

Warming Waters: Implications for Invasive Species in the Northeast

SUMMARY: Climate change is warming northeastern water bodies and changing the environmental conditions that structure aquatic communities, presenting new challenges for the management and conservation of these ecosystems. The altered physical, chemical, and biological conditions resulting from warming waters may benefit or harm native species while providing new opportunities for non-native species to establish or expand. Here, we summarize how increasing water temperatures may influence aquatic invasives and synthesize the growing body of scientific evidence on this topic. Managers should consider these changes when drafting management plans, creating species watch lists, and planning strategically for the future.

Changing Aquatic Ecosystems

In the Northeast, water temperatures and ice-out dates correlate with increasing air temperatures associated with climate warming. In long-term studies, stream and lake temperatures have been increasing consistently¹, spring thaw dates are happening earlier, and fall freezing later^{2,3}. Stream flows are also more extreme, increasing the risk of both droughts and floods⁴.

How Does Temperature Affect Aquatic Ecosystems?

Temperature is a key variable that influences the physical, chemical, and biological properties of aquatic ecosystems. Warmer waters:

1. Alter solubility of gases and compounds. Importantly, warmer water can hold less dissolved oxygen.
2. Increase the sensitivity of organisms to toxins, such as copper and lead.
3. Increase metabolic rates of fish and other ectotherms, requiring increased feeding to meet energy needs. This could increase predation rates as well as competition for food.
4. Cause physiological stress, which can lead to negative health outcomes (including mortality) for organisms if certain temperature thresholds are crossed.
5. Alter historic temperature seasonality, an important cue for breeding in some fish, which can reduce reproductive success.

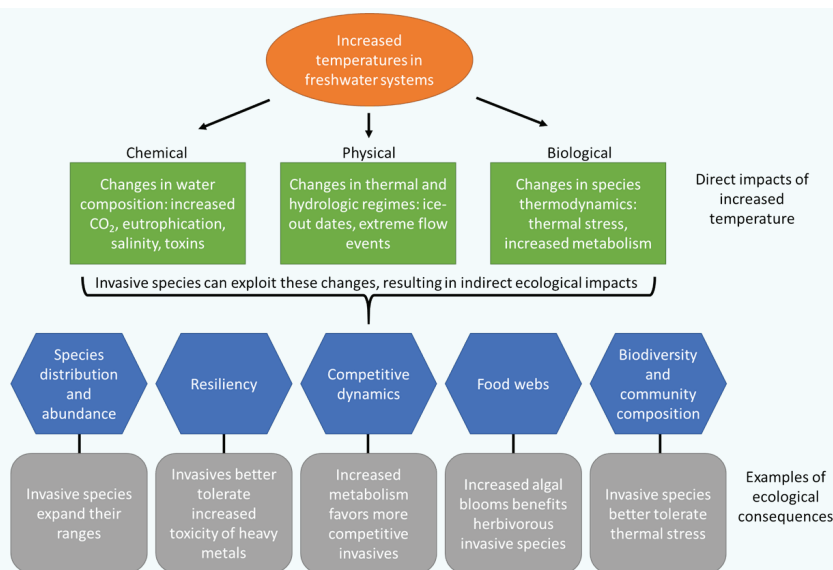


Figure 1. Warming waters could favor invasive aquatic species through a variety of mechanisms. Increased water temperatures exacerbate water quality issues, alter seasonal regimes that organisms rely on, and thermally stress organisms. These changes may favor invasive species over native counterparts (adapted from Rahel & Olden, 2008)⁵.

Evidence & Examples of Invasive Species Response

1. Increased Growth Rates and Competitive Advantage of Existing Invasives

Several studies have shown invasive species have a competitive advantage over natives in warmer waters. For example, growth rates of the invasive plant curly pondweed (*Potamogeton crispus*) doubled and invasive milfoil (*Myriophyllum* spp.) growth rates increased in warmer waters relative to native aquatic plants^{6,7}. In a study of relative competition, invasive brown trout was an increasingly better competitor against native brook trout as temperatures climbed⁸. However, findings are not consistent across studies and species. Other investigations have found no significant response of non-native aquatic plants to warmed temperatures, or no difference in growth response between native and non-native plants.

Additionally, warmer late season temperatures may prolong the growing season for the non-native while the native transition to setting seed, as in a study of *Myriophyllum* species⁷.

