15 Adaptive Collaborative Restoration: A Key Concept in Invasive Plant Management

James H. Miller and John Schelhas

CONTENTS

15.1 Introduction 251
15.2 Society Needs a New Approach to NNIPs 252
15.3 What is ACR? 254
15.3.1 Adaptive Management 254
15.3.2 Collaborative Management 258
15.3.3 Restoration Management 258
15.4 Program Elements 260
15.5 Is ACR Achievable? 262
References 263

15.1 INTRODUCTION

Nonnative invasive species (NNIS) present a severe human dilemma due to their collective threat of replacing and damaging human sustaining ecosystems (U.S. Congress Office of Technology Assessment 1993; Mack et al. 2000; Pimentel 2002). Rapid developments in global trade have caught governments and their regulatory agencies unaware and ill prepared to prevent entries of foreign invasive species across previously insurmountable barriers of oceans, mountains, and desserts (Pierre 1996; Simberloff 1996). New introductions of NNIS have accelerated among and across all continents and have been characterized as bioinvasions of bioterrorists that threaten many countries' biosecurity (Vitousek et al. 1996; Pimentel 2002; Meyerson and Reaser 2003). Of the 20,000 nonnative plant species now free living in the United States, about 4,500 have invasive tendencies, while thousands more reside in our gardens, increasingly in the expanding urban fringe, with unknown consequences to adjoining lands (U.S. Congress Office of Technology Assessment 1993; Pimentel 2002). Deficiencies in policy, deficiencies in consistent research and management funding, and persistent gaps in scientific knowledge have all been

identified as root causes of our current invasive dilemma in the United States (Simberloff et al. 2005). We would add that the lack of social organization to counter these invasions is just as obviously a major shortcoming.

Intentional introductions of NNIS for profit, cultural continuity, and support of government programs have been common while unintentional entries by hitchhiking species in ballast water, cargo, and containers go essentially unchecked in the United States and elsewhere (Mack et al. 2000; Pimentel 2002). The U.S. borders, like those of most countries, are relatively porous to plant movement because of the increased volumes of trade, including international internet sales and lack of policies and border surveillance resources (Simberloff et al. 2005). Most plant invaders of wildlands have gained entry to the United States through the plant production industry or by other deliberate introductions, since there is yet little regulation on which species are imported (U.S. Congress Office of Technology Assessment 1993; NRC 2002). If coordinated programs are not immediately institutionalized, future introductions will occur that will markedly and permanently alter forest, agricultural, and conservation lands and waters as NNIS exponentially spread from urban, suburban, and exurban lands and connecting right-of-ways (Liebhold et al. 1995; Simberloff 1996; NRC 2002; Von der Lippe and Kowarik 2006).

In spite of the increasing damage and threats from NNIS, few countries have yet devised effective infrastructures to deal with the alien invasive onslaughts within their borders (Pimentel 2002; Pal 2004; Britton et al., 2004; Schrader 2004). Nonnative invasive plants (NNIP) are currently replacing natural ecosystems in many parts of the globe with currently useless monocultures or stark assemblages of NNIP species (Vitousek et al. 1996; Pimentel 2002; D'Antonio et al. 2004). Ecosystem services that provision human civilizations and regulate and support natural processes and cultural amenities are eroded or drastically altered by encroaching NNIP. At the same time, nonnative and potentially invasive plant species continue to have societal value for soil stabilization, beautification, and restoration, and there are as yet generally few developed native substitutes (Ewel and Putz 2004). Invasive plants thus represent a complex and perplexing societal dilemma, with need for a more comprehensive awareness, management strategies, coordinated programs, and effective laws if we are to avoid bequeathing future generations with degraded ecosystems and ecoservices. It has become clear that a concerted, holistic effort that integrates science with management in new ways will be required for predicting, managing, and mitigating the spread of invasive species (McPherson 2004), and that society needs to develop a new approach to this inconvenient predicament.

15.2 SOCIETY NEEDS A NEW APPROACH TO NNIPs

Natural resource management today in general requires new approaches to deal with the complexity and uncertainty inherent in linked human and natural systems, and management challenges resulting from the multitude of public and private land ownerships that characterize most landscapes. Ecosystems are increasingly recognized as complex and changing, often in response to growing human actions, more rapid climate change, atmospheric pollution, and increasing occupation by alien invasive species. Effective resource management in today's world must work

through multiple partners on multiple scales and take uncertainty into account to form systems that integrate efficient social learning.

