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Toward Consensus-Based Actions that Balance Invasive Plant Management and Conservation of At-Risk Fauna

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Abstract Limiting the spread of invasive plants has become a high priority among natural resource managers. Yet in some regions, invasive plants are providing important habitat components to native animals that are at risk of local or regional extirpation. In these situations, removing invasive plants may decrease short-term survival of the at-risk taxa. At the same time, there may be a reluctance to expand invaded habitats to benefit at-risk species because such actions may increase the distribution of invasive plants. Such a dilemma can result in "management paralysis," where no action is taken either to reduce invasive plants or to expand habitats for at-risk species. A pragmatic solution to this dilemma may be to develop an approach that considers site-specific circumstances. We constructed a "discussion tree" as a means of initiating conversations among various stakeholders involved with managing habitats in the northeastern USA to benefit several at-risk taxa, including New England cottontails (*Sylvilagus transitionalis*). Major components of this approach include recognition that expanding some invaded habitats may be essential to prevent extirpation of at-risk species, and the effective control of invasive plants is dependent on knowledge of the status of invasives on managed lands and within the surrounding landscape. By acknowledging that management of invasive plants is a complex issue without a single solution, we may be successful in limiting their spread while still addressing critical habitat needs.

Keywords Invasive shrubs · Shrublands · *Sylvilagus transitionalis* · Thickets

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Introduction

Limiting the spread of invasive plants is a common goal of natural resource managers because invasives can have substantial negative effects on native species and communities (e.g., Lockwood et al. 2007). Among terrestrial habitats, invasive plants can physically dominate an area (Mitich 2000), cause a reduction in available food/prey (Tallamy and Shropshire 2009; Ortega et al. 2006), or alter habitat structure (Schmidt and Whelan 1999), ecological processes (Dibble and Rees 2005), or phenology (Harrington et al. 1989). However, in some regions, invasive plants have become important habitat components of native animals, including species that are at risk of local or regional extirpation. For example, in New Zealand, the non-indigenous weed gorse (*Ulex europaeus*) provides protection, food, and a refuge for oviposition for the endangered giant weta (*Deinacrida* spp., Orthoptera: Stenopelmatidae) where the original habitat has been destroyed by feral goats (Sherley and Hayes 1993; Stronge et al. 1997). In portions of the southwestern USA, endangered willow flycatchers (*Empidonax traillii*) often nests in extensive stands of invasive salt cedars (*Tamarix* spp.; Sogge et al. 2006). In these situations, removing the invasive plants might reduce the short-term survival of the at-risk species; yet expanding invaded habitats also seems undesirable because such efforts could increase the distribution and abundance of invasive plants. Such a dilemma, where success of one goal (increase habitat for at-risk species) may lead to failure of the other (decrease abundance of invasive plants) can result in "management paralysis," causing no action to be taken either to reduce invasive plants or to expand habitats for at-risk populations.

In the northeastern USA, a wide variety of animals utilize food and cover found in early-successional forests and shrublands (Litvaitis et al. 1999; DeGraaf and Yamasaki 2000). The abundance of such habitats (collectively referred to as *thickets*) prior to European settlement has been debated (e.g., Litvaitis et al. 1999; Motzkin and Foster 2002). Land use by European colonists increased thickets as a consequence of wide-spread clearing of forests for agriculture and subsequent abandonment of many farms during the late nineteenth and early twentieth centuries (Litvaitis 1993; Foster 1995). This resulted in large areas reverting to thickets that subsequently matured into mid-successional forests (Litvaitis 1993; Foster 1995). Although the abundance of young forests has returned to levels more consistent with natural-disturbance regimes (Trani et al. 2001; Lorimer and White 2003), development of coastal areas and pine barrens (Noss et al. 1995), loss of wetlands (Dahl 1990), construction of dams that subsequently reduced riparian habitats (Hall et al. 2011), and local extirpation of beavers (*Castor canadensis*; Gotie and Jenks 1982) have decreased the abundance of naturally occurring shrublands (Litvaitis et al. 1999). Consequently, remaining thickets are often small and disjunct (Litvaitis 1993) and their coverage continues to decline (Brooks 2003). In response to these changes in habitat availability, natural resource agencies in the region have made the expansion of early-successional forests and shrublands a conservation priority (Litvaitis 2003; Oehler et al. 2006).

