A River Network Publication Volume 19| Number 2 - 2009

River Voices

Roles for the River Conservation Community:

Invasive Species

by Chris Dionigi, National Invasive Species Council www.invasivespecies.gov

Throughout human history, people have carried species to new ranges. Many non-native species are essential to human existence; they comprise most of our crops and livestock. Others are considered game species, sport fish, landscaping materials, soil stabilizing "ecological bridge" plants used in habitat restoration and pets. A few species—when either deliberately or accidentally introduced into new ranges—persist and spread, causing environmental and economic harm. Certain species harm human health directly. These "invasive species" can be plants, animals or microorganisms. They can be found in every type of terrestrial, marine and freshwater habitat. At least 4,500 species of foreign origin have established free-living populations in the U.S.[1] While most non-native species are not invasive, a single invasive species can have wide-spread impact.

Aquatic Invasive Species (AIS)—also called nuisance or exotic species—are aquatic to semi-terrestrial organisms, animals, plants and microorganisms that have been introduced into ecosystems. Aquatic invasive species plants have adapted to living in, on, or next to water, and that can grow either submerged or partially submerged in water. Aquatic invasive animals require a watery habitat, but do not necessarily have to live entirely in water.

Credit: U.S. Geological Survey

Sea Lamprey on an adult Lake Trout

Impacts

Aquatic invasive species threaten the biodiversity and function of healthy, aquatic systems; present huge economic burdens for communities, states and agencies and are extremely difficult to control and remove. Some invasive species, such as Emerald Ash Borer insects, snakehead fish and Sea Lamprey, prey upon or parasitize biologically significant native species. Lampreys are parasitic, ocean-going creatures that enter fresh water to reproduce. They critically damage the fish they feed upon, creating large open wounds where they rasp away at the flesh and tissues for their food, drinking the blood of their victim. Due to the activities of man in the previous and current centuries, they have found ways into fresh water lakes that were formerly unavailable to them. Presently, they inhabit all of the Great Lakes and the Finger Lakes (NY), and many rivers and tributaries thereof. Over its lifetime, one Sea Lamprey can kill an estimated 40 pounds of fish.[2]

Many invasive species, such as kudzu, tree of heaven, cheatgrass, tamarisk and zebra mussel, displace other species and transform entire landscapes and aquatic systems. Zebra mussels are fingernail-sized freshwater mussels native to the Caspian Sea. They were transported to the Great Lakes by ship ballast water. Some researchers believe that zebra mussels (and closely related species) are transforming the Great Lakes from planktonic (water column) ecosystems rich in game and commercial fish to benthic (lake bottom) dominated systems (USGS).

[1] Office of Technology Assessment 1993 [2] Wisconsin Department of Natural Resources

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River Network

Connecting People, Saving Rivers

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River Network is a national, nonprofit organization whose mission is to help people understand, protect and restore rivers and their watersheds.

From The President

Photo credit: River Network Collection

Tamarisk shrubs from the Middle East will soon be sucking more water from Colorado streams than the entire city of Denver. European reed canary grass is taking over like bamboo in our wetlands and is just about as hard to get rid of. And don't even get me started on rock snot—a disgusting diatom that coats river rocks in thick slippery mats—and, as in a bad sci-fi movie, seems to be it's spreading far beyond its native range.

The list of invasive species that are just plain bad news for our rivers and wetlands goes on and on—purple loosestrife, hydrilla, Japanese knotweed, water chestnut and dozens more that are displacing native plants and animals, rendering waterways impassable for boats, and like the zebra mussel in the Great Lakes, perhaps even fundamentally changing the entire ecosystem.

But, as awareness of the problem grows, there's also good news: those of us who love to spend time on rivers are in a great position to help. Many River Network Partner groups and other organizations have created "early detection teams" that are proving effective in drawing the line against the spread of new invaders, while other volunteers are hard at the admittedly unglamorous work of removing established invasive species. You can learn more in this special issue of *River Voices*.

River ecosystems are dynamic and we may never be entirely free of "alien" aquatics. Climate change will only complicate our work to define, let alone restore, what is "natural." River Network's emerging strategic plan includes a special focus on the intersection between restoring natural systems and responding to climate change. Just as many of you are helping to create this new plan of action. I hope you will also play a major role in the plan's implementation. The outlook is encouraging that we can find an uneasy truce with these unwanted neighbors and protect the best of our home rivers.

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Their impacts are showing up in the food chain where competition for plankton from zebra mussels is reducing the growth of larval fish.[3]

Preventing invasive outbreaks is not an exact science. Environmental conditions are dynamic from year to year and may be altered by an unpredictable change in climate, making it difficult to determine which species will become invasive in an area. The most troublesome species are often the most adaptable. Populations may interbreed, hybridize or otherwise change genetically. While disturbances such as wildfires, floods, water diversions and road building can open new corridors for invasive species, many species do not require disturbance to become established and spread. Indeed, some of the richest, most biodiverse sites suffer the greatest impacts from invasive species. Species-rich islands and riparian areas are especially hard hit.

Credit: Dave Grafton (courtesy of Ohio Environmental Council)

A freshwater sponge being suffocated by Zebra mussels.

Economic Costs

It is difficult to estimate the total economic harm caused by invasive species. Aquatic invasive species clog irrigation canals and pipes that supply water to power plants and factories. Zebra mussel densities were as high as 700,000/m^2 at one power plant in Michigan, where water flow through the pipes was cut by two-thirds.[4] Whirling disease, which primarily affects rainbow trout, is caused by a microscopic parasite *Myxobolus cerebralis* that was introduced to the U.S. from Europe in the 1950s and is now found in 25 states. Once established, the parasite or its aquatic tubifex worm host cannot be eradicated.[5] Data from Colorado indicate a loss of $35.8 million dollars in money spent on trout fishing annually due to whirling disease impacts on trout fisheries. In the Southwest, tamarisk trees (i.e., salt cedars) take up water that could support native vegetation and wetlands. Salt-rich tamarisk leaf litter can build up on the soil surface, especially during droughts and low river flows, increasing the salinity to the point that inhibits the growth of native plant seedlings. The aquatic invasive plant Eurasian water milfoil grows rapidly, is well adapted to many climates and can grow to the surface of lakes in depths of up to 5 meters. Shading out native species, milfoil infestations are associated with a 20% to 40% decline in shoreline property values.[6]

Challenges

Certain groups of organisms (taxa) are relatively well known; however, many groups are poorly studied. Despite the need, there is little funding for this type of research. Universities and others are not training and hiring new scientists to replace retiring professionals. Their irreplaceable records, expertise and collections are in danger of falling into disuse or being lost all together.[7] While some ground-breaking work looking at the DNA of century-old (pre 1910) herbarium records and specimens is yielding results useful to identifying and removing invasive species, additional advancement in this field will not be possible if samples and data are not collected and preserved today. Our vital

[3] Rikow 2004 [4] USGS [5] Colorado Department of Natural Resources [6] Halstead et al. 2003 [7] OSTP, 2009

taxonomic infrastructure is eroding, yet the prevention, eradication and control of invasive species depends upon it.

For invasive species that are wide-spread, there are several types of control tools that are currently being used (e.g., see NISC Control and Management Guidelines). Invasive plants can be removed by hand or by equipment. Guided by research, prescribed fires can shift some invaded marsh communities back toward native plants and animals. Biological control insects greatly reduce the impacts of invasive plants over wide areas, but great care must be taken that they themselves do not become invasive. Pesticides together with other methods that are carefully applied and monitored by professionals have largely removed invasive melaleuca trees from wetlands in the 140,000 acre Arthur R. Marshall Loxahatchee National Wildlife Refuge in Florida[7]. Unfortunately, in many cases these tools the may be few or altogether lacking.

Invasive species are particularly difficult to control in aquatic habitats. Available tools are limited and species are difficult to locate and monitor in such a dynamic environment as water. Additionally, there are very few registered compounds that can be used to control invasive fish, and they don't work universally. Furthermore, our waterways transcend political boundaries, complicating eradication efforts and policy. Such challenges make the prevention of aquatic invasive species especially important.

Probably no other invasive species has caught the public's attention more than the Snakehead fish. This large predatory invasive fish was a "media star" and even the inspiration for two Sci-Fi Channel films. The year 2002 was even called the "Summer of the Snakehead".[8] Native to the Yangtze

Credit: U.S. Geological Survey Archive

Snakehead fish

River in China, northern snakeheads are quite tasty, possess the ability to breath air, can move about on dry land and can live for up to three days out of water, ensuring fish markets some of the freshest fish available. A few years ago, a dealer sold a pair of live snakeheads to a fish enthusiast who originally intended to make them into soup; instead of a kettle he put them in an aquarium and eventually—due to their voracious appetite—released them into a pond. Within days of the discovery, federal officials announced a proposal to impose trade and import bans on 28 species of snakeheads. The ban is none too soon, as snakeheads have already been found in six other states: California, Florida, Hawaii, Maine, Massachusetts, and Rhode Island. Despite the hyperbole, snakehead eradication from this one pond in Maryland illustrates the complexities of even a limited early detection rapid response operation and underscores the particular need for and importance of prevention in aquatic systems.