To address threats to biological diversity, natural resource managers have increasingly incorporated ideas from the new scientific area of adaptive management and the new governance approaches involving collaboration (Lee 1993; Buck et al. 2001; Minteer and Manning 2003; Colfer 2005; Plummer and Armitage 2007). At the sametime, ecosystem restoration is rapidly evolving as a science and practice, and both scientists and managers are working to develop the technologies and plant resources to repair invasive-species-impaired ecosystems (Sauer 1998; Taylor and McDaniel 2004). Restoration is complex, and authors differ in their views of its goals. For example, Sauer (1998) envisions restoration to save or reconstruct similar habitat features of the past, while there are no clear *pristine* ecosystems remaining as guides to desired future conditions, only scattered fragmented stands and altered communities (Minteer and Manning 2003). Botkin (2003) at the other extreme would argue that it is only the ecoservices of any human-dependent ecosystem that we must preserve and guarantee, even if invasive plants provide parts of these services. Owing to the degree of current occupation by NNIPs and projected human populations, that compromises in restoration approaches and outcomes will be necessary to maintain sustaining landscapes. However, the degree of compromise required will have much to do with society's awareness, its sense of threat, commitment of resources, and political leadership in forging national and state NNIP plans and initiatives.

Even though major strides have been made within the past 10 years in invasive plant awareness among scientists and professional managers and in invasive plant research, there remains a worrisome lack of strategies and organization for effectively halting introductions, dealing with spreading invasions, and restoring stands and ecosystems. Furthermore, the lack of public awareness and continued widespread sale and planting of invasives suggest that invasive plant presence in future landscapes depends solely on cooperative human action (Colton and Alpert 1998). Thus, we advocate a new, integrated process involving adaptive management cycles carried out through collaborative networks across landscapes for the containment of NNIS and the restoration of impacted stands and ecosystems. We have termed this process *Adaptive collaborative restoration* (Figure 15.1). It is *adaptive*, because we must learn as we go; *collaborative*, because it requires coordinated individual efforts across ownership boundaries and among landowners, managers, and scientists; and *restoration*, because our aim is to restore both sustainable food and fiber production systems and the wildlife habitat and cultural values associated with these. Because the challenges are too great to be shouldered by any single institution, unprecedented collaboration among both pubic and private agencies and entities across multiple levels of organization will be critical. At least in the short term, there are no adequate federal and state agencies with mandates to specifically address this dilemma, and there are few historical precedents for social and political mobilization on the required scale for natural resource management. Immediate collaboration is certainly required for organizing early detection networks that will ensure that widespread epidemics do not continue to occur, or at least that their impacts are mitigated in a timely manner (Meyerson and Reaser 2003). In this chapter, we outline a general

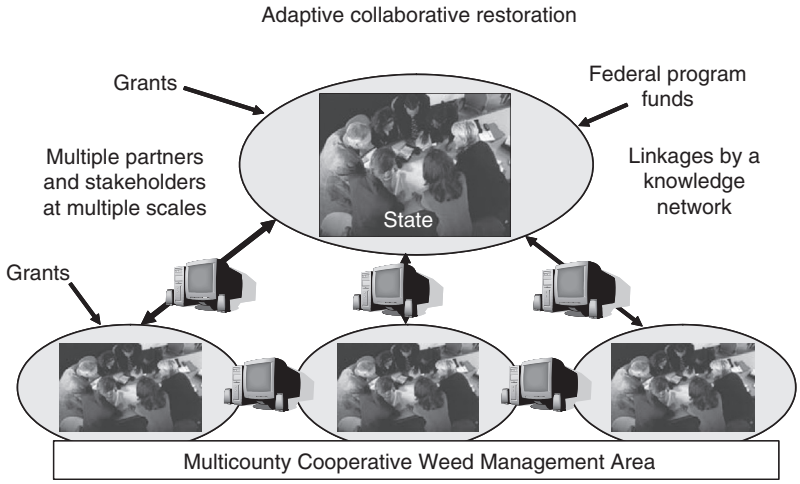

FIGURE 15.1 Horizontal and vertical networks of an ACR program for invasive plants are facilitated by web-based knowledge networks. Funding for programs come from federal, state, and county appropriation and grants. CWMAs are becoming common collaborative networks.

approach to ACR that seeks new synergies in management, science, collaboration, and web-linked technologies to address the historically unique challenges of NNIP invasions.

15.3 WHAT IS ACR?

ACR incorporates elements from three key ecosystem management trends from the 1990s (Sauer 1998; Buck et al. 2001; Plummer and Armitage 2007): adaptive management, collaborative management, and restoration management.

