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Invasive species challenge managers in their work of conserving and managing natural areas and are one of the most serious problems these managers face. Because invasive species are likely to spread in response to changes in climate, managers may need to change their approaches to invasive species management accordingly.

An example of how the threat of an invasive species might change in response to climate is that of purple loosestrife (*Lythrum salicaria*). Purple loosestrife is an invasive species of northern wetlands; the species may be limited both by hot temperatures in the South and by cold temperatures in the North (Middleton, unpublished data). With climate change, the range of purple loosestrife may decrease in the South and expand in the North (Fig. 1). The immediate removal of newly invaded satellite populations before seeds are formed and populations establish may be an effective approach to curtailing the spread of invasive species in a changing climate because it is much easier to remove a species soon after it invades rather than after it establishes (Ashton and Mitchell, 1989; Middleton, in press).



Figure 1. Purple loosestrife (*Lythrum salicaria*) at the northern limit of its range near Amos, Quebec, Canada. Pictured in the right foreground is Dr. Raja Sengupta of McGill University.

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Managers at the edge of an invasive species' range need to be especially aware that their activities might contribute to the spread of the species into new areas. Managers should aggressively treat invasive species of concern and reduce activities that might spread seeds. For example, to avoid the spread of seeds, roadside mowers should be cleaned of weed seeds between mowing different areas to prevent the spread of seeds into new areas. Managers who mow roadsides should give some thought to the manner in which they mow weeds so that they lessen the spread of seeds of invasive species.

Dispersal is a key issue in invasive species, because most invasive species disperse readily. If climates change, then new invasive species may disperse into novel climate regions. Managers should be alert to new infestations along the fronts of species invasion, and they should target populations that are likely to spread readily. For example, the landscape pattern of invasive species dispersal in wilderness canyons is a key issue in the control of Chinese yam (*Dioscorea oppositifolia*). The aerial tubers of this species disperse downstream to spread the species vegetatively, so that controlling upstream populations may be the key to controlling the spread of this invasive species (Thomas and others, in press). In another example, the invasive scale insect *Dactylopius ceylonicus* presumably is wind dispersed, and these insects have spread to the mainland of North America via the Florida Keys on air currents (Simberloff and Stiling, 1996). These scale insects kill cacti and were released on Nevis in the Caribbean in 1979 to control an invasive cactus. Because of its migration, this scale insect could negatively affect southwestern U.S. populations of cacti, so it is important for managers to control this species as it spreads across the Gulf of Mexico (Middleton, in press). Clearly, an understanding of the dynamics of dispersal aids in the understanding of the potential of invasive species to invade new regions during climate change. The manner in which an invasive species will respond to climate change will vary according to the life history requirements of the species, its current range, its ability to disperse, and the conditions under which it can regenerate. Managers need to be on the alert for new threats by invasive species if climates change, and they must be ready to respond to situations as they arise.

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