2. Arrival and Survival of New Invasive Species

Elevated winter water temperatures may also allow invasive species previously limited by winter temperatures to survive. Water hyacinth (*Eichornia crassipes*), a species that is on ‘watch lists’ of many northeastern states, can successfully overwinter at higher temperatures and regenerate more vigorously the following spring when not subjected to extreme lows. Cold tolerance experiments with the Asian clam (*Corbicula fluminea*) suggest that this species will soon be able to survive in more areas in the Northeast⁹.

3. Altered Natural Processes

Changes in normal disturbance regimes can favor invasive species. Annual spring melt dislodges large pieces of ice that can scour the shores and bottom of waterbodies, a disturbance that benefits species adapted for early successional conditions. The reduction of ice coverage and spring scouring correlates with the increased growth and abundance of the algae Didymo¹⁰. A lack of scouring could allow the algae to persist on the bottom of the waterbody, giving Didymo a head start when temperatures warm.

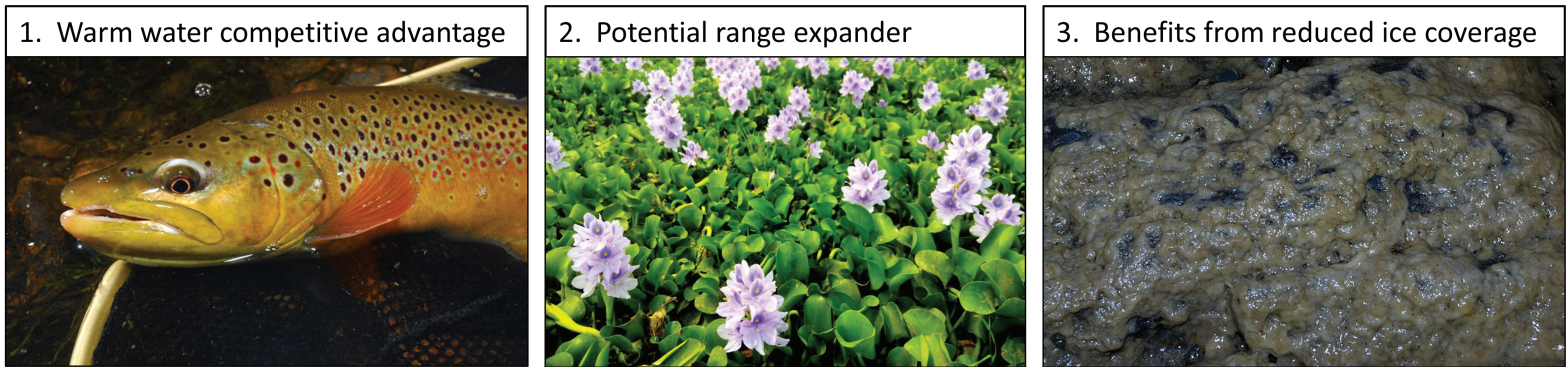


Figure 2. 1.) Non-native brown trout (*Salmo trutta*) competes equally with native brook trout (*Salvelinus fontinalis*) at colder temperatures, however has a competitive advantage in warmer waters. 2.) Global invader water hyacinth (*Eichornia crassipes*) is anticipated to expand its range northward as climate warms. 3.) Outbreaks of rock snot (*Didymosphenia geminata*) are suspected to be related to reduced ice scouring. Images sourced from the Wikipedia Commons.

Management Considerations

- ❏ As warmer temperatures lengthen the seasons for boating as well as aquatic invasive species growth, boat wash and other sanitation stations may need to extend beyond the traditional Memorial Day - Labor Day season.
- ❏ Where feasible, add storm water retention wetlands to slow and cool water entering lakes and rivers from urban systems.
- ❏ Buffer temperatures of water bodies by increasing tree cover and shading, including prioritizing treatments of tree-killing pests in riparian areas.
- ❏ Talk to southern neighbors to proactively identify invasive aquatic species at lower latitudes. Include these species in early detection and rapid response plans and watch lists.

Where Can I Get More Information?

- 2008 Conservation Biology Series on Aquatic Invasive Species and Climate Change
- Northeast Regional Invasive Species and Climate Change (RISCC) Management Network
- Northeast Climate Science Center
- U.S. EPA. Effects of Climate Change on Aquatic Invasive Species and Implications for Management and Research (Final Report)
- IUCN Policy Brief on Invasive Species and Climate Change

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