15.3.1 Adaptive Management

Adaptive management generally refers to a process of self-conscious learning-by-doing that incorporates formal processes of goal setting and modeling, monitoring, and rapid incorporation of new knowledge into refined goals and models to create a cyclical process of learning and managing (Walters 1997; Schelhas et al. 2001). Acquiring new information and rapidly incorporating new knowledge and experiences into planning and actions are of the utmost importance with NNIP management due to the number of new species arriving on the scene, evolving perspectives and laws, and the current lack of developed strategies. Instilling adaptive management cycles into an integrated approach can turn reactive management of invasives into a proactive mode (Foxcroft 2004). An example of a simple adaptive management cycle for use at the local level is illustrated in Figure 15.2. For adaptation to work, knowledge networks must play the vital role of providing instant information and connectivity (Jordan et al. 2003). Table 15.1 lists the crucial elements of a knowledge network system for NNIP management, where both real-time information

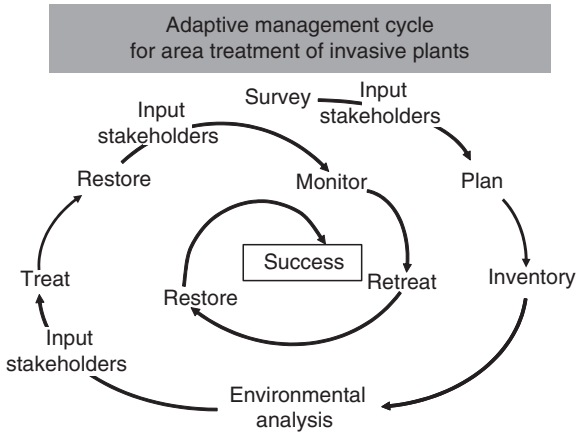

FIGURE 15.2 An adaptive management cycle for an area includes the programmatic steps and repeated treatments required for restoring invasive plant infestations.

and connectivity are subsystems. Table 15.2 enumerates current websites that when linked together could provide knowledge networks hosting formidable information resources. As yet, these websites have little to no connective capabilities, although the linking process is beginning through several national listservs in the United

TABLE 15.1
Web-Accessible Knowledge Network for Invasive Plant Management Must Contain Real-Time Information and Real-Time Connectivity to Facilitate Adaptive Management

Real-Time Information

- Invasive species by
  - Categories of threat
  - Commodity group
  - Land- and water-use categories
- Detailed identification guides
- Occupation maps at expanding scales and spread predictions
- Cost–benefit and risk analyses
- Control, containment, and eradication methods and restoration procedures
- Spread pathways and prevention means
- Comprehensive and multispecies strategies
- Impacts to ecosystem services, safeguards, and mitigation strategies

Real-Time Connectivity

- Decision networks and listservs among collaborative partners (see list in Table 15.3)
- Formal EDRR network
- Directories of service providers for control and restoration
- Directories of native plant sources for restoration using local ecotypes
- A library of pertinent laws, policies, and strategic plans
- Current approved documents such as environmental assessments and environment impact statements

TABLE 15.2
Current Websites That Provide Many of the Functions Needed to Create a Knowledge Network for NNIP Management in the United States

Name	Internet Link
Global	
Global Invasive Species Database	http://www.issg.org/database/welcome/
The Nature Conservancy's Global Invasive Species Team	http://tncweeds.ucdavis.edu/
An International Nonindigenous Species Database Network	http://www.nisbase.org/nisbase/index.jsp
National	
Bugwood Network	http://www.bugwood.org/index.cfm
Institute for Biological Invasion	http://invasions.bio.utk.edu/Default.htm
Invasive and Exotic Species (Invasive.org)	http://www.invasive.org/
National Association of EPPCs	http://www.naeppc.org/
NatureServe	http://www.natureserve.org/explorer/
U.S. Environmental Protection Agency Invasive Species Program	http://www.epa.gov/owow/invasive_species/
Regional	
Invasive Plant Atlas of New England	http://nbii-nin.ciesin.columbia.edu/ipane/index.htm
Mid-Atlantic Exotic Pest Plant Council	http://www.ma-eppc.org/
Mid-West Invasive Plant Network	http://mipn.org/
Nonnative Aquatic Species in the Gulf of Mexico and South Atlantic Regions	http://nis.gsmfc.org/
Southeast EPPC	http://www.se-eppc.org/
Federal Government Agencies	
Alien Plant Invaders of Natural Areas (PCA, National Park Service)	http://www.nps.gov/plants/alien/factmain.htm

