasshopper Sparrow	Other ecosystem modifications	M
Horned Lark	Other ecosystem modifications	M
Karner Blue Butterfly	Not Specified	H
Lake Trout	Dams & water management/use	M
Lake Whitefish	Dams & water management/use	M
Least Terns	Other ecosystem modifications	M
Nelson's Sparrow	Other ecosystem modifications	H
New England Cottontail	Other ecosystem modifications	H
Northern black racer	Other ecosystem modifications	M
Northern Harrier	Other ecosystem modifications	M
Pied-billed Grebe	Not Specified	M

Pine Barrens Lepidoptera	Not Specified	M
Piping Plover	Other ecosystem modifications	M
Prairie Warbler	Fire & fire suppression	M
Prairie Warbler	Not Specified	M
Prairie Warbler	Other ecosystem modifications	H
Puritan Tiger Beetle	Not Specified	M
Purple Martin	Other ecosystem modifications	M
Rapids Clubtail	Dams & water management/use	M
Rapids Clubtail	Not Specified	M
Redfin Pickerel	Dams & water management/use	M
Round Whitefish	Dams & water management/use	H
Ruffed Grouse	Not Specified	M
Saltmarsh Sparrow	Other ecosystem modifications	H
Sea Lamprey	Dams & water management/use	H
Seaside Sparrow	Other ecosystem modifications	H
Shortnose Sturgeon	Dams & water management/use	M
Skillet Clubtail	Dams & water management/use	M
Skillet Clubtail	Not Specified	M
Sleepy duskywing	Not Specified	M
Sora	Not Specified	M
Spotted Turtle	Dams & water management/use	M
Triangle Floater	Dams & water management/use	M
Vesper Sparrow	Fire & fire suppression	M
Vesper Sparrow	Other ecosystem modifications	M
Willet	Other ecosystem modifications	H
Wood Turtle	Dams & water management/use	H

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