It is widely recognized that social awareness and action on invasive species is critical, but many questions remain unanswered. Why are some communities active and others not? How does awareness and the attitudes of individuals concerning invasive species vary among communities with differing economic, social, ethnic and racial compositions? Are public outreach messages

[7] Personal communication Jeffrey D. Schardt, Florida Department of Environment Protection [8] Dolin 2003

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available for in other languages? When available, are they simple translations of the English versions, or are they truly targeted messages that were made for a community and released in their anchoring institutions? Public awareness of individual invasive species has always been high, but the recognition that an invasive species is part of a broader multifaceted problem is also becoming more extensive. This is reflected in the number of bills on the issue in both state houses and the U.S. Congress. A search of Thomas.gov, the Library of Congress website, will bring up a current list. Although it is important that people remind their political representatives about invasive species problems, it is critical that they also educate them about the opportunity for success. Success is measured by the number of invasive species *not* present and the value of the vast resources that remain. It is also measured by areas that are now recovering. When success is left out of the conversation, invasive species can be viewed incorrectly as inevitable and unsolvable. They are neither.

Opportunities

There are many different types of aquatic invasive species, but relatively few significant pathways of spread. Identifying those pathways and interdicting them has widespread benefit and is a key element of invasive species prevention. Any time equipment, people or goods are moved, there is a chance for the movement of invasive species. This is true on global scales as when container ships cross oceans and on much smaller scales when canoes are hauled to a new launch site. Relatively simple actions such as keeping boat ramp areas free of weeds, cleaning equipment before transport, using weed-free forage for pack animals, not releasing live bait, scrubbing fishing waders between stops, and rinsing boats and trailers before moving to new areas can prevent a wide range of species from spreading and thereby protect favorite places. Just as anti-litter campaigns encouraged people to take relatively simple steps to prevent it, awareness of invasive species and simple steps one can take also do a great deal of good.

But, even the best prevention efforts cannot stop all invasive species. The early detection and rapid response system (ED&RR) is a critical second defense against the establishment of invasive populations (see NISC ED&RR Guidelines, pg 38). ED&RR increases the likelihood that localized invasive populations will be found, contained and eradicated before they become widely established. ED&RR can slow range expansion, and avoid the need for costly long-term control efforts.

In order to control and eradicate them, invasive populations must first be found. Although they can be detected by professionals conducting targeted surveys, they are often found fortuitously by informed lay people. Trained volunteer groups provide vital early warning information and greatly expand monitoring networks. Hundreds of trained volunteers are currently working with the Invasive Plant Atlas of New England (IPANE) project to do just that.

Once a species is detected in an area, the rapid assessment process (Rapid Response) is used to determine if further actions or an overall strategy are needed. Rapid Response

is a systematic effort to eradicate or contain invasive species while infestations are still localized. These efforts may address totally new introductions into the U.S. or range-expanding infestations of previously established species. It is critical to quickly mobilize resources to contain and intensely control an infestation before it becomes more widely established. The period that a population is large enough to detect, but localized enough to stop, is brief. In some cases, volunteers can help in these efforts directly.

Clean Angling Pledge

All of the waters that we depend on to support our fishing and boating are being threatened by invasive species that have the potential to devastate natural habitats. These invaders are often inadvertently spread by anglers and boaters who are carrying unwanted hitchhikers to their favorite waters.

Each of us must take these simple actions to ensure that we do not spread these destructive species:

- **INSPECT - carefully examine all of your equipment at the end of your trip to see if there are any visible signs of unwanted material attached. This includes any types of plants or mud. If you see any sign of a problem:**
- **CLEAN - first remove any visible material by hand then use water to wash your equipment clean. It's ok to clean with water from where you are leaving as you will be leaving behind any problem that you may have picked up. However, never clean your equipment at your put in spot since you can easily be cleaning off hitchhikers that have been with you since your last trip. If you cannot clean before you leave a site make sure to clean at home where there is no chance that an invader can reach the water.**
- **DRY - a thorough drying of your equipment will kill any live invaders you may have picked up. If you are counting on drying to eliminate any hitchhikers you must make sure that every bit of hidden moisture is gone before you can feel that you are safe.**
- **TAKE THE PLEDGE to inspect, clean and dry after each use by filling out the form below. By taking the pledge you are joining a group of dedicated anglers working to keep our waters safe (e.g., Visit www.cleanangling.org to take the pledge).**

Developed in cooperation between Trout Unlimited and Bob Whiltshire of the Federation of Flyfishers. Reprinted with permission from Trout Unlimited. www.tu.org

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Volunteers working with resource managers are making great strides in controlling invasive species. The Nature Conservancy works with volunteers in the Washington, D.C. area on National Park lands. Friend's groups of National U.S. Fish and Wildlife Refuges are also pitching in. Organizing and participating in such efforts greatly expands the capabilities of land managers. One example of such an effort is Trout Unlimited and the Federation of Flyfishers, who ask people to sign a "Clean Angling Pledge." Stakeholder groups can help people understand the need for temporary closures and other inconveniences associated with rapid response actions and can also help with the all-important follow up monitoring.

Credit: MU photo by Steve Morse

Asian Carp

It is not possible to list all of the species that are—or are potentially—invasive. It is, however, possible to develop a targeted list of priority invasive species for an area. Monitoring and mapping data are critical to this process, but often lacking. Informed members of the public (citizen scientists) working with resource managers can help fill these data gaps, and know that they are providing important information to protect a resource.

Eradication of widespread invasive species may not always be feasible. Widespread invasive species are subject to control and management efforts that slow range expansion and lessen impacts. Populations can span geographic and jurisdictional boundaries. Their control requires interjurisdictional communication and regionally coordinated action. There are more infestations than control resources, which requires prioritization. Understanding the ecological, economic, and social impacts of invasive species is important in prioritizing control operations. Information from stakeholders that are deeply familiar with a watershed can inform the process.

Federal Response

Federal agencies are starting to work collaboratively on invasive species. Their efforts are coordinated by the National Invasive Species Council (NISC), established in 1999 by presidential Executive Order (EO) 13112. NISC members include the Secretaries of Transportation, State, Defense, Homeland Security, Treasury, and Health and Human Services; the Administrators of the Environmental Protection Agency and the National Aeronautics and Space Administration; as well as the Director of the U.S. Agency for International Development and the U.S. Trade Representative. EO 13112 called on NISC to prepare and issue the first national plan to deal with invasive species. Completed in 2001, the National Invasive Species Management Plan served as a comprehensive "blueprint" for federal action on invasive species. In August of 2008, the second national management plan was completed.[9] This document directs Federal efforts to prevent, control and

[9] NISC 2008

minimize invasive species and their impacts through 2012. The same Order that created NISC also required the Secretary of the Interior to establish the Invasive Species Advisory Committee (ISAC), a diverse group of 30 non-federal advisors from around the U.S.

Taking Action

Invasive species can be a difficult concept to comprehend; to address this, they are often compared to more familiar issues such as "green pollution." However, pollution does not increase un-aided as invasive species do. Battle metaphors such as the "war on weeds" are frequently used, yet even battles eventually end; invasive species are ongoing. Invasive species also have been called a "wildfire in slow motion." However, a wildfire is obvious, does not require "authoritative identification" and it is generally clear how to put it out. Invasive species may be more cryptic than a wildfire, but none-the-less damaging. The most apt analogy for invasive species may be "rust." Like rust, invasive species steadily erode the things that we care about. Like rust, invasive species damage is best prevented and like rust, it requires constant vigilance.

Invasive species can be anywhere, but they are not everywhere. Our most valuable resources remain largely intact. We cannot stop all invasive species, but we can prevent many of them. Most importantly we can buy time. More than 50 years ago when the structure of DNA was first being described, it could not be predicted that crimes would be solved from a tissue sample. Yet, today it is commonplace. Problems that are intractable today may someday be solvable, but only if we protect what we have today.

While it is true that addressing invasives in your watershed can be a challenging endeavor, here are three basic steps you can take…and encourage others to do the same.