Aquatic Nuisance Species Task Force (ANS)	http://www.anstaskforce.gov/default.php
ARS: Exotic & Invasive Weed Research	http://www.ars.usda.gov/main/site_main.htm?modecode=53-25-43-00
CSREES Invasive Species (USDA Cooperative Extension Service)	http://www.csrees.usda.gov/invasivespecies.cfm
FHWA—The Nature of Roadsides and the Tools to Work with it	http://www.invasivespeciesinfo.gov/docs/plants/roadsides/
Forest Inventory and Analysis (FIA)	http://srsfia2.fs.fed.us/nonnative_invasive/southern_nnis.php
National Institute of Invasive Species Science	http://www.niiss.org/cwis438/websites/niiss/About.php?WebSiteID=1
National Invasive Species Information Center	http://www.invasivespeciesinfo.gov/index.shtml
NBII Invasive Species Information Node	http://invasivespecies.nbii.gov/
Nonnative invasive plants of southern forests: A field guide for identification and control	http://www.srs.fs.usda.gov/pubs/gtr/gtr_srs062/index.htm
PLANTS National Database	http://plants.usda.gov/
Sea Grant Nonindigenous Species Site	http://www.sgnis.org/
The U.S. National Arboretum	http://www.usna.usda.gov/Gardens/invasives.html
U.S. Army Environmental Center (USAEC) Pest Management	http://el.erdc.usace.army.mil/pmis/
U.S. Fish and Wildlife Service Invasive Species Program	http://www.fws.gov/invasives/
USDA Animal and Plant Health Inspection Services	http://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/index.shtml
USDA ARS Invaders Database System	http://invader.dbs.umt.edu/Noxious_Weeds/
USDA Forest Service Invasive Species Program	http://www.fs.fed.us/invasivespecies/index.shtml
USDA Forest Service	http://www.fs.fed.us/foresthealth/programs/invasive_species_mgmt.shtml
USGS Nonindigenous Aquatic Species	http://nas.er.usgs.gov/
Weeds Gone Wild: Alien Plant Invaders of Natural Areas	http://www.nps.gov/plants/alien/
State	
National Association of State Department of Agriculture (NASDA)	http://www.nasda.org/
State Laws and Regulations	http://www.invasivespeciesinfo.gov/laws/statelaws.shtml
State Exotic Pest Plant Councils	http://www.naeppc.org/

States that provide unstructured connectivity (e.g., regional exotic pest plant councils, Alien Plant Alliance, and Native Plant Conservation).

15.3.2 Collaborative Management

Collaborative management seeks to develop working linkages among all partners that collectively manage land and water resources across ownerships and jurisdictional boundaries within a defined area. Collaboration for invasive issues has two components. Horizontal connectivity among landowners and managers links people across landscapes, while vertical networks link local, county, state, regional, and national levels (Colfer 2005). Table 15.3 displays the multitude of partners that should be linked within a state at various scales to act in some manner of coordination to enact strategies. Because of federal and state appropriations, most organizational and program formation occurs at the state level, while the *actual work* happens on the ground level. At least 36 states have established some type of interagency invasive species council or working groups to address either selected NNIS or a range of invasive species (Environmental Law Institute 2002). These councils are either nonprofit organizations, governmental entities, or more loose associations of coordinating bodies. The most widely recognized and successful collaborations for invasive plant management in the United States have been Cooperative Weed Management Areas (CWMAs), which are organized at the county, multicounty, or state level (Midwest Invasive Plant Network 2006). A CWMA is a partnership of federal, state, and local government agencies; tribes, individuals, and various interested groups that manage noxious weeds or invasive plants in a defined area (Midwest Invasive Plant Network 2006). Most CWMAs were originally formed in the western United States and now are being organized in the midwestern, northeastern, and southeastern states. While CWMAs are clearly collaborative networks, it is unclear whether they have formalized elements of adaptive management.

15.3.3 Restoration Management

Restoration management is an indispensable part of integrated invasive plant management, providing technology for creating native-based communities and assemblages to replace invasive species infested lands. The restoration or rehabilitation phase requires establishment and/or release of fast-growing native plants that can outcompete and outlast any surviving NNIPs while stabilizing and protecting the soil. It has been learned that reforestation plantings are often necessary to suppress severe invasive grasses and vines, when eradication is not possible, and at the same time can yield a productive tree crop (Otsamo et al. 1995; Harrington et al. 2003). Failures in rangeland NNIP control have been attributed to the absence of a restoration phase that includes controlled recolonization of prairie and prairie-shrub communities resistant to reinvasion (Sheley and Krueger-Mangold 2003). When invasive trees have dramatically changed water courses, perhaps only ecological functions and ecosystem services can be restored when revegetation is enacted along with control measures (Taylor and McDaniel 2004). Natural succession can play a crucial role and be promoted when appropriate NNIP control methods are used that safeguard native species and the soil seed bank (Barnes 2004; Allen et al. 2007).

