The spiny water flea (Bythotrephes longimanus Leydig) is an Eurasian cladoceran invasive in the Laurentian Great Lakes basin of North America. It was first documented in Lake Ontario in 1982 and dispersed into Lakes Erie and Huron by 1984, Lake Michigan by 1986, and Lake Superior by 1987 (1, 2). The Great Lakes act as a propagule source for Bythotrephes, which is now rapidly expanding into inland lakes along a latitudinal band from New England and Quebec to Minnesota and Manitoba (3, 4; see Figure 3). New invaded lakes are reported regularly, although surveys are incomplete and there appears to be a gain and loss pattern for spiny water flea dispersal.

As a large conspicuous zooplankter, Bythotrephes is subject to heavy predation by young fish. This triggered the evolution of two important adaptations: firstly, a chitinous spine, barbed spiral, that comprises more than 2/3 of the body length and that acts as a defense mechanism (5, 6; Figure 1), and secondly, there are double, tough-shelled diapause eggs that can pass through fish guts intact (7, 8; Figure 2). Gut passage means that fish can act as a dispersal vector. Resting eggs in baitfish can be transferred from one lake to another, unintentionally dispersing the spiny water flea.

Bythotrephes is a voracious predator, and individuals consume up to 40 smaller zooplankton species, Bythotrephes can have major effects on native zooplankton communities, causing assemblage shifts in invaded lakes (11, 12).

Figure 3. Distribution map of Bythotrephes longimanus in the Great Lakes region. Red circles symbolize lakes where the spiny water flea was present, blue and light blue circles represent lakes where it had not been detected as of 2010. The larger red and the light blue circles represent our own sampling efforts in 2008–2010. The Great Lakes are depicted in pink to indicate the occurrence of Bythotrephes in each. The land shading shows August air temperatures as a proxy for lake water temperature in many of the inland lakes. The distribution pattern is clearly correlated with temperature as Bythotrephes is spreading mainly along a northerly latitudinal band, where maximum temperatures are less than 26 degrees. The Great Lakes warm less during the summer, accounting for the anomalously southern distribution. Historically, sampling efforts in eastern Ontario have been more intense than in other areas.

Figure 4. Map of Voyageurs National Park highlighting the 5 interconnected lakes sampled for invaded VOYA lakes. Lakes with high Bythotrephes densities are labeled in red (Rainy, Kabetogama and Namakan), while more recently invaded lakes with low Bythotrephes densities are labeled in blue (Sandpoint and Crane). Note that the park borders Canada, which runs through 3 of the 5 major lakes (see Figure 5) and a temporal one (pre- versus post-invasion).

Figure 5. Mean Bythotrephes densities for VOYA lakes 2007–2011. Red bars are for lakes considered high density for this study, whereas blue bars show the more recently invaded low density lakes at the southern end of the system. Error bars show one standard error.