1. **PREPARE:** *Know what species are invasive in your area.*
   - Ask local experts, such as your local County Extension Office, for help in identifying invasive species in your area. www.csrees.usda.gov/Extension
   - Learn about your local invasives and then educate others. www.anstaskforce.gov/default.php or www.seagrant.noaa.gov/themesnpa/aquaticinvasivespecies.html
2. **PREVENT:** *Don't spread invasive species.*
   - Clean hiking boots, boats and outdoor equipment to prevent the spread of hitchhiking weed seeds and other invasive species.
   - Don't release pets, aquarium plants, live bait or exotic animals into the wild. www.habitattitude.net
3. **PROTECT:** *Protect against invasive species.*
   - Report sightings of invasive species to natural resource managers.
   - Volunteer at your park, forest, refuge or wildlife area to monitor and remove invasive species. If no program exists, organize one.
   - Ask your elected representatives to support invasive species efforts.
   - Donate to organizations that protect natural resources from invasive species.

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Towards a Comprehensive & Collaborative Approach:

Reframing Invasive Species Management

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Purple loosestrife (*Lythrum salicaria*) is a four-foot tall perennial herb that occurs in cattail marshes, sedge meadows, open bogs, roadside ditches and other wetlands and disturbed areas. Due to its prolific purple flowers, loosestrife is easy to recognize and has long been a popular ornamental plant—even today, it can be sold in nurseries in some states. However, purple loosestrife's productivity and rapid growth have severe side-effects: it displaces native vegetation and produces monotypic stands, choking out wetland areas and reducing the population of endemic plants and associated wildlife. Purple loosestrife is now established in every state except Florida.

Just as purple loosestrife occupies edge habitats that straddle aquatic and terrestrial ecosystems, responsibility for its management straddles lines of government agency responsibility. In many cases, terrestrial and aquatic ecosystems are managed separately via distinct regulatory agencies and legal authorities. Loosestrife is generally considered an "aquatic" species and therefore is often, but not always, managed under specific legal authorities for aquatic invasive species (AIS). For example, the Maryland Department of Natural Resources regulates "aquatic organisms," including aquatic plants. The Maryland Department of Agriculture could also regulate the plant, however. In fact, however, neither agency has regulated purple loosestrife, leaving a gap so that the species can be grown, sold and imported without restriction. The situation is different in neighboring Virginia, where two agencies—the Department of Game and Inland Fisheries and the Marine Resources Commission—regulate aquatic invasive species (AIS). Neither of these agencies has jurisdiction over plants, however—instead, the Department of Agriculture and Consumer Services has declared purple loosestrife to be a noxious weed. Thus, loosestrife is regulated in Virginia, but not by a natural resources agency.

Does it matter whether purple loosestrife is regulated as an aquatic or a terrestrial species, or by a natural resources agency or an agriculture department? Noxious weed laws were created to protect agriculture, and therefore work very differently from laws expressly intended for AIS. The agencies responsible for implementing these laws act independently, so regulatory actions by one agency may not be communicated to or coordinated with sister agencies. As a result, different regulatory programs may well work at cross-purposes, especially when biological reality is considered. Invasive species do not respect jurisdictional boundaries—so Maryland's decision not to regulate loosestrife may affect Virginia habitats. And a control action by a parks department may be ineffective if not echoed outside park boundaries. Cooperative approaches are needed to enable invasive species management programs to reflect these biological imperatives.

Shortcomings of the Single-Species Approach

Neither the federal government, nor any state government, has enacted a comprehensive invasive species law bringing invasive species management under one roof. Instead, invasive species are regulated

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based on a complex patchwork of interwoven laws and regulations that have evolved over more than a century. This type of regulatory system inherently leads to gaps and overlaps in agency authorities and has produced a fractured approach to invasive species management in practice. When combined with the interstate nature of invasion, this regulatory crazy quilt can produce unpredictable responses to invasion.

Invasive species laws are structured so that agencies regulate each species individually. Plant and wildlife laws generally are not directed at invasive species in particular, but rather evolved from decades-old provisions to protect and promote agriculture and conserve game species, respectively. In most instances, these laws authorize the regulatory agency to determine that a particular species is harmful. Once the agency adds a species to the list of noxious or injurious species, it becomes unlawful to import, release, sell or propagate that species. For example, noxious weed laws authorize departments of agriculture to identify and create a list of noxious weed species. The sale of listed weed seeds is unlawful and landowners are required to destroy listed species on their land. Similarly, wildlife laws generally authorize the state fish and game agency to identify specific injurious species. Once listed, it may be unlawful to possess, release, purchase or sell the species.

Credit: Linda Wilson, University of Idaho

Purple loosestrife

The single-species approach to biodiversity regulation is often criticized as ineffective. Take the Lacey Act, the federal government's law governing wildlife importation. The Lacey Act was first enacted in 1900 to prohibit the importation of certain species—notably, the European starling, a serious agricultural pest in Representative Lacey's home state of Iowa. Under the Act, the Fish and Wildlife Service can list any species it deems "injurious to the interests of agriculture, horticulture, forestry, or to wildlife or the wildlife resources of the United States." In more than a century, the Service has listed only about 35 taxa, and a recent study determined that it takes about 4 years to list a single species. As a result, few species are listed, and often it is too late to prevent even listed species from becoming established in the United States. Additionally, a 2004 study by the Environmental Law Institute found substantial differences between noxious weed listing among the Great Lakes states—while Minnesota had listed more than 130 weeds, neighboring Wisconsin had listed only three.

On-the-ground invasive species management commonly adopts a single-species model similar to that used in the regulatory process. The massively-funded Chesapeake Bay Program, for example, has created management plans for six invasive species, including purple loosestrife. Similar approaches are used throughout the country to target species of particular concern in particular habitats or geographic or jurisdictional areas. While well-intentioned, this single-species approach to management has clear limitations. First, it is based on species that are already a problem, rather than on future threats. Second, it is impossible to create a management plan for more than a few of the many species of concern.

Encouraging Coordinated Management

The solution to the shortcomings of the single-species approach to invasive species regulation and management is to develop general approaches that can be applied to a broad variety of circumstances and species. In recent years, some states have moved towards a general approach to the invasive species question. These developments have moved along two tracks: individual agency regulations have evolved to more comprehensively recognize the invasive species threat, and states have made concerted efforts to bring agencies together so that they work synergistically. For example, some states now outlaw the release of any non-native wildlife species—not just those on a list. And others are working on early detection and rapid response plans that can be applied to any newly-discovered invasive species.

The creation of interagency councils and management plans to address invasive species represents a major shift in the approach to invasive species management in the U.S. Invasive species councils and management plans date to 1990, when Congress enacted the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA). NANPCA created the Aquatic Nuisance Species Task Force (ANSTF) and its regional panels to promote coordination between responsible agencies and among states. In addition, it provided funding to assist states in developing and implementing their own AIS management plans. While slow to take hold, most states have created management plans, and some have gone so far as to create new AIS-specific legal authorities and programs.

The strategies to promote collaborative interagency management planning for AIS represent a significant step forward, but also indicate the challenges in developing

Credit: Steve Dewey, Utah State University

Purple loosestrife invading riparian area.

comprehensive invasive species legislation. Both NANPCA and the National Invasive Species Act of 1996 (which reauthorized NANPCA) were focused solely on aquatic species. As a result, terrestrial species were left out in the cold, operating as they always have. Consider tamarisk, or salt cedar (Tamarix spp.). First introduced more than a century ago, tamarisk is widely established throughout western states, where it is considered highly invasive. Like purple loosestrife, tamarisk occupies riparian habitats and affects aquatic ecosystems. Unlike loosestrife, however, it is not considered an aquatic plant, and therefore is not generally addressed in aquatic invasive species management plans.

General invasive species councils can assist agencies in coordinating to address terrestrial species and habitats, overcoming some of the limitations inherent to AIS-specific efforts. In 1999, President Clinton attempted to broaden the scope of interagency coordination by issuing Executive Order 13112. The order accomplished two things: it defined invasive species and created the National Invasive Species Council (NISC). Amazingly, invasive species had not been defined to that point, and even today, few states have adopted a definition. As defined by the federal government, an invasive species is

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any non-native species that causes harm to the environment, economy or public health. NISC brings together all agencies responsible for protecting the United States from these species. It is also assisted by a committee of private sector members—the Invasive Species Advisory Committee. As directed, NISC created, and recently updated, a national management plan for invasive species. Unfortunately, NISC has not unified invasive species management. Understandably, NISC has chosen to focus more on terrestrial species than on aquatic species, which remain coordinated by the ANSTF. In addition, NISC funding is limited, and not all agencies have participated equally in the committee's work. As a result, there remains a divide between terrestrial and aquatic species management.