TABLE 15.3
Potential State Collaborative Partners for an Invasive Plant ACR Program

State level
- Department of agriculture and industries
- Department of conservation and natural resources
- Lands, parks, aquatic fisheries, and wildlife
- Department of transportation
- Forestry commission, department, or service
- Land grant universities and extension service
- Conservation and development districts
- Resource conservation and development districts
- Heritage programs
- Electric power generation and transmission authority
- Department of environmental management or protection
- Port authority, where appropriate

County and city level
- Commissions
- Planning boards
- Roads
- Parks, formal gardens, and lands
- Water providing authorities
- Electric cooperatives
- Land trusts, realtors, and developers
- Citizen groups for natural resource conservation

Federal lands
- Natural Resources Conservation Service
- Farm Services Administration
- U.S. Fish and Wildlife Service
- USDA Forest Service
- U.S. National Park Service
- River authorities, e.g., Tennessee Valley Authority
- Army Corp of Engineers

Industry level
- Commodity producers (livestock, crops, turf, fruit and nuts, aquiculture, etc.)
- Timber producers
- Plant production, wholesale, and retail industry (terrestrial and aquatic)
- Gas and other pipeline companies that manage right-of-ways
- Invasive control consultants
- Restoration consultants
- Herbicide and equipment producers, distributors, and retailers

NGO Partners
- The Nature Conservancy Lands
- Invasive plant councils
- Farmer associations
- Forestry associations
- Crop production associations
- Cattle production associations
- Wildlife, hunting, and fishing associations and federations
- Garden, wildflower, and native plant clubs and associations
- Trail and outdoor recreation associations

Restoration can range from rehabilitation that depends solely on natural succession when invasions are low to more complex reclamation procedures that add plants, structures, and growing medium when the soil and subsoil are highly disturbed or absent (Sauer 1998).

15.4 PROGRAM ELEMENTS

Program elements of an ACR program for NNIP are as follows:

- Cooperative knowledge networks linking stakeholders, land managers and scientists, policy makers, and political representatives at the national, regional, state, multicounty, and county levels, providing real-time information and connectivity. The functioning and power of the network ultimately relies solely on timely contributions and communications of individuals through voluntary, delegated, and assigned responsibilities.
- Collaborative strategies and programs for spread prevention through the following: (1) improved laws, policies, and public education; (2) promotion of new corporate and personal ethics to not sell, buy, or plant invasive plants; (3) sanitization of personnel, equipment, and animals when moving from or among infested sites; and (4) prohibitions regarding the sale and transportation of contaminated products such as extracted native plants, potted plants, fill dirt and rock, and mulch (Bryson and Carter 2004; Evan et al. 2006).
- Effective and efficient early detection and rapid response (EDRR) networks to identify and locate new high-risk introductions, communicate and verify the sites, eradicate the outlier infestations, and restore plant communities resistant to reinvasion (Westbrooks 2004).
- Creation and maintenance of a web-accessible spatially interrelated survey, inventory, and mapping system to corporately track existing and spreading invasions (e.g., Southeast Exotic Pest Plant Council's Early Detection and Distribution Mapping System, http://se-eppc.org/). Such a system with retrievable maps is invaluable for identifying and communicating zones of high infestations, advancing fronts, outliers, and weed-free zones. An example of the value of current survey results is shown in Figure 15.3 for tree-of-heaven (*Ailanthus altissima* (P. Mill.) Swingle) from the Invasive Plant Database of the USDA Forest Service, Southern Research Station's Forest Inventory and Analysis (FIA) Unit in cooperation with state partners. These data and those for 52 other invasive plants in the southern forest region of the United States are posted on a periodically updated website at http://srsfia2.fs.fed.us/nonnative_invasive/southern_nonnative_invasives.htm. Updating cycles for this FIA invasive plant survey depend on the survey activities within individual states, with most updated in part annually.
- Formulation of coordinated control, containment, and eradication programs to include cycles of integrated vegetation management treatments along with monitoring and corporate sharing of successful results and mistakes.

