NOAA FISHERIES SERVICE

Technical Guidance for the Development and Review of Habitat Restoration Practices

Purpose

This technical guidance is intended to:

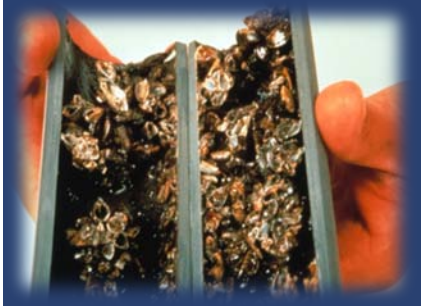
- Provide guidance to the technical monitors and grantees to consider potential impacts of invasive species during development and implementation of habitat restoration actions.
- Increase awareness and understanding of ramifications of the potential effects of invasive species on proposed habitat restoration activities.
- Guide the development and technical review of the habitat restoration actions to prevent the introduction of invasive species, reduce and control invasive species within a project area, and monitor for potential new introductions of invasive species.
- Encourage NOAA habitat restoration staff and grant recipients to consider ways to avoid or minimize the introduction of invasive species and reduce the likelihood of spreading invasive species into a project area.

Background

Invasive species are any species or viable biological material (including seeds, eggs, and spores) that are transported into an ecosystem beyond its historic range and cause economic or environmental harm or harm to human health. The environments into which invasive species are introduced often lack the conditions or factors that would normally limit expansion of these species in their natural habitats (e.g., predators, pests, or diseases). This factor, accompanied by characteristics such as high reproductive rates, the ability to utilize a variety of resources, and tolerance to a wide range of environmental conditions, allow non-indigenous species to spread quickly following introduction, often resulting in serious consequences for the environment.

Consequences of invasion include the extinction of native species through predation, grazing, niche competition and/or species hybridization. Invasive organisms can also profoundly alter ecosystem functioning through modification of fire frequency, drought, natural disease, soil or water column hydrology, nutrient cycling and productivity. In 2005, invasive species cost the U.S. economy in excess of $137 billion (Pimental et. al. 2005), and the occurrence and extent of exotic species continue to increase. Today, invasive species pose one of the dominant environmental threats to biological diversity, second only to habitat destruction (Simberloff et. al. 2005), and are cited as a cause of endangerment for 48 percent of the species listed under the U.S. Endangered Species Act (ESA 2000).

A native species is one that occurs naturally with respect to a particular ecosystem, rather than as a result of an accidental or deliberate introduction into that ecosystem by humans. These species evolved over geologic time in response to the distinct environmental characteristics of a specific habitat and interactions with the other species inhabiting the local community.



In addition to the ecological damage caused by zebra mussels (*Dreissena polymorpha*), hundreds of millions of dollars have been spent to clean up fouled pipes and keep the mussels from fouling drinking water treatment, industrial and power plant intakes. (Photo credit NOAA)

The emerald ash borer (*Agrilus planipennis*) has killed at least 50 million ash trees so far and threatens to kill most of the ash trees throughout North America. This insect can be transported by logs or hardwood firewood. (Photo credit: The Nature Conservancy)

Criteria to Consider for Invasive Species Prevention and Control

Executive Order 13112 supports a "place-based" approach to restoration, which emphasizes the importance of using native plant and animal species that are appropriate for the particular habitat. The benefit of using native species is they are more likely to thrive under the local conditions while being less likely to invade new habitats. Consequently, native species reduce maintenance costs and produce healthy natural communities; thus providing a practical and ecologically valuable option for landscaping, conservation and restoration projects.

The natural range of many species may be confined to particular ecosystem within a given state or ecological region. In determining whether a species can be considered native at a particular site, evidence of clear natural, native occurrence should be balanced against evidence of introduction. Expert assistance should be sought in questionable cases before making irreversible management decisions, whether eradicating a species which is suspected to be non-native or introducing a species at a site where it is thought to have once been native.

The highly invasive nature of purple loosestrife (*Lythrum salicaria*) allows it to form dense, homogeneous stands that replace native grasses, sedges, and other flowering plants that provide a quality source of nutrition for wildlife (Photo credit: National Park Service).

