A Decision-making Guide for Invasive Species Program Managers

***Note to Readers**: This guide was prepared to assist senior level program managers and policy makers in establishing priorities and making choices for invasive species management programs. While recognizing the critical and primary importance of prevention programs, the focus of the guide is the management of invasive species once they have arrived, which is an uncomfortable, but increasingly familiar role for many program managers and policy makers.*

*The idea for the guide was conceived at the 2010 annual meeting of the **Continental Dialogue on Non-Native Forest Insects and Diseases**. Michael Buck, from the National Association of State Foresters led the effort, assisted by many members of the Dialogue.*

The Dialogue's Steering Committee believes this guide can be a valuable resource and recommends its wide distribution and consideration. We note that while the guide may not provide specific answers to your invasive species problems, it can provide context, based on many years of experience and lessons learned, to assist in making the best management decisions possible.

A series of case studies (see attachment) involving high-priority invasive species were developed to demonstrate how this guide could be used. These case studies are not intended to judge any actions taken or not taken by entities – but rather to pose questions to spur discussion regarding the tough decisions faced by invasive species program managers.

Introduction

Invasive species inflict significant economic burdens by undermining biological diversity, disrupting natural systems, diminishing ecosystem resources and services, posing public health risks, and burdening the agricultural, ranching, forestry, and fisheries industries. Yet the nation's current protection system is piecemeal; it lacks adequate rigor and comprehensiveness, virtually ensuring invasive species will continue to arrive and spread.

This inevitable scenario will be accelerated by other trends: 1) decreased operational capacity compounded by the inherent challenges for invasive species budgeting; 2) competition from other forest health issues (e.g., native bark beetles); 3) lack of developed detection/survey, management/mitigation, and restoration tools for the vast majority of "new" invasive species that become established; and 4) acceptance by the general public of the incremental deterioration of environmental values from impacts from invasive species.

Invasive species program managers will be forced to establish priorities about which invasive species to focus on and which management options to choose. There is no status quo with invasive species – the game is always on - with you or without you. The decisions made, as well as the ones you don't make, will both have long reaching impacts.

Lessons Learned

We have met the enemy …. and they are us!

Management strategy and policy must engage the human dimension of the invasive species issue. While invasive species have important biological implications, the human dimensions will be paramount in achieving solutions. The concepts of "native" and "natural" are value laden, and vary with cultural and

temporal perspectives. People have purposely introduced new species into their environment for a long time. Since human behavior leads to most invasions, it follows that solutions will need to influence this behavior by addressing the socio-economic motivations for introductions and the costs to prevent and control them.

Prevention is your best management option.
The theme of prevention is familiar to all invasive species program managers, yet it is one of the hardest to implement because of its regulatory nature. Prevention strategies are based on biologic predictions and involve diverse cooperators. They are frequently limited by short term economic interests. In many cases the regulatory agencies (state departments of agriculture, for example) with prevention authority may not have the same enthusiasm or urgency level as the management agency charged to clean up the mess. Regulatory agencies may also have conflicting legislative and constituent mandates. Often their traditional constituents will be the most impacted by prevention regulations. Your regulatory partners need to be your friends, so make sure you understand them and support them.

An increased focus on point-of-origin inspections and compliance is needed to augment current efforts on stopping invasives at our borders. In addition, the risk of invasion can be significantly reduced if stakeholders work cooperatively to conduct applied, interdisciplinary research on the biology on invasions (including invasion pathways and modes); develop and apply cost-effective, practical methods and technologies to manage invasive species; and make this information easily accessible so that it is incorporated into management and policy decision making.

Choose your battles wisely.
Efforts to manage invasive species are most effective when focused on clearly defined, measurable goals; based on current biological and socio-economic information; applied rapidly (even when "perfect" knowledge is lacking); benefit a diversity of stakeholders; and are integrated across all spatial and temporal scales. This, of course is much easier said than done. When you commit to invasive species projects, keep your eyes open to biological surprises, irate stakeholders, and policy makers that are more than willing to look the other way until their constituents call. Do not overextend yourself, your staff, or your supporters by starting a program with little chance of success as you run the risk of losing financial support, credibility, and capability for the next round. Set your expectations, measures of success, and estimation of collateral losses honestly, and communicate them effectively.