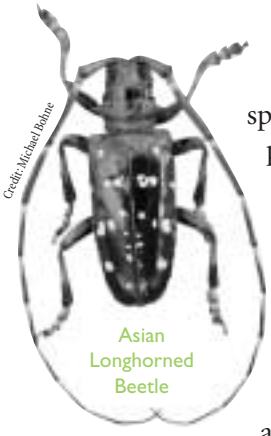
Many state governments have again followed the federal lead and have established invasive species councils (ISCs) to encourage interagency communication and planning. These ISCs vary in terms of structure, membership and funding. Some are ad hoc groups of interested parties, while others have a formal legal authority and membership. In most cases, these bodies either admit members of the public directly or have advisory committees to allow public participation. Few ISCs have permanent staff or funding, however, and they therefore work intermittently as time and agency investment and funding allow. The primary role of each ISC is to produce and implement a comprehensive invasive species management plan—generally, adding a terrestrial component to the existing AIS plan. When effective, they also provide a forum for the development of linkages and information-sharing among state and federal agencies, citizen groups and industry. The ISC can then feed information about priorities and needs into the legal and management process both at the legislative and individual agency levels. However, like their federal counterpart, state ISCs often struggle with funding, integration with existing AIS initiatives and moving beyond creation of a management plan to its implementation.

The Role of River Conservation Organizations

Coordinated approaches to invasive species management are easier to recommend than to carry out, and support from the private sector is crucial to their success. Individuals and agencies may reasonably resist expanding programs beyond their expertise—or simply may not know who to call in a sister agency or state. Resources and manpower are limited, and coordination requires agencies to devote time and energy over a long time scale. Support from watershed groups and other private sector organizations can help invasive species councils overcome these challenges by communicating grassroots support for coordination to policymakers and by sharing expertise on specific invasive species problems and needs.

River conservation organizations can take a number of concrete actions to support invasive species council activities. The appropriate activities depend on the status of individual states.

- **In states without an invasive species council**, outreach to the governor, to agencies and to the state legislature can prod the government into action. In particular, note funding opportunities for councils and management plans and their benefits in other states.
- **In states where management planning is ongoing**, participate in the process by testifying about important issues at public meetings and submitting comments on drafts of the proposed plan. Management plans can determine policy for many years, and it is important to identify important issues at the outset.
- **In states with an active council**, participate in decision making by testifying at public meetings and nominating members to serve on advisory committees. Some states allow nongovernmental representation on the council itself—if so, river groups can join as full members.


Credit: Michael Bohne

Asian Longhorned Beetle

In addition to participation in formal regulatory processes, river organizations play an important role at the grassroots level when management plans are put into place. River groups are not bound by political boundaries or jurisdictional lines; to the contrary, watersheds often include a multi-state area in which different state, county, and local agencies are managing invasive species on both public and private lands. To succeed, these efforts require buy-in from private landowners, and without it, they often fail. River groups can raise awareness of invasive species in the community and facilitate collaboration across jurisdictional lines for a common goal, thereby avoiding confrontations and negative outcomes. Effective advocacy can thus create public-private partnerships and informal linkages among agency personnel and between communities and their regulatory agencies.

In the end, general approaches to invasive species management—whether in the aquatic or terrestrial realm—must be brought to bear on specific problems. And it is in the context of these specific applications that public involvement may be the most important component of a successful invasive species strategy. Agencies rarely have the resources or authority to inspect lands where species may invade, leaving it to the public to identify new invasions and bring the governmental machinery to bear on the issue. A private entomologist identified the first Asian longhorned beetle in New York City, launching a multimillion-dollar, multi-state effort to eradicate the pest. And anglers first found snakehead fish in a pond in Crofton, Maryland. The same story can be told for countless other species. Thus, public education and training on identification of likely invaders, common invasion pathways, and steps to prevent introduction may be among the most effective tools for preventing invasions and enabling effective response actions when new species are discovered.

Volunteers Can Monitor for Invasive Species:

Riverine Early Detectors

by Laura MacFarland
River Alliance of Wisconsin
www.wisconsinrivers.org

Slipping through the cracks

Aquatic and terrestrial invasive species such as the New Zealand mud snail, zebra mussel, purple loosestrife, and others are slipping undetected through the blue cracks in our maps—our rivers. Invasive species not only degrade the health of our rivers, they use the rivers as dispersal corridors spreading throughout a watershed. Species, such as Japanese knotweed, can spread as high flows carry rhizomes or live vegetative matter that can resprout when deposited on fertile floodplains downstream.

Credit: River Alliance of Wisconsin

Early Detectors in action.

Early detection of an infestation in or along a river can enable containment or eradication before it is too late. Monitoring these systems can be difficult for those that do not frequently romp along or between riverbanks due to difficult terrain or because of private lands. Control and eradication of invasives in flowing waters is difficult, and in some cases impossible, due to the low contact time of chemical treatments in flowing water (which are commonly used to control invasive plants in lakes).

It is for these reasons the River Alliance of Wisconsin and local groups throughout Wisconsin are engaging river enthusiasts (paddlers, anglers, etc.) and riparian landowners in helping to detect invasive species.

Project RED: A Paddle with a Purpose

In 2008 the River Alliance of Wisconsin, a statewide nonprofit organization, conducted a one-year pilot project to test whether paddlers in canoes and kayaks could detect four easily identified invasive plant species along the banks of a river. The four pilot species were all wetland plants: purple loosestrife, Japanese hops, Japanese knotweed, and common reed grass. The Alliance worked with several volunteer groups such as the Sheboygan County Master Gardeners and the Friends of Badfish Creek to monitor over 50 miles of streambank detecting several new infestations.

The pilot evolved into Project RED (Riverine Early Detectors), early detection and rapid response being the objective. The number of invasive species of concern was increased to 15, including plants and animals along the streambank and in the water. In partnership with Wisconsin's Department of Natural Resources (WDNR) and the National Institute for Invasive Species Science (NIISS), River Alliance of Wisconsin is offering six free workshops throughout Wisconsin to train volunteers to identify and report these 15 species in home waters.

Prioritizing Species of Concern

Identifying the invasive species of concern is the first step in developing a riverine invasive species monitoring effort in your watershed. Take caution not to let your list get too long as too many species will intimidate your volunteers. It is necessary prioritize.

The River Alliance of Wisconsin selected their 15 aquatic, wetland and terrestrial species of concern because they met most of the following four criteria:

- considered regionally as an early detection species;
- presented an existing or potential threat to river ecosystems;
- detectable by volunteers with rudimentary training; and
- identified as a priority species to our partners.

Project RED is a statewide program that can and should be tailored to meet local needs. Therefore, we have been more inclusive in our listings. We recommend keeping your local or regional list shorter than 15 if possible.

Other factors you may wish to consider while compiling your species list include:

- current range of each invasive species in your region;
- current and potential impacts of the species;
- value of the habitats/areas the species infests or could infest; and
- the difficulty of control and establishing desirable replacement species.

Ask state and local resource managers to identify species that, in particular, are not yet known to be on the site but which are present nearby; species in your region that are likely to use a river corridor as a pathway or alter riverine ecosystem processes such as nutrient cycling or sedimentation and erosion; species that are likely to impact the most highly valued habitats or areas that contain rare or highly valued species or communities within river corridors; and species that, with available resources, can be controlled and replaced by desirable natives. Finally, ask potential partners, including state and local agencies, what their priorities are.

The River Alliance of Wisconsin has already identified additional species of concern (i.e., buckthorn and garlic mustard) that will be added to the project next year. Be aware that this needs to be a living list; species should be added and deleted as it is deemed necessary.

RIVER ALLIANCE OF WISONSIN: 15 SPECIES OF CONCERN

Common Name	Scientific Name	May	June	July	Aug	Sept
Purple loosestrife	*Lythrum salicaria*			x	x	x
Japanese knotweed	*Polygonum cuspidatum*				x	x
Japanese hops	*Humulus japonicus*		x	x	x	x
Common reed	*Phragmites australis*			x	x	x
Flowering rush	*Butomus umbellatus*		x	x	x	
Hydrilla	*Hydrilla verticillata*			x	x	x
Curly-leaf pondweed	*Potamogeton crispus*	x	x			
Eurasian water milfoil	*Myriophyllum spicatum*		x	x	x	
Brazilian waterweed	*Egeria densa*			x	x	x
Didymo	*Didymosphenia geminata*	x	x	x	x	x
Zebra mussel	*Dreissena polymorpha*	x	x	x	x	x
Quagga mussel	*Dreissena rostriformis bugensis*	x	x	x	x	x
New Zealand mudsnail	*Potamopyrgus antipodarum*	x	x	x	x	x
Chinese mystery snail	*Cipangopaludina chinensis*	x	x	x	x	x
Banded mystery snail	*Viviparus georgianus*	x	x	x	x	x

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Monitoring Protocols: Keep it Simple

Project RED protocols are incredibly simple and opportunistic, the goal being to engage individuals who already frequent rivers to assist in early detection. Examples of more rigorous protocols may be found at the National Biological Information Infrastructure website, www.NBII.org.