A variety of management actions that remove trees (e.g., timber harvests, mowing, or controlled fires) are known to generate or perpetuate thickets (DeGraaf and Yamasaki 2003; Oehler 2003). However, the frequency and intensity of these activities may increase the vulnerability of thickets to encroachment or invasion by undesirable non-native plants (Hobbs and Huenneke 1992; Johnson et al. 2006). Additionally, some invasives [e.g., autumn olive (*Eleagnus umbellata*), multiflora rose (*Rosa multiflora*), and honeysuckles (*Lonicera* spp.)] were intentionally planted in these habitats to enhance food and cover for game animals (Gill and Healy 1974), conserve soil, or for esthetics (Silander and Klepeis 1999; Kurylo and Endress 2012). As a result, invasive plants are often disproportionately more abundant in thickets as compared to other terrestrial habitats. Such parcels can act as "invasive hotspots" from which surrounding habitats are colonized.

Thicket habitats composed exclusively of native plant species are rare in portions of the northeastern USA and are also difficult to maintain in the long term. Consequently, invasive shrubs can be an important habitat element of several species of conservation concern by providing suitable food and cover unavailable in other habitats. This is especially relevant for such thicket obligates as New England cottontails (*Sylvilagus transitionalis*), a lagomorph that is currently restricted to a small portion of its historic range in the northeastern USA (Tash and Litvaitis 2007) and is a candidate for listing under the federal Endangered Species Act (U.S. Fish and Wildlife Service 2006). In some areas, invasive shrubs dominate thickets occupied by this cottontail (Litvaitis et al. 2003; Hanley Unpublished report). Removing these plants in small, isolated sites or sites with few rabbits would likely put cottontails at immediate risk to higher rates of predation as a consequence of reduced cover (Barbour and Litvaitis 1993) or cause them to abandon the site. Management activities at two sites in coastal Maine occupied by New England cottontails support this speculation. Dense patches of invasive barberry (*Berberis thunbergii*), honeysuckle, and bittersweet (*Celastrus orbiculatus*) were cleared and rabbits have not been detected in the immediate vicinity of cleared habitat since the removal of invasives.

Recently, Skurka Darin et al. (2011) proposed a system for prioritizing control efforts of invasive plants that incorporated plant and site characteristics. This approach avoids blanket prescriptions in favor of a targeted approach toward populations of invasives that are most problematic and likely to degrade new habitats. Additionally, such actions could foster a more pragmatic campaign against invasive shrubs by acknowledging that in some situations a tolerance of invasives may be the most appropriate response (at least short term), especially if specific invasives are providing a desired function (Schlaepfer et al. 2011).

Responding to Habitat Shortfalls

Our goal was to develop a land-management framework that would foster efforts to increase the abundance of thicket habitats while minimizing the potential harm from the expansion of invasive shrub populations. To achieve this, we organized a panel of natural resource specialists that are involved with all stages of management of thicket habitats from research to implementation. The 11-member panel (the authors) included: (i) federal, state, and university biologists familiar with the needs of thicket-dependent species and factors that contribute to the spread of invasive shrubs, (ii) federal and state natural resource agencies responsible for providing technical and financial assistance to private landowners, land trusts, and public reserves to help conserve natural resources, (iii) outreach personnel involved with public education on invasives, and (iv) a private contractor involved with controlling invasive plants on managed public and private lands. Panel members met on several occasions to outline potential management scenarios and then conducted field visits to identify possible limitations of each approach.

