Invasive plants are beneficiaries of climate change in Thoreau's woods

February 3 2010

Purple loosestrife, an invasive plant species common in the northeastern United States, is seen near Concord, Mass. Credit: Abraham Miller-Rushing

Invasive plants could become even more prevalent and destructive as climate change continues, according to a new analysis of data stretching back more than 150 years.

Writing in the journal PLoS ONE, the Harvard University scientists who conducted the study say that non-native plants, and especially invasive species, appear to thrive during times of climate change because they're better able to adjust the timing of annual activities like flowering and fruiting.

"These results demonstrate for the first time that climate change likely

plays a direct role in promoting non-native species success," says author Charles C. Davis, assistant professor in Harvard's Department of Organismic and Evolutionary Biology. "Secondly, they highlight the importance of flowering time as a trait that may facilitate the success of non-native species. This kind of information could be very useful for predicting the success of future invaders."

Mayweed chamomile is a non-native species that has exhibited an impressive response to climate change by adjusting its flowering time response to be much earlier in the year. It is not yet classified as an invasive plant, but dominates the landscape in various parts of the northeastern United States (shown here in Concord, Mass.). Credit: Abraham Miller-Rushing

Davis and his colleagues analyzed a dataset that began with Henry David Thoreau's cataloging of plants around Walden Pond in the 1850s, when the famed naturalist kept meticulous notes documenting natural history, plant species occurrences, and flowering times. Since then, the mean annual temperature around Concord, Mass., has increased by 2.4 degrees Celsius, or 4.3 degrees Fahrenheit, causing some plants to shift their

flowering time by as much as three weeks in response to ever-earlier spring thaws.

"We set out to use this dataset to examine which plants have been the beneficiaries of climate change," Davis says. "Our research suggests quite decisively that non-native and invasive species have been the climate change winners. Climate change will lead to an as-yet unknown shuffling of species, and it appears that invasive species will become more dominant."

Davis and colleagues compared a plethora of plant traits -- everything from height at maturity to flower diameter to seed weight -- against species' response to more than a century and a half of climate change. Alone among all these traits, plants that have fared well share a common phenology, a suite of traits related to the timing of seasonal events such as flowering, leaf growth, germination, and migration.

By contrast, many plants with a less flexible flowering schedule -- and thus prone to flowering at suboptimal times -- have declined in population, in many cases to the point of local extinction.

Purple loosestrife is one of the worst invasive plant species in the northeastern United States, and has exhibited a remarkably favorable response to climate change. It now flowers three weeks earlier since the time of Thoreau. In many wetland areas it has crowded out native vegetation and competes for local pollinators like this monarch butterfly in the area of Concord, Mass. Credit: Abraham Miller-Rushing

The current work builds upon a 2008 paper by Davis and colleagues which showed that some of the plant families hit hardest by climate change at Walden Pond include beloved species like lilies, orchids, violets, roses, and dogwoods. The scientists also reported that some 27 percent of all species Thoreau recorded from 1851 to 1858 are now locally extinct, and another 36 percent are so sparse that extinction may be imminent.

"Invasive species can be intensely destructive to biodiversity, ecosystem function, agriculture, and human health," Davis says. "In the United States alone the estimated annual cost of invasive species exceeds $120 billion. Our results could help in developing predictive models to assess the threat of future invasive species, which may become greatly exacerbated in the face of continued climate change."

More information: www.plosone.org/home.action

Provided by Harvard University