Adaptability to local climate helps invasive species thrive

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This is purple loosestrife at Koffler Scientific Reserve, University of Toronto. Credit: Rob Colautti

University of Toronto research has found that purple loosestrife – an invasive species that competes with native plants for light and nutrients and can degrade habitats for wildlife – has evolved extremely rapidly, flowering about three weeks earlier as it has spread to northern Ontario. This has allowed populations of the species to thrive in the colder climate with a more than 30-fold increase in seed production.

"The ability of invasive species to rapidly adapt to local climate has not generally been considered to be an important factor affecting spread," said Dr. Rob Colautti, who conducted the research as a Ph.D. student in U of T's Department of Ecology & Evolutionary Biology under the supervision of Professor Spencer Barrett.

"Instead, factors such as escape from natural enemies including herbivores, predators, pathogens or parasites were thought to explain how species become invasive. We found that the evolution of local adaptation to climate in purple loosestrife increased reproduction as much as or more than escaping natural enemies. Understanding that species can evolve rapidly to local climates is important for predicting how invasive species spread and how native and non-native species alike will respond to climate change."

To determine whether populations have evolved local adaptation, the scientists collected seeds from three different climatic regions (north, south and intermediate latitudes in eastern N. America) and then grew them at three sites spanning the distribution of the species to see if there were differences in survival and reproduction, i.e. fitness. They found that 'home' plants collected from latitudes most similar to each common garden location always had higher fitness than the 'away' plants. For example, plants collected from northern latitudes had the highest fitness when grown at the northern site in Timmins, Ontario but the lowest fitness when grown at a southern site in northern Virginia relative to plants collected from southern latitudes.

This is purple loosestrife in marsh at Koffler Scientific Reserve, University of Toronto. Credit: Rob Colautti

This is the purple loosestrife experiment, Koffler Scientific Reserve, University of Toronto. Credit: Rob Colautti

The team's previous work showed that northern populations flower about 20 days earlier but at half the size of southern populations when both were grown in the same 'common garden' experiment. They wondered whether these genetic differences could account for the observation of locally adapted populations. So in the next phase of the research, they directly measured Darwinian natural selection on flowering time at each of the common garden sites. They found that early flowering was adaptive at the most northern site, because early-flowering plants produced the most offspring while plants with delayed flowering began reproduction near the end of the growing season, when pollinators were scarce and flowers were prone to frost damage. But later flowering was favoured by natural selection at more southern sites because delayed reproduction allowed plants to grow larger and produce more seeds when the growing season is longer. Remarkably these differences have evolved over the past 50 years as the species moved northwards, following its initial introduction to the east coast of the USA.

More information: "Rapid Adaptation to Climate Facilitates Range Expansion of an Invasive Plant," by R.I. Colautti et al. *Science*, 2013.

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