Rather than develop a universal approach for managing invasive plants, we restricted our charge to lands that have been identified as potential habitat for thicket-dependent species in the northeastern USA. In this region, several initiatives have emerged that are recruiting public and private lands into a comprehensive network of managed thicket habitats. These include the Young Forest Project (http://www.youngforest.org/, accessed 24 February 2013), and the Conservation Strategy for the New England Cottontail (http://www.newenglandcottontail.org/, accessed 24 February 2013). Both initiatives have assembled state and federal natural resource agencies, along with prominent non-governmental organizations (e.g., Wildlife Management Institute, National Fish and Wildlife Foundation, National Wild Turkey Federation, Environmental Defense, and Ruffed Grouse Society) with a mandate to increase the abundance of shrublands and early-successional forests.

To facilitate site visits by the panel members and benefit from ongoing discussions between landowners and habitat managers involved in thicket restoration, we further restricted our deliberations to portions of southern Maine and New Hampshire that have been identified as focal areas for habitat restoration for the New England cottontails (Fuller and Tur 2012). In this region, habitat needs of New England cottontails are deemed critical and invasive plants are pervasive (Litvaitis et al. 2003; Tash and Litvaitis 2007). Despite this regional focus, the issues, principals, and approaches we describe will inform discussions of invasive control in any region or ecosystem where invasive control potentially has costs as well as benefits.

Early in our deliberations, we recognized a need to construct a protocol that would be comprehensive in identifying potential pitfalls to habitat managers and sufficiently transparent and understandable by land owners and concerned lay audiences. Agency personnel involved with recruiting private and public lands into regional initiatives indicated that land managers and private landowners were enthusiastic about providing critical habitats but also expressed concern about potential spread of invasive plants onto their lands. As a first step, we coined the phrase “discussion tree” (rather than decision tree, e.g., Zimmerman et al. 2011) because we felt it was important to encourage input from landowners and other stakeholders that are likely to be involved in subsequent discussions without giving an impression that we were guiding them to a specific conclusion. We also realized that an obvious benefit of a discussion tree would be the ability to use it as a vehicle to increase public understanding of the plight of thicket-dependent species while acknowledging current concerns on the impacts of invasive plants, and how both require immediate action.

Discussion Tree

Our framework is intended to bring stakeholders together while they consider management alternatives at candidate parcels that are currently occupied by at-risk thicket-dependent species or parcels that could be modified and subsequently occupied (via immigrations or translocations). Among all candidate parcels, the landowner goal is assumed to be managing habitat for thicket-dependent species. Candidate parcels include second-growth forests, agricultural fields or pastures, and existing shrublands or young forests that could be enlarged. In our discussion tree, we have intentionally avoided using specific criteria (e.g., percent coverage by invasive plants, distance to nearest source population of invasive, etc.) to describe pre-management conditions. Such features are best put into context of the actual site and landscape under evaluation. For example, along the immediate coast of southern Maine, invasive plants are likely encountered in all suitable habitats. In such areas, it is not relevant to distinguish the integrity of local plant communities based on the presence/absence of invasives. However, at locations 50 km inland, the presence/absence of invasives may be an important distinction.

To start the process, field reconnaissance of the candidate parcel and the surrounding landscape are employed to determine the current status of invasive shrubs and degree of threat posed by surrounding lands. With this information, a series of questions is then used to evaluate potential action plans. First, the current condition, based on plant community species composition and structure, is evaluated. If the candidate parcel is devoid of invasives or they are present at manageable levels, then threat of invasion following disturbance is the next consideration (Fig. 1a). Proximity of invasive plants (distant vs. adjacent) should then be discussed. If existing populations of invasive plants are distant, are there obvious conduits (roads, riparian corridors, powerline rights-of-way, etc.) that may transport propagules to the candidate parcel (e.g., Gelbard and Belnap 2003)? If adjacent lands are already occupied by invasive plants, does the magnitude of the proposed management of the candidate parcel increase its vulnerability to invasion? For example, if abutting habitats include dense populations of invasive plants and the planned management actions include canopy removal and associated soil disturbances, then the likelihood of substantially spreading invasive plants into the candidate site is high. Under this scenario, the discussion tree will terminate at "stop and re-evaluate objectives" (Fig. 1a) and it would be appropriate to reconsider management actions or acknowledge that costly pre- and post-eradication efforts may be needed. In situations where the parcel and surrounding landscape do not contain invasives, then management should proceed toward developing a native shrubland with monitoring for invasive plants (i.e., following all left branch decisions to end at "Manage/Monitor/Maintain native shrubs" in Fig. 1a).