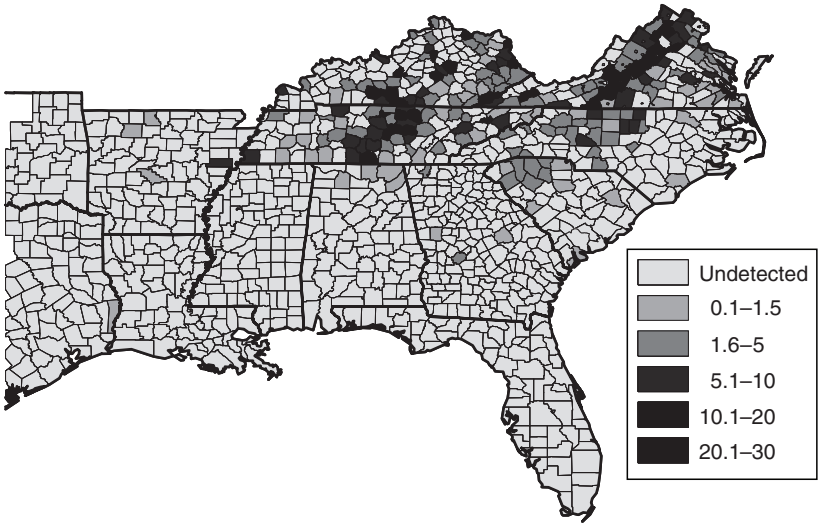

FIGURE 15.3 Percent occurrence of subplots within a county occupied by the invasive tree-of-heaven (*Ailanthus altissima*). (Data from USDA Forest Service, Southern Research Station's FIA Unit, Invasive plant database, Knoxville, TN, http://srsfia2.fs.fed.us/nonnative_invasive/southern_nonnative_invasives.htm. and imported into ArcView GIS.)

As is visible on Figure 15.3 with tree-of-heaven, a coordinated multistate control and eradication program is required to target outliers to stop the spread, contain advancing fronts, and protect special habitats in severely infested zones (Figure 15.4). As part of an integrated effort, prevention programs are crucial as are regional biological control programs for widespread severe NNIPs in certain situations (Simberloff and Stiling 1996; Moran et al. 2005).

- Restoration treatments to dovetail with control and eradication efforts. Adaptive information cycles are especially needed in this rapidly developing field. Restoration will guarantee invasive plant suppression and ensure that ecosystem functions and services are maintained. Continued surveillance and monitoring will be essential for restoration success.
- Focused research and research syntheses are needed with rapid technology transfer through effective networks along with feedback from the field on research needs (McPherson 2004).

The spread of invasives from state to state requires that every state have an Invasive Plant Management Plan with common elements that ensure regional protection. Included in each plan should be working elements and programs for ACR. Adaptive management cycles of learning and sharing advancements in understanding to all stakeholders must be permanently implanted. Regional and state strategies and actions should be nested spatially through collaborative networks across fragmented landscapes with the aim to constrain invasions and restore ecoservices.

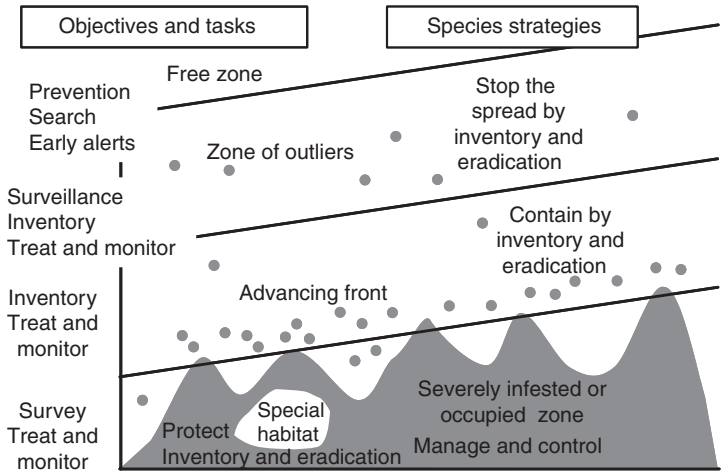

FIGURE 15.4 The degree of infestation shown in the four zones dictates the *objectives and tasks* employed to enact and achieve the *species strategies*. This is a static representation of a dynamic system that could have multiple invasive plants having similar or different zones of occupation.

15.5 IS ACR ACHIEVABLE?

It may seem overly idealistic to think that people can collaborate across institutional and property boundaries and across local to national levels to carry out complex processes of invasive species detection, prevention, and eradication and restore ecosystems in reflective scientific-based, adaptive learning processes. The question might be what would be an alternative approach to achieve the needed objectives? To be sure, there are few fully functioning adaptive collaborative management or restoration processes to serve as real-world models, although many efforts are ongoing (see Buck et al. 2001; Colfer 2005). Yet, natural resource managers worldwide, facing similar management issues, are either adopting adaptive collaborative ideas as a formal approach or drawing on the general principles to improve existing management approaches. Clearly, the ideas of ACR are of great relevance to the common difficulties faced by invasive plant management. New scientific understanding is rapidly accumulating on particular species impacts and means of control, while formal publication of results in scientific journals is too slow and too restrictive. Translating this information into useful technology that is then communicated through collaborative knowledge networks and finally put to use on the ground is the key.