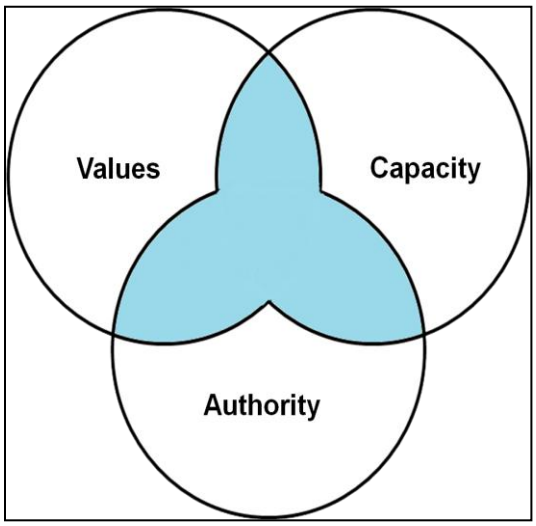
Science is not the only answer.
Invasive species management issues are nested in a sea of values, emotions, politics, and science. Do not overemphasize science as the dominant decision force. While science is integral in providing data to help frame up policy and management decisions, it may play a lesser role in the tough and controversial issues, especially if the emotional and political issues have already defined the parameters. Science issues may not be at the table in the final stages. Your goal is to embed the science parameters as early as possible through an experienced and mature effort at public outreach. If you are late to the party, science issues can be ignored or lost in conflicting experts' scenarios.

Show me the money.
There is always a need to consider the cost of taking no action with a rapid but credible assessment of impacts that may arise when a new invasive is found. Unfortunately, there have been many cases of inaction, especially when an influential constituent base hasn't pushed for action or actively resists regulatory actions. The use of existing screening systems for invasiveness should be improved and further utilized. Before committing to action, remember to factor in the long term costs involved with

control or eradication activities. There are many case histories which can be used to estimate what those costs may be**.**

Expand your capabilities.

Managing invasive species will take you to places you and your agencies have not gone before, with new partners, stakeholders, and political interests. Visualize your playing field as the area where three circles - representing values (what your stakeholders care about), capacity (resources you can mobilize), and authorities (formal or informal) - intersect. Be realistic in deciding what you can do and when and how you need to expand the playing field. Increase your influence by expanding the circles. Social marketing and public outreach can increase the size of the circle representing value. Increased budgets, new partners, and volunteers can enlarge the circle representing capacity. New laws or regulations can expand the circle representing authority. Informal authority can also be increased with effective public outreach.



Visualize your playing field when managing invasive species as the intersection of three circles representing values, capacity, and authority.

You can't handle the truth.

No one likes to hear bad news. Unfortunately the very nature of many invasive species issues involves nothing but bad news. Establish your credibility early - stick to the facts, communicating the best science available, and be completely honest. You don't want to earn the reputation of someone who constantly cries wolf, yet you must alert decision makers of big problems as they occur. Remember that there is never one right answer, but there are always truthful options. Provide policy makers with science – based information that forces them to consider your proposed action in terms of avoided costs versus the costs of no action at all. Identify specific sectors contributing to the problem, and find a way to quickly bring them to the table. Local communities need realistic mitigation options that are affordable and within their capabilities. Whenever you can, connect your issue to a sense of place and/or quality of life.

Establishing Priorities

You will not be able to digest all the invasive species on your plate, so you have to establish priorities. Pick species known or suspected to be invasive but still found in small numbers, those that can alter ecosystem processes, species that occur in areas of high conservation or economic value, and those that are likely to be controlled successfully**.** In the long run, it is more efficient to devote resources to immediately addressing incipient infestations.

Historically, setting priorities has been based on environmental values, but political and public support should be front and center at the table for any decision. Depending on public perception, some species will be harder to target than others, requiring intensive public awareness campaigns and convincing arguments. The media can be a powerful tool for influencing the public. Make sure you clearly define your target area boundaries, as problem could become regional in scope, demanding a wider set of cooperators.

Management Options

The diversity of potential invasive species (e.g., mammals, insects, pathogens, and plants) is enormous and some management options may not be effective for all types of organisms.

While terms differ, there are three main options for dealing with established invasive species: 1) *eradication*; 2) *control*; and 3) *mitigation*. *Eradication* is the elimination of the entire population of species in questions, and encompasses all life stages. *Control* is the long-term reduction in density and abundance of an invasive species to below a pre-set acceptable threshold. If these first two management strategies cannot be employed, the remaining option is *mitigation* of the impacts of the invasive species, finding the best ways in which to "live with it."

Plan your management options with adaptive off-ramps and on-ramps for changing conditions and biological surprises. Some of the particularly tough decisions you will face are when to move (or be forced to move) from an eradication action to a slow-the-spread strategy, or from a slow-the-spread strategy to one of just preserving a few sites. You may have to accept the establishment of the invasive organism, as in the case of chestnut blight, and focus on mitigation options.

Eradication

The feasibility of eradication needs to be carefully and realistically assessed. Many failed attempts at eradication have been costly and significantly affected non-target species (e.g., fire ants in the southern states of the USA). Eradication as a management strategy has many caveats. There is plenty of literature about successes and failures in the eradication of invasive species. Your best chances of success are with isolated, small populations of species with low reproductive rates and no dormant life stages. In most cases, avoid well-established populations that are established in large areas. For example, populations of mammals are easier to eradicate than established populations of plants and insects with dormant life stages (e.g., soil seed banks). Species with a high intrinsic rate of reproduction present more of a challenge for eradication, even in isolated populations.