If the candidate parcel and surrounding landscape are invaded (where control is difficult), then magnitude of changes to local and surrounding plant communities following management actions will likely be limited (Fig. 1b). Among parcels with only modest invasive populations, pre- and post-management actions should limit the immediate spread of exotics to benefit native plants. However, if both the site and surrounding landscape support extensive populations of invasives, then eradications efforts may not be effective, or worthwhile. Here, the discussion tree would lead to "Manage for food/cover for targeted species…" Management actions should consider both native *and* exotic plants that provide the best food and cover for the targeted at-risk species (Fig. 1b) and it may be possible to shift the current mix toward a greater representation by native plants. Under these circumstances, having information on the attributes of specific plants would be beneficial. For example, Fickenscher (2009) found that multiflora rose (invasive non-native) supported as many herbivorous insects as silky dogwood (*Cornus amomum*, native) and twice as many as glossy buckthorn (*Frangula alnus*, invasive non-native). If our intent for the site was to provide nesting habitat for chestnut-sided warblers (*Setophaga pensylvanica*), a species of conservation concern (Schlossberg and King 2007), we might encourage a mix of multiflora rose and silky dogwood by pre- and post-management reductions of glossy buckthorn in an effort to enhance populations of insect prey for nestlings. Similar treatments could be done on the basis of escape cover for New England cottontails. However, caution is recommended as ecological interactions of invasive plants are complex and can have both positive and negative effects (Rodewald et al. 2010; Rodewald 2012). Subsequent colonization (or not) by other plants after removing invasives may yield unexpected outcomes (Sogge et al. 2008).

Since development of our discussion tree, a land-management panel in southeastern New Hampshire has incorporated the discussion tree as part of their evaluation of five parcels that were being considered as part of the New England cottontail habitat initiative. In all instances, the surrounding landscape contained an abundance of invasive shrubs as did the individual parcels. Panel members concluded that management actions could be designed to maintain existing representation of native plants while maintaining suitability for cottontails. In particular, areas with a dense understory of multiflora rose were not altered because there were considered important cover for cottontails whereas larger shrubs and young trees (native and non-native species) with limited near-ground cover were removed.

Recommendations

It is important to note that we are not advocating efforts to actively reduce the abundance of native shrubs under any circumstance. On the contrary, we encourage fostering native shrubs wherever they occur. Also, if any single species of invasive plant threatens to create a monoculture, reductions of the dominant species may be warranted because monocultures may reduce habitat suitability for at-risk species (Schlossberg and King 2010). In some jurisdictions, laws or regulations limit the introduction and spread of invasive species, so encouraging the spread of invasive plants in these areas would not be appropriate. For example, Executive Order 13112 requires federal agencies in the USA to control or limit the spread of invasive species. This requirement has obvious implications to federally supported efforts and programs.