Establishing fully comprehensive ACR processes across logical units of the landscape may seem to be a daunting task, and clearly, it will take time for public awareness and political will to develop to the point that this can happen. With that in mind, it is important to understand that, because many policy makers, managers, and scientists are individually grappling with the same problems, many of the components of ACR are already being put into place including CWMAs, invasive species

task forces, and knowledge networks. Guided by the principles of ACR, the concepts and elements presented here can assist in crafting roadmaps for the expansion of interlinked knowledge networks. State and county leaders with their constituents and partners can continue to form cooperative networks that will increasingly carry out collaborative actions and gain funds that move things in the right direction. Individual scientists can create knowledge and syntheses that are available on websites with updating cycles in an adaptive manner, such as current annual state extension weed control recommendations. Agencies and universities can orchestrate linkages among websites and develop intelligent networks that integrate knowledge and site specifics to guide management and restoration prescriptions. ACR must build on existing institutions, issues, and interests at specific places, and will not look the same everywhere. Furthermore, ACR will always be a work in progress—never fully realized and always adapting to a changing world. While our own individual actions may seem insignificant given the magnitude of the NNIS problem, the ACR concept provides a framework with the potential to meld individual actions into a concerted process of effectively stopping new entries, collectively holding lines of defense, and ultimately reversing the current deluge of occupation to restore sustainable ecosystems needed now and tomorrow.

REFERENCES

Allen, S.L., Hepp, G.R., and Miller, J.H., Use of herbicides to control alligator weed and restore native plants in managed marshes, *Wetlands*, 27, 3, 739, 2007.

Barnes, T.G., Strategies to convert exotic grass pastures to tall grass prairie communities, *Weed Technol*., 18, 1364, 2004.

Botkin, D.B., The naturalness of biological invasions, *West. North Am. Nat*., 61, 261, 2001.

Britton, K.O., Duerr, D.A., II, and Miller, J.H., Understanding and controlling nonnative forest pests in the South, in *Southern Forest Science: Past, Present, and Future*, Rauscher, H.M. and Johnsen, K., Eds., General Technical Report GTR SRS-75, United States Department of Agriculture, Forest Service, Asheville, NC, 133, Chap. 14, 2004.

Bryson, C.T. and Carter, R., Biological pathways for invasive weeds, *Weed Technol*., 18, 1216, 2004.

Buck, L.E., Geisler, C.C., Schelhas, J., and Wollenberg, E., Eds., *Biological Diversity: Balancing Interests through Adaptive Collaborative Management*, CRC Press, Boca Raton, FL, 2001.

Colfer, C.J.P., *The Complex Forest: Communities, Uncertainty, and Adaptive Collaborative Management*, Resources for the Future and CIFOR, Washington, DC and Bogor, Indonesia, 2005.

Colton, T.F. and Alpert, P., Lack of public awareness of biological invasions by plants, *Nat. Areas J*., 18, 262, 1998.

D'Antonio, C.M., Jackson, N.E., Horvitz, C.C., and Hedberg, R., Invasive plants in wildland ecosystems: Merging the study of invasion processes with management needs, *Front. Ecol. Environ*., 2, 10, 513, 2004.

Environmental Law Institute, *Halting the Invasion: State Tools for Invasive Species Management*, Environmental Law Institute, Washington, DC, 112, 2002.

Evan, C.W., Moorhead, D.J., Bargeron, C.T., and Douce, G.K., *Invasive Plants Responses to Silvicultural Practices in the South*, Bugwood Network, BW-2006-03, The University of Georgia, Athens, GA, 51, 2006.

Ewel, J.J. and Putz, F.E., A place for alien species in ecosystem restoration, *Front. Ecol. Environ.*, 2, 7, 354, 2004.

Foxcroft, L.C., An adaptive management framework for linking science and management of invasive alien plants, *Weed Technol.*, 18, 1275, 2004.

Harrington, T.B., Rader-Dixon, L.T., and Taylor, J.W., Jr., Kudzu (*Pueraria montana*) community responses to herbicides, burning, and high-density loblolly pine, *Weed Sci.*, 51, 965, 2003.

Jordan, N., Becker, R., Gunsolus, J., White, S., and Damme, S., Knowledge networks: An avenue to ecological management of invasive weeds, *Weed Sci.*, 51, 271, 2003.

Lee, K.N., *Compass and Gyroscope: Integrating Science and Politics for the Environment*, Island Press, Washington, DC, 1993.

Liebhold, A.M., McDonald, W.L., Bergdahl, D., and Mastro, V.C., Invasion by exotic forest pests: A threat to forest ecosystems, *For. Sci. Monogr.*, 30, 1, 1995.

Mack, R.N., Simberloff, D., Lonsdale, W.M., Evans, H., Clout, M., and Bazzaz, F., Biotic invasions: Causes, epidemiology, global consequences, and control, *Ecol. Appl.*, 10, 689, 2000.