During the pilot project, the River Alliance of Wisconsin quickly discovered that timing is everything. A small patch of knotweed that could easily go undetected in June was hard to miss in late August while in bloom. Project RED volunteers are encouraged to float their river at different times throughout the paddling season to monitor for select species based upon the timeline (see pg. 17).

Volunteers will use GPS units that are stored at technology libraries throughout the state to record the latitude and longitude of any invasives. These are provided by the Citizen Based Monitoring Network of Wisconsin and are available for check-out by Wisconsin citizen monitors. The species name, coordinates, and estimated size of the infestation will be recorded on a field data sheet printed on waterproof paper provided by Project RED.

Sharing the Data

Project RED volunteers enter their data into a citizen scientist website (www.CitSci.org), an online tool created by NIISS. The web site allows volunteer organizations to tailor online data reporting sheets and maps to meet their specific needs. Through the site, data may be shared with other project members, resource management agencies, funding sources, landowners and the general public.

It is important to remind volunteers that their job is not done after they submit their data; it is their responsibility to assist in creating and implementing an action plan to contain or eradicate the invasive, if deemed possible. Volunteers should be provided contact information for local and state resource managers that can provide technical and/or financial assistance. It is important to empower volunteers to become local leaders by teaching them about available resources, including small grants.

Training and Engaging Volunteers

The Project RED trainings are approximately four hours long. During this time, volunteers learn where to look for each species and how to identify them, collect a specimen or photograph for verification, use a GPS unit and the www.CitSci.org database and report their findings to regional Department of Natural Resources staff to discuss control options.

The amount of available material on invasive species is staggering. It is not necessary to recreate species identification handouts or keys. Rely upon existing educational materials created by local and state agencies, Sea Grant Institute, U.S. Fish and Wildlife Service and others.

Engaging and retaining volunteers can be challenging in the fight against invasives. It is important to constantly remind volunteers why we are concerned about the impact of invasives. The easiest way to do this is to focus on the positives, introduce them to the current diversity in your watershed that is worth protecting. Although it is tempting to just focus on the invasives and the harm that they do, be sure to introduce a few natives as well as the non-natives to your volunteers.

Remind volunteers about the other benefits of participating in such a program. If anyone needs an excuse to go paddling or stroll on the banks of the river, why not for an ecological treasure hunt. In addition, this project is great for local organizations that are in need of a hands on activity for their members, beyond the usual annual clean-up day. It is also a great opportunity to partner with folks that you might not have thought to partner with before (e.g., prairie enthusiasts, master gardeners, etc.).

Credit: Tom Heutte, USDA Forest Service

Japanese knotweed

Inspiring Action

During the Project RED pilot in September 2008, the Friends of Badfish Creek identified a pioneer stand of Japanese knotweed adjacent to the creek at a bridge abutment. The Friends quickly took matters into their own hands, contacting both the landowner (a farmer) and the Wisconsin Department of Natural Resources (DNR). Together these three pooled the necessary resources to develop and implement a three year control and monitoring plan to eradicate the stand before it could spread downstream.

The Friends of Badfish Creek recruited a local boyscout troop and many other partners to host two work parties each year, the landowner granted them permission to dry and burn the cut plant material and the DNR provided a small grant to pay for herbicide application.

This is what the River Alliance of Wisconsin envisioned when designing Project RED: local partners working to detect infestations early and then responding rapidly. We hope that this is the first of many such success stories to come.

VOICES FROM THE FIELD

Invasive species are crawling, slithering, flying and swimming their way to watersheds across the county. Below are a few examples of how River Network Partners are addressing these unwelcome and uninvited intruders.

In 2004, the Stilly-Snohomish Fisheries Enhancement Task Force (SSFETF), in partnership with the Snohomish County Noxious Weed Control Board and several other project partners, began a multi-year project to monitor and control invasive knotweed species in the Stillaguamish Basin in Snohomish County, Washington.

Chinook salmon in the Stillaguamish Basin are listed as Threatened under the federal Endangered Species Act. Current populations of Stillaguamish Basin Chinook are estimated at about 7% of historical levels (Mobrand Biometrics 2004). The Stillaguamish Watershed Chinook Salmon Recovery Plan (SWCSRP) identifies non-native invasive species, including Japanese knotweed and related knotweed species, as one of many factors affecting depressed populations of Chinook salmon and other salmonid species in the Stillaguamish Basin. The loss of functionally mature riparian vegetation in the Stillaguamish watershed has resulted in increased water temperatures and erosion, as well as reduced instream cover, habitat complexity and large wood recruitment (SWCSRP 2005). Addressing the Japanese knotweed complex in the Stillaguamish Basin is necessary to restore riparian habitat function and processes in the Basin. The Stillaguamish Cooperative Weed Management Area (CWMA) Working Group was established to promote an integrated and coordinated approach to controlling knotweed species in the Stillaguamish watershed. As part of the CWMA's effort, the Stilly-Snohomish Task Force began implementing a landscape-scale control of knotweed in the Stillaguamish watershed, with the following objectives:

- Survey and control Japanese knotweed and other knotweed species along tributaries of the North Fork, South Fork and Mainstem Stillaguamish rivers;
- Enhance or restore riparian corridor previously infested with knotweed by planting appropriate native riparian vegetation;
- Provide education and outreach to private and public landowners and watershed citizens; and
- Develop lasting partnerships with agencies working in the watershed and build our capacity to identify, develop and implement salmon restoration projects within the Stillaguamish watershed.

Credit: Friends of Rock Creek

Porcelain Berry about to pounce on a cyclist

Since 2004, the Task Force has worked with community volunteers to survey over 250 miles of tributaries to the North Fork, South Fork and Mainstem Stillaguamish River to identify knotweed infestations on public and private property. The Task Force identified and contacted 160 landowners with knotweed infestations to offer information and control assistance and established knotweed control agreements with 107 landowers. Knotweed control on these properties occurred between one and four times over the four-year project.

The 2008 survey of previously-treated knotweed areas suggests an 86% reduction in knotweed presence from 2007 observations. The reduction in knotweed patch areas varied from 10% to 99%.

Stilly-Snohomish Fisheries Enhancement Task Force (WA)
www.stillysnofish.org

Charles River Watershed Association's volunteer invasive weed removal project is an ongoing effort to eradicate water chestnut, an invasive aquatic plant, from the Charles River. In 2007 and 2008, we recruited diverse groups of volunteers to hand-pull the invasive weeds from the river, working in collaboration with Charles River Canoe and Kayak, which provided canoes for all volunteers, and Massachusetts Department of Conservation and Recreation, which contracted mechanical harvesters to remove the weeds in deep areas of the river.

Credit: Charles River Watershed Association

Volunteers remove water chestnuts

Last year we recruited more than 250 volunteers for the project. There was an overwhelming swell of support from neighbors and businesses along the river during these events, as local residents volunteered their time and motorboats to assist with transporting the weeds from the canoes to the dumpsters on shore—there was even a neighbor who brought out his pontoon boat and distributed hot dogs to volunteers. After volunteering, nearly all participants in the water chestnut removal were enthusiastic proponents of the project, and they enjoyed the opportunity to get out on the river for a good cause. The sense of accomplishment gained by volunteers, combined with the chance to explore the priceless and oft-overlooked river environment, makes this project unique and appealing to volunteers of all ages.

Charles River Watershed Association (MA)
www.crwa.org

Credit: J. Jeffrey Mullahey, University of Florida

Tropical soda apple

The Wildflower Center has joined with the Texas Forest Service, Texas Parks and Wildlife, Texas Master Naturalists, Houston Advanced Research Center and others to recruit volunteers who detect and report invasive species in their communities. The Invaders of Texas program provides training and materials to volunteers who find, track, describe and photograph invasive species and report occurrences to a centralized database at www.texasinvasives.org. The anticipated outcomes of this citizen scientist program include a statewide network of volunteers contributing to our knowledge of the distribution of invasive species in Texas and increased public awareness of the dangers imposed by invasive species and what steps citizens can take when they encounter them; and reduced spread of invasive species through more timely control and eradication.