Historically, successful eradication programs have common elements: 1) a commitment to complete the action; 2) an ability to put the entire population of the target species at risk (e.g., removing them faster than they can reproduce); 3) the capacity to prevent re-invasion, and 4) support from affected local communities. In many situations, the feasibility of eradication will also be affected by risks to non-target species.

Reliable sources of funding should be secured for a period beyond the estimated period of eradication itself to allow for unanticipated problems and to secure adequate resources for follow-up evaluations and studies. The public must be made aware of problems caused by the species under consideration, and their support should be secured well before the eradication action is started. These steps take time, but it should be appreciated that faster responses to new invasions yield better results.

Advantages of Eradication:

- Complete eradication typically yields results that are more environmentally sound and ethically acceptable than those of long term control. Sustained control may involve the perpetual use of pesticides and other toxins and trapping or shooting, and can entail more environmental risks and many more animal deaths than a relatively shorter eradication program.
- Eradication allows the affected habitat a better chance to return to the conditions prevailing prior to the invasion.
- There are few long-term control costs involved, although precautionary monitoring for early warning and/or prevention measures may be appropriate.
- Ecological impacts and economic losses are reduced to zero immediately after a successful eradication action.

Disadvantages of Eradication:

- Eradication may not succeed, in which case the entire investment will have been largely wasted.
- Eradication is usually very costly and may necessitate the need to reduce funding to other areas of work; the action may require full commitment and attention from staff until its successful completion.
- Eradication is most effective when populations are low and occupy small geographical areas; this is also a time when it is difficult to generate support for implementing a program when most constituents have not seen a significant problem.

Control

Control of invasive species should be planned to reduce the density and abundance of the target to below an agreed threshold, lowering the impact to an acceptable extent. The suppression of a population reduces its competitiveness and, under optimal conditions, native species may regain ground. All methods of control require long-term funding and commitment. If the funding decreases or ends, the invasive population and corresponding negative impacts will increase, perhaps leading to irreversible damage.

Control of invasive species may involve containment (keeping species within regional barriers), or, in a stricter sense, suppressing population levels of invasive species to below an acceptable threshold. Defining this threshold is not entirely straightforward, but consideration of the projected level of impact of the invasive species and its corresponding collateral damage to the economy and environment must be taken into account.

In the short-term, control seems to be less expensive than eradication, and it is often the preferred method. Funding and commitment for control programs can be less than those for eradication programs, and funding can be varied between the years depending on the perceived importance of the problem, political pressure, and public awareness. However, this reasoning may be deceiving: in the long run, effective control is usually more expensive in total than a successful eradication campaign.

Successful control may be easiest to achieve in areas with lower densities of the invasive species. Such control will immediately mitigate the impact of the invasive species, allowing a relatively resilient natural system to recover from negative impacts.

Containment

The purpose of containment is to restrict an invasive species to a limited geographical range. In order to establish these parameters there needs to be clear understanding of the purpose of the containment (e.g., to protect particular areas or habitats from invasion, to allow time to mobilize other control or eradication measures, etc.). Invasives can be suppressed using a variety of methods along the border of the defined area; individuals attempting to spread outside of the defined area will be eradicated, and introductions from outside of the area will be prevented.

An important component of a containment program is the ability to rapidly detect new infestations of the invasive species: those spreading from the margins of its distribution, and/or those moving into completely new areas. Based on these detections, control measures must be implemented as rapidly as possible. New infestations begin at very low densities, so early detection is challenging. The most suitable cases for containment are those involving habitat islands which are isolated from other habitats and thus do not facilitate emigration of invasive species. A good example of where containment could be a feasible strategy is the restriction of spread of freshwater species between different parts of watersheds.

Advantages of Containment:

- If containment of an invasive species in a well-defined area is successful, natural habitats and native species will be safeguarded against negative impacts.
- In cases where eradication is not feasible and the range of the invasive species is restricted within a relatively isolated area, containment of the species can protect outlying areas.

Disadvantages of Containment:

- Containing a species in a defined area requires constant attention and control at the borders and adequate prevention measures against spread of the species.
- Successful containment is difficult to achieve, often involves costly methods, and involves a long-term commitment.

A related but different approach is exclusion, which protects a sensitive area against invasive species by fencing them out. This method also often combines eradication, prevention, and fencing techniques. For example, an area of high conservation value is fenced with an animal-proof fence and any invasive organisms occurring within the fenced area is eradicated. This mainland-islands concept is very effective in supporting crucial populations of endangered species when eradication of the invasive species within the containment is possible. However, eradication on a large-scale is not usually feasible.

Mitigation

Historically, mitigation has been most commonly used in conservation efforts (e.g., translocation of a viable population of an endangered species to safe areas). In the future, mitigation as a management option will become even more important as many invasive species continue to naturalize. This will be especially relevant where extensive collateral damage from certain invasions (e.g., urban tree removal and replacement as a result of infestations by emerald ash borer) is occurring. While mitigation can be labor intensive and costly, it is often a politically viable option when taken in tandem with eradication, containment, or control efforts.