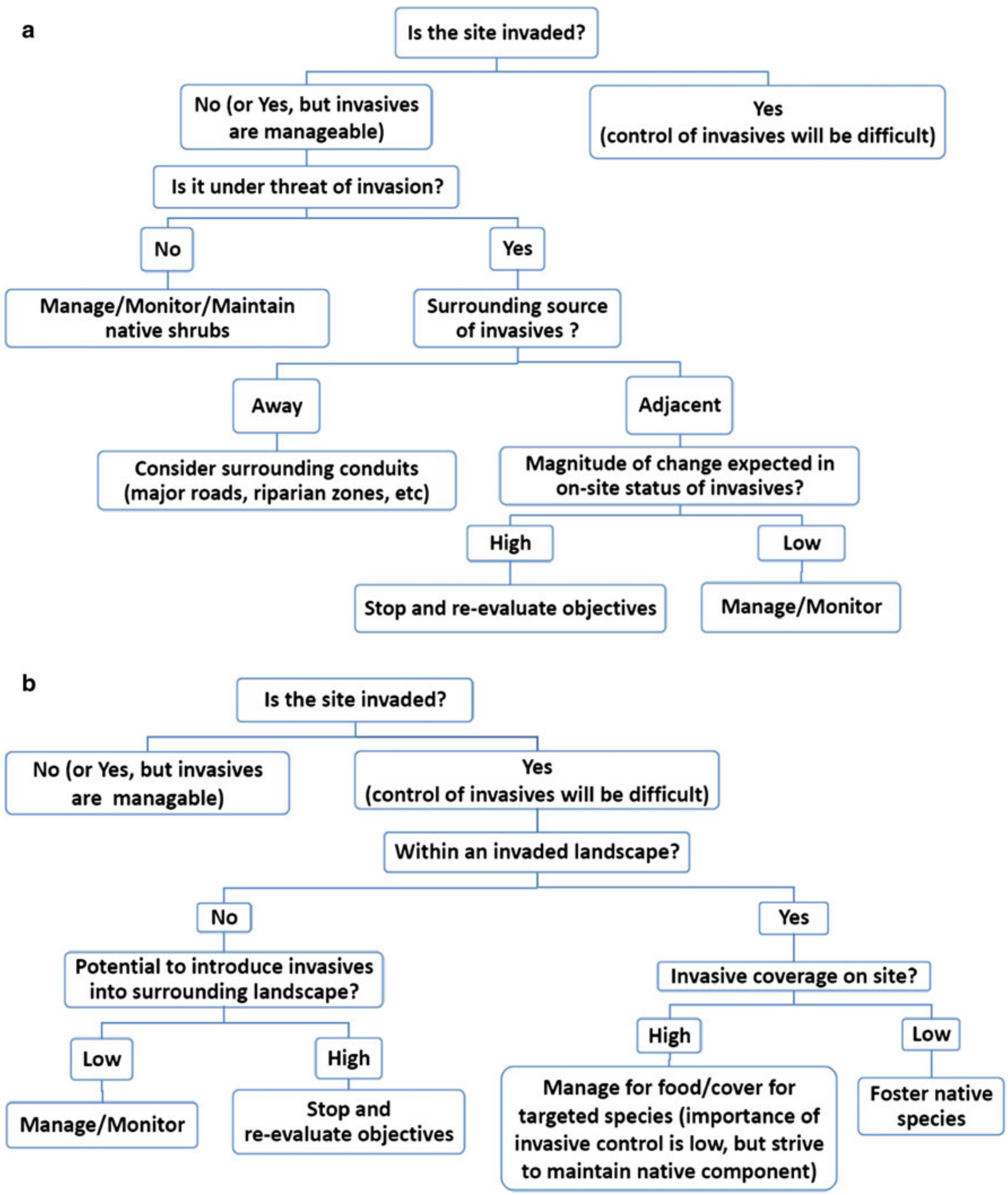

Fig. 1 Discussion trees that summarize major issues to consider prior to setting the level of invasive plant control within habitats dedicated for at-risk fauna (e.g., *Sylvilagus transitionalis*). *Nodes* of Tree **a** are relevant to habitats where invasive plants are essentially absent or at levels where modest control can prevent spread. *Nodes* of Tree **b** are relevant to habitats where populations of invasive plants are substantial and likely difficult to control

Our recommendations for maintaining populations of invasive shrubs should not be taken as a declaration of defeat, but rather as an acknowledgment that attempting to eradicate all invasive plants in all situations is biologically and economically unrealistic. We are encouraging site-specific evaluations that consider whether the benefit of expanding thicket habitats essential to at-risk fauna is associated with an unacceptable threat from invasive plants. It is possible that attitudes and actions toward invasive plants will change as more is learned about their role in the context of broader conservation concerns and goals (Goodenough 2010; Schlaepfer et al. 2011; Vitule et al. 2012). Accepting the positive contributions of some invasive plants in areas already colonized should facilitate our ability to provide thicket habitats while at the same time have limited consequences to habitats supporting mostly native plants.

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