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Prioritizing Patches for Control of Invasive Plant Species: A Case Study with Amur Honeysuckle

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INTRODUCTION

Managers of nature reserves are frequently faced with two dilemmas when the problem of invasive plant species is considered. First, invasive plants may not be limited solely to specific habitats or sites but instead may be widely distributed, occupying a range of habitats and showing various levels of performance. Such a pattern is common in invasive plants because of generalist habitat requirements (Bazzaz 1986) and also because invasion success may be associated with historic disturbance regimens (Orians 1986). Second, measures that resource managers can take to control invasive species are expensive while budgets for managing nature reserves are limited. In the Cape of Good Hope Nature Reserve in South Africa, 39 percent of the management budget is presently devoted to the control of invasive woody plants (Macdonald et al. 1988).

One potential solution to these dilemmas is a prioritization process that considers both the performance (productivity) and resilience (reestablishment of performance after a stress event) of invasive plant species. Such a prioritization process is perhaps best-suited to invasive woody plants occurring in patchy nature reserves but may also be applied to grasses and herbaceous species as well. Prioritization of management effort is based on the assumption that performance and resilience of invasive plant species vary in a predictable fashion relative to plant age and relative to gradients of environmental factors (Luken 1988; Luken and Mattimiro 1991). If management unit patches can be identified relative to these factors, then prioritization can occur that will guide the application of control measures.

CASE STUDY

Concepts presented here for the control of invasive species are based largely on data collected in the exurban landscape of northern Kentucky. Here, Amur honeysuckle (*Lonicera maackii* (Rupr.) Maxim.), an upright, deciduous, multistemmed shrub (Fig. 1) native to northeastern Asia, dominates habitats ranging from recently disturbed soil to mature forest.

Research on the performance of this shrub in different habitats indicates that light is an important environmental factor affecting production, reproduction, population structure, demography, and resilience (Table 1). Specifically, open-grown adult shrubs have higher performance when undisturbed and greater resilience when cut than do forest-grown shrubs of similar age. These data indicate that forests are not optimal habitats for Amur honeysuckle.

Further observational data suggest that forest patches with complete canopies can resist invasion by Amur honeysuckle. However, if gaps are created or if

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FIGURE 1.—*Lonicera maackii* with fruit. (photo by B. N. McKnight)

forests pass through a developmental stage where canopy gaps exist, then Amur honeysuckle will invade and it will persist. Efforts to eradicate adult plants of Amur honeysuckle will be most successful when the shrubs are young or when they are growing in light-limited habitats (i.e., closed-canopy forests).

Forest and open sites presently exist that are essentially Amur honeysuckle thickets. These dense thickets are associated with a near complete absence of ground cover species. This greatly complicates the task of control because removal of the shrub component exposes the site to both erosion and colonization by other invasive species.

PRIORITIZATION PROCESS

The landscape element of interest in the development of a prioritization process for invasive species control is the management unit patch. This is a single area of land that is managed to manipulate the community development path (Luken 1990a). In invasive species control, the management goal is commonly to eliminate invasive species while allowing the gradual release or establishment of plants from the native flora.

Management unit patches can be classified in terms of performance and re-

TABLE 1. Characteristics of open- and forest-grown Amur honeysuckle populations when undisturbed and after cutting. Data from Luken (1988) and Luken and Mattimiro (1991).

PARAMETER	OPEN-GROWN	FOREST-GROWN
Above ground production	high	low
Leaf/stem ratio	high	low
Standing dead stems	low	high
Seed production	high	low
Stem release after cutting	high	high
Stem survival after release	high	low
Shrub survival after cutting	high	low

silience of the invading plant. The best indicator of performance or importance is net primary production, because this is a direct measure of resource utilization (Whittaker 1975). The best indicator of resilience is measurement of plant performance after an artificially imposed stress regimen (e.g., repeated clipping, burning or herbicide spraying). However, more easily measured parameters may be used as performance and resilience indices. For example, in Amur honeysuckle, both performance and resilience increase with shrub population age and then decrease as trees invade the shrub populations and forests develop (Luken 1988; Luken and Mattimiro 1991). Thus population age and successional development of management unit patches produce a gradient of performance and resilience (Fig. 2). The successional phases presented in Fig. 2 represent convenient categories for grouping patches. Yet in any successional phase where invasion is recent, shrubs will be less resilient than in phases where shrubs are older.