Restoration of the natural habitat should be addressed whenever the control or eradication of a non-native species is planned. Habitat rehabilitation is often necessary to avoid the replacement of one invasive species with another, control flooding, and to prevent soil erosion and other problems associated with the absence of biological materials. For restoration projects that do not include the control of invasive species, attention should be given to actions that may prevent establishment of invaders not yet present within the project site. Invasive species may be transported within materials used for landscaping, erosion control, and excavation. They may also hitchhike on vehicles, watercraft, construction equipment, and personal gear. Additional guidance bulletins are provided to assist NOAA technical monitors and grantees in proper methods to clean and inspect these materials to prevent unwanted organisms.

Below is a list of questions that should be considered during the development of habitat restoration projects:

- Are there known invasive species present within the project area? If so, what is the probability of these invasives increasing in numbers and causing damage during construction or following the project completion?
- What is the probability that the proposed restoration activities could threaten the existence or stability of native species?
- Does the proposed site monitoring program include procedures for conducting a baseline species survey, monitoring for the presence of invasive species during construction, and evaluating site conditions after project completion?
- If the restoration objectives involve re-introducing a native species, could this species be inadvertently acting as a vector for invasive species (e.g. insects or fungi on plants, or disease in shellfish)?
- If the restoration involves utilization of a non-native species, although discouraged, does the species pose a risk of becoming invasive? If yes, it should not be considered for introduction without further analysis or mitigation measures.

Below is a list of actions that should be considered during restoration planning:

- Complete an inventory of existing species, including invasive populations using field reconnaissance and mapping. Knowing where invasive species live is essential to control efforts; the species will continue to spread until controlled.
- Control any invasive populations within the project site that may be disturbed during habitat restoration activities.
- All materials and native species used for restoration should be inspected and, when possible, certified that they are not acting as vectors for invasive species.
- New invaders can show up at any time and are easiest to control when they first arise in an area, thus regular monitoring of the site and updating of the species inventory is important.
- Once it is determined which invasive species are priority concerns within the project area, train staff and volunteers to identify these species. Invasive species awareness and education will improve the effectiveness of prevention methods.

Case Study: San Francisco Bay - Smooth Cordgrass (*Spartina alterniflora*)

Smooth cordgrass, a native plant to the East Coast of the United States, was intentionally introduced to the San Francisco Bay Estuary in the 1970s to restore and stabilize shorelines. The plant spread rapidly; today the invader covers more than 69,000 acres of tidal marsh and mudflats on the West Coast and has invaded every marsh restoration project in the Bay.

Smooth cordgrass also has the ability to hybridize with native California cordgrass (*S. foliosa)*. In 2000, surveyors tallied 470 acres of hybrid smooth cordgrass, while the original introduced species had become extremely rare. By 2003, the hybrids inhabited more than 2,000 marsh acres. The hybridization between smooth and California cordgrass resulted in a high degree of genetic variation, which allows individual plants to survive in different habitats. For example, some hybrids grow well in higher marsh elevations while others flourish on open mudflats. Smooth cordgrass hybrids may also adapt qualities to grow taller and faster, produce more seed, and have greater tolerance of extreme environmental conditions than the native cordgrass specie. The hybrid cordgrass tends to grow in dense stands, crowding out native salt marsh plants species, thus turning diverse marshes into monocultural meadows. This transformation reduces fish habitat area and quality, destroys foraging grounds for shorebirds, and impedes tidal flow through channels.

In 2000, the California State Coastal Conservancy began to organize a multi-agency, region-wide control effort in the San Francisco Estuary called the Invasive Spartina Project (http://www.spartina.org). The aggressive control actions demonstrated that, given adequate funding, non-native cordgrass could be effectively eradicated from the San Francisco Estuary within several years. To support and maintain eradication, additional steps are necessary, including long-term monitoring to detect new infestations, rapid response processes to quickly remove any newly found plants, extensive public education and outreach programs, and procedural modifications to prevent intentional or accidental reintroduction of plants.

The smooth cordgrass invasion of San Francisco Bay demonstrates the extensive environmental damage a non-indigenous species can cause in a short period of time as well as the time consuming, costly measures that are needed to control and eradicate invaders. This case study also emphasizes the benefit of using *only* native species for landscaping, conservation and restoration projects.

Left unchecked, Spartina, will take over mudflats, resulting in the loss of valuable habitat and disruption of bird migrations (Photo credit: Northeast Aquatic Nuisance Species panel).