San Antonio River Authority (TX)
www.texasinvaisves.org

The Johnson Creek Watershed Council (JCWC) started its Riparian Rehabilitation Program in 2006 in an effort to survey, map and control invasive Japanese knotweed along the riparian corridor throughout the Johnson Creek Watershed. During extensive field surveys, it soon became apparent that knotweed wasn't the only regionally significant invasive weed threatening the health of native riparian plant communities; other species like false brome and yellow flag-iris were also appearing within our target area. Thanks to generous funding from Metro (Metropolitan Portland's regional government) and Oregon Department of Agriculture, these weeds were added to our species target list in 2007. By the end of 2007, JCWC had surveyed, mapped and initiated control measures for these three plant species within 95% of the watershed. In 2008, thanks to a generous grant from Portland's Watershed Investment Fund, the Council added garlic mustard to our target list as sparse populations of this plant were being documented. Our initial focus in this program has been to implement an early detection/rapid response (ED&RR) model for managing high priority invasive weed species. Over the course of this program, we have worked with over 250 private land owners to survey their riparian properties. Based on our mapping, we have received written permission from 197 of these property owners to conduct treatment on their property.

Credit: Johnson Creek Watershed Council

Sizing up Japenese knotweed

Credit: Johnson Creek Watershed Council

Yellow flag iris: attractive but invasive

To date, we have reduced targeted weed species infestations by 85%-100%. What began as a project focused on a single species and funded through one grant has grown into a project with a four species focus funded through four additional grants. We recently received an additional grant from Metro to seed and plant native trees and shrubs in areas where weeds have been successfully suppressed, the critical next step to ensure long-term weed control, native plant establishment and restoration of riparian functions.

Credit: Johnson Creek Watershed Council

Invasive Garlic mustard

JCWC staff surveyed the entire mainstem of Johnson Creek (26 miles) plus an additional 40 miles on tributary drainages and, to-date, have treated 84,000 knotweed stems, (55,000 via stem injection); 4.5 acres of yellow flag iris; 1.5 acres of Garlic mustard; 0.2 acres of false brome, as well as other species of concern such as Purple loosestrife, pokeweed, spurge laurel, and lesser celandine.

Johnson Creek Watershed Council (OR)
www.jcwc.org/resources/knotweed.htm

tncinvasives.ucdavis.edu

Credit: Johnson Creek Watershed Council

A volunteer removing invasive Garlic mustard

CASE STUDY

Collaborating to Restore the Fowl Meadow Wetland

by Carly Rocklen
Neponset River Watershed Association
www.neponset.org

During the summer of 2008, the Neponset River Watershed Association (NepRWA) began a five-year collaborative wetland restoration project with the South Region Headquarters/Urban Parks Division of the Massachusetts Department of Conservation and Recreation (DCR). NepRWA and DCR are partnering to apply a biological control to several wetland sites to reduce Purple loosestrife (*Lythrum salicaria*) infestations there. Our goal is to control Purple loosestrife and thereby encourage the growth of diverse native wetland plants, improving native wildlife habitat and restoring native species diversity and the ecological value of the wetlands.

Annually, each Purple loosestrife plant produces several million seeds, which lodge in the soil, to germinate in the future. The seeds also are transported to other wetland areas by water and also on the wildlife and people that pass between wetlands. Due to a lack of effective native predators, once Purple loosestrife establishes a foothold in a local wetland, it can spread until it out-competes native wetland plant species and dominates the landscape. A Purple loosestrife-infested wetland does not provide an array of ecological benefits equal to that of a wetland of diverse native wetland plants. The loss of diversity is of particular concern at Fowl Meadow, where some state-listed endangered, threatened and special concern species are known specifically not to nest or forage in Purple loosestrife.

The Wetlands Restoration Program (WRP) of the Massachusetts Office of Coastal Zone Management has taken the role of project guide, and an online network of experienced beetle-ranchers and managers of Purple loosestrife biocontrol projects provide additional guidance, as unofficial (yet essential) advisors. A large, diverse and regional corps of committed volunteers adds project manpower and intellectual resources.

Our strategy is to establish a self-sustaining population of the Galerucella beetle in the project areas to control Purple loosestrife. The beetles are not native to North America; they are native throughout the natural range of Purple loosestrife. Purple loosestrife is believed to have arrived in North America in the early 1800s from Europe and Asia, possibly in ship ballast water and wool, and purposefully, as an ornamental plant and/or medicinal herb.

The biocontrol insect population will rise and fall at the project sites and in the general vicinity, depending on the availability of Purple loosestrife, the weather, insect reproduction and mortality rates, and the migration of the beetles to and from the sites (the beetles search out new sources of Purple loosestrife). Through data gathered via site monitoring both prior to and after each year's beetle releases for all five years of the project, we will assess whether this biocontrol method is an effective means for reducing Purple loosestrife populations at the treatment sites. WRP also will integrate our project data into its statewide project database.

Getting Involved

Biological control (biocontrol), or using a living organism to control a species, has proven effective at reducing Purple loosestrife infestations and improving wetland wildlife habitat. We chose biocontrol over other forms of control (i.e., manual removal, herbicide application, etc.) because of the expansiveness of the Purple

loosestrife infestations and their proximity to highways, residential areas, and aircraft flight paths. Also, the promised project guidance from WRP; potential funding from the Corporate Wetlands Restoration Partnership; the accessible network of experienced Purple loosestrife biocontrol project managers and participants; the success stories of this biocontrol method; and the interest of the landowners in trying this land management tool, led us toward implementing biocontrol.

As advised by WRP, we are using two biocontrol Galerucella beetle species: *G. pusilla* and *G. calmariensis*, which feed primarily on Purple loosestrife and very little if at all on other plant species. The beetles' appropriateness for use as a biological control here in the United States has been tested since 1986, and since 2000, the beetles have been incorporated into the WRP Purple loosestrife biocontrol program.

Opportunities for Public Involvement

Biocontrol projects can provide project managers with community involvement opportunities in the form of hands-on, outdoor, seasonal, multi-year and multi-faceted volunteer activities. Project partnership offers a larger pool of potential project volunteers of varying age, gender, background and interest. For example, we have involved Boy and Girl Scouts, college

Credit: Neponset River Watershed Association

Intern Emily Tran and project partner DCR South Region Forestry Assistant Alexandra Echandi monitor a study plot.

professors and students, elementary, middle and high school teachers and classes, estate managers, staff and members of other environmental conservation organizations, zoos, and individual volunteers and families. Interestingly, staff from other environmental organizations have volunteered in part to learn how to run similar programs. A benefit of this type of project is that volunteers can see the results of their labor, gain a better understanding of the state of the watershed and the workings of local ecosystems, and ideally, perceive that environmental protection is an achievable goal for them and their families.

In the Public Eye

Biocontrol projects can result in increased visibility for the project partners. With a little effort—sometimes direct and indirect—the project may be publicized in local and regional newspapers, radio and television programs, in listservs and mass emails, on local websites, at meetings of potential volunteer and sponsorship sources, and in signage, newsletters, flyers and postcards.

Credit: NepRWA

Two photos of the Galerucella Beetle species.

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Press releases, photographs and interviews can be released to garner publicity. Sources of potential volunteers also are likely to mention their constituents. Project partners' websites can detail the project and direct visitors to additional information. Signage at treatment sites can introduce site visitors to the project, explain what it is that the public sees at the sites, and direct visitors to websites and phone numbers for more information.

Partnering for Success

Credit: Neponset River Watershed Association

Volunteer Jim Kaemmerlen harvests Galerucella beetls from a wetland field site for use in Beetle Ranching. He is using a beetle aspirator.

Certainly, if there is a property owner, town, group, funder, government agency, environmental organization and/or school that wants to work with a watershed group on such a restoration project, it is advisable to consider the offer. Collaborations facilitate land management projects. Characteristics of potential partners might include:

- ownership or management of potential treatment sites;
- past experience with similar projects;
- wide volunteer or colleague network;
- potential project funding; and
- available assistance from late winter through early fall, for a multi-year time period.

It is important to consider each project partner's availability and resources, to decide which activities each will be responsible for. However, each partner must be prepared to take over any responsibility in case one partner is not able to fulfill its role.

Project partners might work together on a variety of tasks, including:

- key decision-making;
- planning the work timeline;
- providing, acquiring and/or transporting equipment;
- obtaining funding;
- implementing study site installation, treatment and monitoring via direct participation and/or via volunteer recruitment, training and coordination;
- locating treatable populations on the property of interest;
- guiding the project, answering questions, connecting project partners with a network of relevant contacts, recommending potential funding sources and helping with the project permitting process.