McPherson, G.R., Linking science and management to mitigate impacts of nonnative plants, *Weed Technol.*, 18, 1185, 2004.

Meyerson, L.A. and Reaser, J.K., Bioinvasions, bioterrorism, and biosecurity, *Front. Ecol. Environ.*, 1, 307, 2003.

Midwest Invasive Plant Network, *CWMA Cookbook: A Recipe for Success*, Midwest Invasive Plant Network, Indianapolis, IN, 22, 2006.

Minteer, B.A. and Manning, R.E., Eds., *Reconstructing Conservation: Finding Common Ground*, Island Press, Washington, DC, 2003.

Moran, V.C., Hoffmann, J.H., and Zimmermann, H.G., Biological control of invasive alien plants in South Africa: Necessity, circumspection, and success, *Front. Ecol. Environ.*, 3, 77, 2005.

NRC (National Research Council), *Predicting Invasions of Nonindigenous Plants and Plant Pests*, National Academy Press, Washington, DC, 2002.

Otsamo, A., Adjers, G., Hadi, T.S., Kuusipalo, J., Tuomela, K., and Vuokko, R., Effects of site preparation and initial fertilization on the establishment and growth of four plantation tree species used in reforestation of *Imperata cylindrica* (L.) Beauv. dominated grasslands, *For. Ecol. Manage.*, 73, 271, 1995.

Pal, R., Invasive plants threaten Segetal weed vegetation in South Hungary, *Weed Technol.*, 18, 1314, 2004.

Pierre, B., A taxonomic, biogeographical and ecological overview of invasive woody plants, *J. Veg. Sci.*, 7, 121, 1996.

Pimentel, D., Ed., *Biological Invasions: Economic and Environmental Costs of Alien Plant, Animal, and Microbe Species*, CRC Press, Washington, DC, 369, 2002.

Plummer, R. and Armitage, D.R., Charting the new territory of adaptive co-management: A Delphi study, *Ecol. Soc.*, 12, 2, 10 [online], Available at http://www.ecologyandsociety.org/vol12/iss2/art10/, 2007.

Sauer, L.J., *The Once and Future Forest: A Guide to Forest Restoration Strategies*, Island Press, Washington, DC, 380, 1998.

Schelhas, J., Buck, L., and Geisler, C., Introduction: The challenge of adaptive collaborative management, in *Biological Diversity: Balancing Interests through Adaptive Collaborative Management*, Buck, L., Geisler, C., Schelhas, J. and Wollenberg, E., Eds., CRC Press, Boca Raton, FL, xix, 2001.

Schrader, G., A new working program on invasive alien species started by the multinational European organization dedicated to protecting plants, *Weed Technol.*, 18, 1342, 2004.

Sheley, R.L. and Krueger-Mangold, J., Principles for restoring invasive plant-infested rangeland, *Weed Sci.*, 51, 260, 2003.

Simberloff, D., Impacts of introduced species in the United States, *Consequences*, 2, 1, 1996.

Simberloff, D., Parker, I.M., and Windle, P.N., Introduced species policy, management, and future research needs, *Front. Ecol. Environ*., 3, 12, 2005.

Simberloff, D. and Stiling, P., How risky is biological control? *Ecology*, 77, 1965, 1996.

Taylor, J.P. and McDaniel, K.C., Revegetation strategies after saltcedar (*Tamarix* spp.) control in headwater, transitional, and depositional watershed areas, *Weed Technol*., 18, 1278, 2004.

U.S. Congress, Office of Technology Assessment, *Harmful Non-Indigenous Species in the United States*, OTA-F-565, U.S. Government Printing Office, Washington, DC, 391, 1993.

USDA Forest Service, Southern Research Station's FIA Unit, Invasive plant database, Knoxville, TN, http://srsfia2.fs.fed.us/nonnative_invasive/southern_nonnative_invasives.htm, 2007.

Vitousek, P.M., D'Antonio, C.M., Loope, L.L., and Westbrooks, R., Biological invasions as global environmental change, *Am. Sci*., 84, 468, 1996.

Von der Lippe, M. and Kowarik, I., Long-distance dispersal of plants by vehicles as a driver of plant invasions, *Conserv. Biol*., 21, 986, 2006.

Walters, C., Challenges in adaptive management of riparian and coastal ecosystems, *Conserv. Ecol*. [online], 1, 2, 1, Available at http://www.ecologyandsociety.org/vol1/iss2/art1/, 1997.

Westbrooks, R.G., New approaches for early detection and rapid response to invasive plants in the United States, *Weed Technol*., 18, 1469, 2004.