The gradient presented in Fig. 2 is complicated by the fact that patch size (edge effects) and canopy gaps may create deviations from the general trend. Small forest patches (strong edge effects) and those with high canopy disturbance may need to be treated as special cases.

Mid-successional sites such as pastures, scrub, small forest patches with canopy gaps, and all sites where shrub populations are old (> 3 years) have low priority for management because of cost associated with shrub removal and low efficiency of eradication methods. Furthermore, removal of the shrub canopy in nonforested sites where invasive performance is high would likely open the area to erosion and colonization by other invasive species. Thus, in order to restore such sites, the manager would need to immediately protect the soil and supplement the propagule supply.

Recently disturbed sites, mature forests lacking canopy gaps, and all sites where shrubs are young (i.e., < 3 years old) should be given highest priority for management because complete eradication would be most easily achieved with the least money invested and the least amount of environmental disturbance. When shrubs are young or are stressed by light limitation they can be easily pulled or killed. Removal of the shrub layer in older forests can occur without colonization by other alien plants and with some native tree regeneration taking place after management (Luken 1990b).

OTHER CONSIDERATIONS

In addition to performance and resilience of invasive species, the presence or potential presence of native species are important factors. Specifically, sites where invasives are threatening rare or endangered species or where diversity is

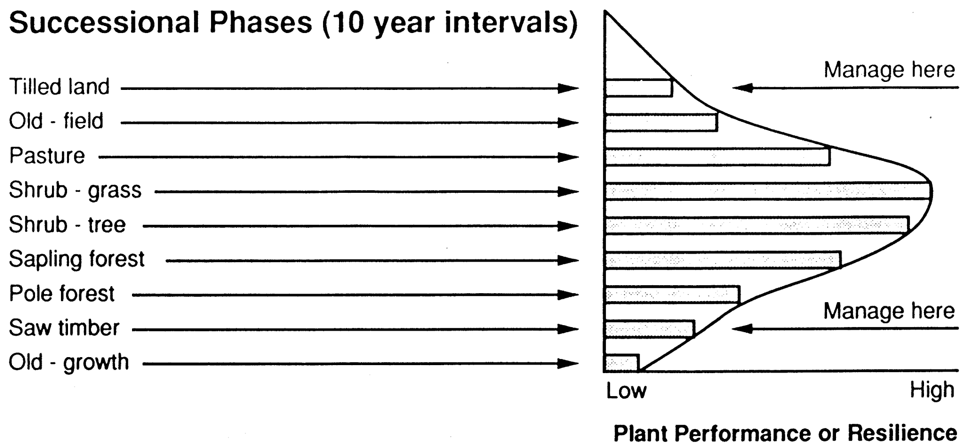

FIGURE 2.—A gradient of performance and resilience created by successional processes in patchy landscapes. Shrubs participating in succession from time zero will show increased performance and resilience as populations age and then will show decreased performance and resilience as forests develop.

being reduced can be given higher priority for plant removal. However, the greater the performance or importance of an invasive plant on a site, the greater will be the disturbance or environmental change as a result of shrub removal. Such conditions favor colonization by other invasive species. As such, resource managers should be prepared for an ongoing process of community restoration in these sites after invasives are eliminated.

It is unknown whether the prioritization process presented here has utility beyond the scope of light-limited invasive shrubs. However, all plant species have varying performance and resilience relative to environmental gradients. Thus it may be necessary to measure and assess the important environmental factor (or factors) controlling performance and resilience for each plant species and then prioritize patches based on this information.

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