A project plan can be modeled on past, similar projects and tailored to fit specific circumstances affected by site and species characteristics and funding and staffing. Project managers should be prepared to modify the project plan over the course of the project. Site conditions change and the biocontrol organism may perform differently than expected. For example, significant numbers of Galerucella beetles migrated to one of our treatment sites, multiplying the effect of our biocontrol insects there. We therefore modified our beetle release plan and selected alternative treatment sites.

As questions arise over the course of the project, interactions with project partners and other experienced project managers and participants can provide feedback key to understanding the progression of a project and making decisions about where, and how, to go next. Partnerships make for a richer restoration experience, and put great resources within reach.

CASE STUDY

Taming the Tamarisk

by Merritt Frey
River Network
www.rivernetwork.org

Tamarisk—also known as salt cedar—is an invasive force to be reckoned with. Tamarisk was introduced as an erosion control measure in the United States during the 1930s. But the tree spread relentlessly, and now infests more than 1.6 million acres across the West.

Tamarisk out-competes native trees and grasses, while providing no forage and little habitat for wildlife. The invasive tree overwhelms campsites and blocks access to the water's edge for anglers and boaters. Tamarisk is also a very thirsty plant—it can consume more than 200 gallons of water in a day, lowering water tables and harming springs, streams and wetlands.

Credit: K. Luscher

Camping among Tamarisk on Colorado's Dolores River

But a project on the San Miguel River provides hope for tamarisk-choked rivers. The San Miguel begins in the high peaks above Telluride in southwestern Colorado, and flows into the Dolores River. Despite a troublesome legacy of mining pollution, the river's riparian habitat and flow regime are largely healthy. This made the San Miguel a river worth fighting for, and an excellent place to invest in extensive invasive species removal efforts.

Spearheaded by The Nature Conservancy, the eight-year San Miguel project shows that tamarisk control is possible. When the project wrapped up at the end of 2008, 120 miles of the San Miguel were cleared of tamarisk. The keys to success: long-term commitment and funding, strong allies and the ability to think several "moves" ahead.

The Project

The project kicked off in 2001 with the mapping of tamarisk infiltration in the basin. The following year, treatment of the tamarisk began. Initial funding came from the Terra Foundation and private gifts ranging from $5,000 to $50,000 in support of the project. Later, Umetco Minerals Corporation and Marathon Oil Company lent their support to the restoration, as well as the National Fish and Wildlife Foundation. This diverse funding mix was critical to maintaining momentum on such a long-term project.

As the project moved into tamarisk removal, the value of strong allies became obvious. The Nature Conservancy's lead staff person on the project, Peter Mueller, stresses the importance of bringing in partners early in the planning process and designing shared vision and goals for the work. Mueller reached out to the Bureau of Land Management (the major land owner in the effected area), the San Miguel and Montrose County Weed programs, and even the Colorado Department of Transportation. These allies provided labor, in-kind support and—in some cases—funding for the project.

Volunteers were also important allies. Twice a year The Nature Conservancy organized volunteer work parties with 30 to 40 volunteers spending a day cutting tamarisk and treating the stumps with herbicides to stop re-growth. Although the majority of the cutting and treating was done by contractors, the volunteer work days were an important outreach and education opportunity with local communities. Project organizers made sure to invite local

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officials to the work days and to encourage news coverage of the events.

Yet even after the strenuous work of tamarisk removal was done, organizers couldn't claim the river as restored. When thick stands of tamarisk are removed, other invasives such as Russian knapweed are often the first to move in to the newly open areas. Project organizers had to think two steps ahead in order to block the next waves of invasives. However, due to the relatively intact system of native grasses, willows and cottonwoods on the San Miguel, native species largely moved into the treated areas without manual replanting—turning the tamarisk removal effort into a true riparian restoration project.

The Beetle Effect

The tamarisk beetle is a new variable in the battle for the West's riparian areas. The beetle was first imported from Eurasia (where they naturally keep tamarisk in check) in the 1990s. The U.S. Department of Agriculture released the beetles in Utah, Wyoming and Colorado, and the beetles have worked their way up many river systems in those areas—defoliating tamarisk as they go.

The beetle had a relatively small impact on the San Miguel project, because they didn't arrive in force in the watershed until the last year of the project (2008). However, a Bureau of Land Management expert on tamarisk control, Brian Keating, explains that where beetles are in place, they can help reduce the need for herbicide treatments after the tamarisk are cut. For example, in areas without the beetle, Keating found that untreated tamarisk stumps would support numerous, ten- to twelve-feet tall re-sprouts a year after cutting. In contrast, tamarisk stumps in beetle-infested areas would have fewer, one-foot re-sprouts. Still, it takes several years of beetle attack to bring a tamarisk to its knees.

But the beetle can create challenges as well. Beetle-killed tamarisk can exacerbate fire danger by creating vast stands of standing dead trees. In addition, large open areas under the dead trees are suddenly inviting to other invasives, and so plans for additional management must be ready for implementation. Lastly, some groups have raised concerns that species such as the endangered Southwestern Willow Flycatcher have begun to utilize the tamarisk as habitat, so the large-scale death of tamarisk can further stress species.

The bottom line for those in tamarisk country? Keating says, "The beetle is out there and if it isn't in your watershed yet, it is coming. Anyone working on restoration should be planning for its arrival; be proactive. The beetle will cross landownership boundaries, so reach out to private landowners, agencies and others to plan for fire and invasives control now—before the beetle arrives."

Taking the Lessons to New Territory

The Nature Conservancy's North San Juan Mountain Program is now taking the tamarisk fight on to the Dolores River. Lessons learned on the San Miguel will be applied in the Dolores, but the situation is quite different. The Dolores' native riparian vegetation is less robust than that of the San Miguel, so manually replanting cleared areas with native species will be much more important, and will require more resources. The tamarisk beetle also has a larger presence on the Dolores—a helpful presence in terms of limiting re-growth of tamarisk, but also a challenge in terms of creating open areas under dead standing tamarisk…open areas other invasives are eager to move into.

LEARN MORE ABOUT TAMARISK

The Nature Conservancy:
www.nature.org/initiatives/invasivespecies

Tamarisk Coalition:
www.tamariskcoalition.org

U.S. Forest Service:
www.fs.fed.us/invasivespecies/index.shtml

Bureau of Land Management:
www.blm.gov/wo/st/en/prog/more/weeds.html

Union of Concerned Scientists:
www.ucsusa.org/invasive_species

CASE STUDY

Stopping the Invasion Via Ballast Water:

What Lies Beneath?

by Dr. Mario N. Tamburri

Alliance for Coastal Technologies

Maritime Environmental Resource Center

Chesapeake Biological Laboratory

University of Maryland Center for Environmental Science

I'm sure you've heard the alarms. Natural ecosystems around the world are under siege by a variety of invasive microbes, plants, animals and even diseases. Biological invasions (non-native or non-indigenous species) are a result of direct or indirect introduction by humans. Whether deliberate or accidental, people have been allowing species to cross natural barriers to dispersal for hundreds, if not thousands, of years and the ecological and economic impacts can be devastating. Invasive species are second only to habitat destruction as a cause for loss of biodiversity. The environmental, industrial and health costs of invasive species are estimated to exceed $138 billion per year, more than all other natural disasters combined.

There are thousands of terrestrial and aquatic invasive species in the U.S., and hundreds of new species from other countries are likely introduced each year. For instance, there are nearly 250 known invasive species in the San Francisco Bay and Delta and over 150 in the Chesapeake Bay. U.S. river habitats have been particularly hard hit with some of the most notorious invasive species, including the European zebra mussel, Asian carp, Rusty Crayfish, purple loosestrife and Hydrilla.

Credit: L. David Smith; Northeastern University, Marine Science Center

Ballast water release

Once a population of invasive species has established itself in a new habitat, it can be difficult to control, and complete removal is often impossible. Therefore, the key to this problem is prevention prior to introduction. The challenge is that invasive species can enter aquatic habitats (including riparian zones, wetlands and estuaries) by a variety of common pathways, including: aquaculture escapes, ornamental plant escapes, aquaria releases, the live food industry and live bait release. However, by far the largest source of aquatic invasive species is the commercial shipping industry.

Large commercial vessels transport about 90% of the world's commodities and are fundamental to the global economy. In addition to cargo, these ships also inadvertently bring invasive species into ports (which are often located in estuaries or river mouths) in either ballast water or as hull fouling organisms. Ships commonly pump in ballast water in one port (to increase the draft, change the trim, regulate the stability or maintain the stress loads) and discharge it at another. Many planktonic organisms captured in ballast waters survive even lengthy journeys

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onboard ships. Examination of ballast water upon arrival of vessels has revealed bacteria, phytoplankton, zooplankton, benthic invertebrates and fish. Similarly, organisms can colonize and grow on the submerged outer surface of ships. These hull fouling species not only increase drag on vessels as they move through the water, but when in port, they can dislodge, release young or spawn.