Arial treatment of *Spartina* spp. within the San Francisco Estuary. (Photo credit: San Francisco Estuary Invasive Spartina Project).

Mechanical removal of *Spartina* (Photo credit USFWS)

Suggested Resources

A Primer on Invasive Species in Coastal and Marine Waters
Jacoby C., Walters L., Baker S., Blyler K. Florida Sea Grant College Program: SGEB 60. 28 pp. Available online at: http://nsgl.gso.uri.edu/flsgp/flsgpg05001.pdf
This document describes the history and pathways of introductions, the harm caused by invasive species, and how we can manage activities to help solve the problem.

Alien Invasive Species: A Toolkit of Best Prevention and Management Practices
Wittenberg, R., Cock, M.J.W. (eds.) 2001. Invasive Alien Species: A Toolkit of Best Prevention and Management Practices. CAB International, Wallingford, Oxon, UK, xvii - 228. Available online at: http://www.gisp.org/publications/toolkit/Toolkiteng.pdf
This document includes an introductory material, methods for prevention of invasive species, risk-analysis, and early detection.

Aquatic Habitat Guidelines: An Integrated Approach to Marine, Freshwater, and Riparian Habitat Protection and Restoration
Washington Department of Fish and Wildlife, Habitat Technical Assistance Available online at: http://wdfw.wa.gov/hab/ahg
The site contains white papers on the following topics: overwater structures, marine and estuarine shoreline modification issues, water crossings, channel design, ecological issues in floodplain and riparian corridors, dredging and gravel removal.

Assessing and Managing Invasive Species within Protected Areas
Tu, M. 2009. Assessing and Managing Invasive Species within Protected Areas. Protected Area Quick Guide Series. Editor, J. Ervin. Arlington, VA. The Nature Conservancy. 40 pp. Available online at: http://www.cbd.int/invasive/doc/ias-tnc-guide-2009-en.pdf
This guide provides protected area managers with guidance on how to create a comprehensive assessment and strategic plan for invasive species.

Coastal Wetlands: Lessons Learned from Past Efforts in Louisiana Could Help Guide Future Restoration and Protection
United States Government Accountability Office. Report to Congressional Addressees. December 2007. GAO-08-130 Coastal Wetlands. Available online at: http://www.gao.gov/new.items/d08130.pdf
This report identifies projects that have been designed and constructed to restore and protect coastal wetlands as well as their estimated costs and benefits and lessons learned to help guide future efforts.

Biotic Invasions: Causes, Epidemiology, Global Consequences and Control
Ecological Society of America. 2000. Biotic Invasions: Causes, Epidemiology, Global Consequences and Control. Issues in Ecology 5. Available online at: http://www.esa.org/science/Issues/FileEnglish/issue5.pdf
A scientific literature review that evaluated the impacts of invasive species as well as methods used to identify future invaders and take effective steps to prevent their dispersal and establishment.

Invasive Free Zone Guidebook
McNamara D. 2007. Invasive Free Zone Guidebook. U.S. Fish and Wildlife Service, Whittlesey Creek National Wildlife Refuge. 40pp. Available online at: http://www.fws.gov/midwest/whittleseycreek/documents/IFZGuidebook.pdf
Whittlesey Creek National Wildlife Refuge, U.S. Fish and Wildlife Service. *This guidebook provides recommendations, information, and insights for creating an Invasive Free Zone; a useful reference for anyone working to control invasive species, especially on a large scale.*

Noxious, Invasive, and Alien Plant Species: A Challenge in Wetland Restoration and Enhancement
US Department of Agriculture; National Resources Conservation Service, National Wetland Team. March 2007, Technical Note No. 190-72. Available online at: ftp://ftp-fc.sc.egov.usda.gov/WLI/NoxiousPlants5_24_2007.pdf
This document provides information on invasive plant species that threaten the success of wetland restoration including describing the impact to native species and recommending methods of avoidance through planning and monitoring. Also includes identification information and control information for 13 plant species that have a significant negative impact on wetlands.

Pimental D, Zuniga R., Morrison D. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics 52, 273– 288.

Simberloff D, Parker IM, Windle PN. 2005. Introduced species policy, management, and future research needs. Frontiers in Ecology and the Environment 3(1): 12-20.