CHAPTER TWO: MANAGING INVASIVE PLANT SPECIES

A. Designing a Management Plan

Most ecologists and conservationists agree that managing invasive plant species is crucial to the survival of sustainable ecosystems, but there is little consensus on how to best accomplish this goal. A few common themes have emerged, however.

> An invasive plant management plan must …
> 1) **Reflect** the complexity of factors modifying ecosystems
> 2) **Monitor** long-term effects
> 3) **Remain** local and dynamic

- **First,** management of invasive plant species alone will not suffice to conserve ecosystems, since other factors—global warming, industrial development, etc.—are simultaneously changing ecosystems.[1] A rigorous invasive species management plan must reflect the *complexity of factors modifying ecosystems.*[2]

- **Second,** *long-term monitoring* of plant invasions is key to understanding the impact of invasive plant species on a particular region, and predicting the damage they may cause in the future.[3]

- **Third,** the most effective invasive species management plans are *local and dynamic*, responding to invasive plant species as they occur and interact with regional ecosystems. This is all the more essential because invasive plant species often exhibit significant biological variation across different regions; thus, management techniques successful in one area may prove fruitless in another.[4]

B. Four Possible Goals of Invasive Species Management

Keeping these general guidelines in mind, conservationists may choose from the following four goals for the management of an invasive plant species:

1. **Eradication:** the complete removal of the invasive plant species from a region.

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[1] Indeed, climate change may promote some biological invasions, while discouraging others; the viability of Japanese knotweed seeds, for example, seems to be related to climate; see Bailey 2009.

[2] Hobbes and Humphries 1995.

[3] Blossey 1999; Strayer, D. L, V. T Eviner, J. M Jeschke, and M. L Pace. 2006. Understanding the long-term effects of species invasions. *Trends in Ecology & Evolution* 21, no. 11: 645–651.

[4] For example, there are several hybrid varieties of Japanese knotweed in the northeast United States, which have been shown to vary in response to mechanical and chemical control techniques; see Bailey 2009, Gammon 2007.

> *Eradication can also cause more problems than the invasive plant species itself.*

2. **Containment:** preventing an invasive species from spreading to any new sites, such as an uninvaded subwatershed.
3. **Reduction:** lowering the density or abundance of invasive plant species at a site. The invasive plant population is allowed to persist at a predefined low-density threshold.
4. **Mitigation:** counteracting the adverse impacts of invasive plant species. Instead of removing the invasive plant species, the negative environmental or economic effects are handled directly.

Of course, these goals are not mutually exclusive; thus, reduction may be the goal for the entire watershed, but eradication is the goal in a subwatershed; or mitigation becomes the goal where the plant species has invaded, but containment is used to stop its further expansion. Using this rubric, however, the BWA will be able to clearly define its invasive species management goals to conservationists and the community at large, facilitating education and public involvement in the project.

C. Eradication: Not the Best Option

Many conservationists and community volunteers, when first exposed to invasive species management, are eager to completely remove invasive plant species from the region.[5] Enthusiasm for invasive species management, however, should not translate into setting eradication as the primary goal of a rigorous management plan. First, eradication is difficult to achieve in practice, even on small scales. Illustrating this point, professional ecologists have so rarely succeeded in eradicating an invasive plant species that almost no data are available to predict the long-term results of an eradication-oriented management plan.[6] From what data are available, it seems that when one invasive plant species is removed, another, often of the same type, simply takes its place, even where native species have been planted to restore the local community.[7] Eradication can also cause more problems than the invasive plant species itself: soil erosion, starvation of herbivore communities, habitat reduction for nesting birds, waterway exposure to

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[5] At the BWA training and informational sessions, we often have to restrain community members from going outside and starting to pull out Japanese knotweed stands, at least until they have the proper tools and some sunscreen!

[6] Eiswerth, M. E, and G. C Van Kooten. 2002. Uncertainty, economics, and the spread of an invasive plant species. *American Journal of Agricultural Economics*: 1317–1322.

[7] The BWA's McMichael Creek demonstration project, described on page ___, supports this assertion. Japanese knotweed plants were removed manually. A cleared area was covered with black garden cloth to prevent regrowth and native plants were installed. The knotweed emerged from an small tear or break in the cloth.

herbicides, etc., etc.[8] Moreover, some invasive plant species reengineer ecosystems—change soil properties, for example, or produce low levels of chemicals harmful to other plants—to the extent that native plant species restoration is no longer possible.[9]

Figure 10. Very Eager Volunteers from BWA, Trout Unlimited and East Stroudsburg University Manually Remove Japanese Knotweed at East Stroudsburg Savings Association Site, April 2009 (See footnote 31).

Finally, conservationists have only so many financial and community resources available to them, so that even in those rare cases when eradication is the *ideal* goal, it will never be achieved, and so some *optimal* and *practical* goal must be set. Environmental economists have studied this problem extensively.[10] They support the BWA's conclusion that *optimal* results will be achieved by management plans that focus less on invasive species removal, and more on ***native community restoration***.

D. Overview of Techniques for Invasive Plant Species Control

Before proceeding to the density results of the BWA's regional invasive plant species survey and action plan, we will define three different sets of techniques for invasive plant species control:

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[8] Zavaleta, E. S, R. J Hobbs, and H. A Mooney. 2001. Viewing invasive species removal in a whole-ecosystem context. *Trends in Ecology & Evolution* 16, no. 8: 454–459.

[9] Gonzalez, A., A. Lambert, and A. Ricciardi. 2008. When does ecosystem engineering cause invasion and species replacement?. *Oikos* 117, no. 8: 1247; Callaway 2000.

[10] Eiswerth and Van Kooten 2002.

1. **Mechanical Control**: Mechanical control options include pulling individual stalks by hand, mowing fields of invasive plants, and other methods of manually targeting and removing or harming invasive plant species. The BWA almost exclusively suggests mechanical control techniques, as they tend to incur minimal environmental damage.

Figure 11. Young volunteers manually clear Japanese Knotweed at Buck Hills Falls.

2. **Biological Control**: In specific circumstances, a biological control agent—a disease, parasite, or herbivore—can be introduced to combat the invasive plant species. This course of action is advisable only after careful laboratory study of the biological control agent because it might actually cause more damage than the invasive plant. For example, the disease can potentially have more of an impact on native plants than the targeted invasive species. In unusual cases where the agent is target-specific and environmentally benign, however, the BWA suggests biological control. Unfortunately, the research on biological agents for many of the invasives found in our watershed is still in its infancy.[11]

Chemical Control: A wide variety of herbicides are currently available from agriculture and biotechnology firms. Herbicides and their applicators are relatively costly, are never fully target-specific (even when injected by syringe directly into the plant[12]), and have unpredictable and potentially dangerous impacts on water quality and aquatic ecosystems. As an organization concerned about all aspects of environmental protection, the BWA discourages using herbicides whenever possible, and does not provide advice on the use of chemical controls in this invasive species

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[11] See, e.g., Discussions at the biocontrol section of Cornell University's Ecology and Management of Invasive Plants Program**:** http://www.invasiveplants.net/monitor/BioControl_home.aspx.

[12] Hagen, E. N, and P. W Dunwiddie. 2008. Does Stem Injection of Glyphosate Control Invasive Knotweeds (Polygonum spp.)? A Comparison of Four Methods. *Invasive Plant Science and Management* 1, no. 1: 31–35. Hagen and Dunwiddie 2008.