State, federal and international law are now being implemented to address ballast water invasive species, and hull fouling is likely to be considered soon. However, the real solution lies in the development, approval and implementation of treatment technologies or approaches to reduce or

Credit: Amy Benson, U.S. Geological Survey, U.S.

Zebra mussels

eliminate the risk of invasive species via commercial vessels. To support these efforts, the Maritime Environmental Resource Center (MERC) has been established by the Maryland Port Administration (www.maritime-enviro.org) and the University of Maryland Center for Environmental Science to provide expertise, test facilities, information and decision tools to address key environmental issues facing the international shipping industry. MERC has built broad academic, agency and industry partnerships, including scientific experts from the Smithsonian Environmental Research Center and University of Maryland; shipping industry advisors, and support from the U.S. Maritime Administration and National Oceanic and Atmospheric Administration. The main objectives of MERC are to:

(1) Provide technology developers/vendors with facilities and expertise for pilot-scale and shipboard testing of treatment systems.

(2) Provide regulatory agencies and classification societies with standardized independent data on system performance.

(3) Provide ship builders and shipping lines with information and decision tools to select the most appropriate treatment options for particular sizes and types of vessels used along particular shipping routes.

(4) Remove as much uncertainty as possible from emerging markets for treatment systems in order to encourage buyers and sellers to engage with one another and make the necessary investments to accelerate the adoption of treatment technologies.

MERC is currently testing a variety of ballast water treatment systems (including filter plus UV treatments and filter plus chlorine treatments) in the Port of Baltimore and onboard active vessels at sea, and has initiated evaluations of hull coatings and fresh water exposures to prevent ship hull fouling.

Through new regulations, and efforts like MERC, we are moving toward the prevention of invasive species and healthier coastal, estuarine and riparian ecosystems we can all enjoy for generations to come.

Unwelcome Visitors

by Sandy Bihn
Western Lake Erie Waterkeeper Association
www.westernlakeerie.org

Invasives continue to plague and alter the Great Lakes ecosystem. In the 1950s I fished the Great Lakes' warmest, shallowest, fishiest waters—Western Lake Erie—and caught two or three yellow perch at a time, filling the cooler in several hours. Fishing today in the same waters, I catch invasive round gobies and white perch and only the occasional native yellow perch.

Credit: Great Lakes Environmental Research Laboratory

Round Goby

Most invasive species come to the Great Lakes from European and Asian ships' ballast water. The foreign, pesky, rapidly multiplying zebra and quagga mussels came to the Great Lakes in the late 1980s, clogging water treatment and power plant intakes. Controlling them now costs millions. The Coast Guard was charged with regulating ballast water, but it never happened. Other Great Lakes invasives include round gobies, introduced in 1990, and white perch, introduced in 1950. Both of these invasives are prevalent in Lake Erie and compete with native fish for food and habitat.

Beach strollers with bare feet risk invasive mussels cutting their feet causing many to wear shoes. Zebra and quagga mussels are also known to excrete phosphorous-aiding algal blooms. The Great Lakes also have Sea Lampreys, which attach to and suck the blood from fish until they die, and phragmites which take out native cattails. The horrendous impact from invasives in the Great Lakes is clear. The demand for water and fish is growing. The need to pass strong laws to prevent more invasives is urgent. Allowing new invasives into the Great Lakes ecosystem would have serious biologic, economic and social implications.

Though issues surrounding ballast water are complex, there is a role for watershed organizations. The Western Lake Erie Waterkeeper Association (WLEWA) encourages all in the region to keep a watchful eye for new invasives. WLEWA was the first to report a new invasive algae, lyngbya (one of the causes of "swimmer's itch"), first observed in 2006 with source unknown. WLEWA also works with Great Lakes United to encourage stronger protective federal ballast water legislation. And, WLEWA regularly hosts community PowerPoint presentations, which include a section on invasive impacts on Western Lake Erie and Great Lakes waters.

Getting the Invasives Out:

Two Ready-Made Educational Campaigns

by Joe Starinchak
U.S. Fish and Wildlife Service
Fisheries & Habitat Conservation Branch of Invasive Speices
www.fws.gov

#1 Stop Aquatic Hitchhikers!®

www.protectyourwaters.net

Stop Aquatic Hitchhikers!® is the first national, branded behavioral change and partnership campaign designed by the U.S. Fish and Wildlife Service on behalf of the national Aquatic Nuisance Species Task Force to help citizens prevent the spread of aquatic invasive species. Stop Aquatic Hitchhikers!® targets all recreational users and empowers them to become part of the solution to this complex resource management issue by cleaning their recreational equipment every time they leave the water. Employing the iconic brand, an action-packed website and a grassroots branding strategy, the Fish and Wildlife Service relies on the involvement and engagement of its state fish and wildlife agency partners and many other diverse organizations interested in conservation to communicate the prevention message and model the cleaning behaviors at boat ramps, river access points, tackle and fly shops, and in communities around the country.

How it works

If your organization in interested in aquatic resource conservation and the threat invasive species pose, and you want to help prevent their introduction and continued spread into waters throughout the country, you can become a campaign partner. Once you've formalized your partnership via the campaign website, you will receive a partnership packet that contains the campaign's cooperative marketing materials so you can effectively communicate the prevention message. Included on a CD are templates for boat ramp signs, brochures, banners and print-quality PSAs.

Additionally, with the campaign's orientation on action, you can engage your community and enlist their support to make invasive species prevention a viable part of your community's social fabric. You will receive some guidance and recommendations about how to make this happen. And with 778 partners around the country, including national and local conservation organizations, businesses and government agencies, the synergies you can create will enhance your ability to prevent the spread of invasive species. Also, to keep abreast of the latest news and developments about invasive species, you can subscribe to an email news alert service, which provides you access to news articles about invasive species impacts around the world. Use the following link to access this service:

www.protectyourwaters.net/emailnews.php

How to participate

Any interested organization can visit the campaign's website www.protectyourwaters.net/activities/partnership_form.php, and provide its contact information. Once submitted, your organization will get approved and listed as a campaign partner and you will be sent a packet of cooperative marketing materials that allow you to take credit for the prevention message while benefiting from an information-packed web site maintained by the U.S. Fish and Wildlife Service.

#2 Habitattitude®

www.Habitattitude.net

Habitattitude® is the second national, branded behavioral change and partnership campaign designed by the U.S. Fish and Wildlife Service in partnership with the Pet Industry Joint Advisory Council (PIJAC) on behalf of the national Aquatic Nuisance Species Task Force to help citizens prevent the spread of aquatic invasive species. Habitattitude® targets anyone who owns a pet and empowers them to become part of the solution to this complex resource management issue by providing them with environmentally-friendly alternatives to releasing their pets into the environment. Initially, efforts have focused on the higher profile aquarium hobbyists and water gardeners segment; however, the campaign is evolving to address terrestrial pet owners as well. Employing the same formula and similar tools as Stop Aquatic Hitchhikers!®, the Fish and Wildlife Service relies on the involvement and engagement of its state fish and wildlife agency partners and many other diverse organizations interested in conservation to communicate the prevention message and model prevention behaviors in communities around the country. However, the difference is the cross-sector relationship the Service has created with PIJAC. As a result, specialty mass retailers like Petco and PetSmart, as well as independent retailers and pet industry media around the country are now promoting the campaign's conservation message.

How it works

If your organization is interested in aquatic resource conservation and the threat invasive species pose, and you have a connection with pets and want to help prevent their introduction and continued spread into waters throughout the country, you can become a campaign partner. Once you've formalized your partnership via the campaign website, you will receive a partnership packet that contains the campaign's cooperative marketing materials so you can effectively communicate the prevention message. Included on a CD are templates for brochures, banners and print-quality PSAs. You also can engage your community and enlist their support to make invasive species prevention a viable part of your community's social fabric. The State of Florida has led the way by sponsoring pet amnesty days where owners of exotic animals can turn these pets over to the state if they can no longer care for them; interested groups can receive additional guidance and recommendations about how to make this happen in your community.

How to Participate

Any interested organization can visit the campaign's website (www.habitattitude.net/partner/gov_form.php) and provide its contact information. Once submitted, your organization will get approved and listed as a campaign partner and you will be sent a packet of cooperative marketing materials that allow you to take credit for the prevention message while benefiting from an information-packed web site maintained by the U.S. Fish and Wildlife Service.

Invasive Species Councils, Task Forces and Plans:

A State-by-State Overview

Compiled by
Susan Carter and
Katherine Luscher
www.rivernetwork.org

Alabama

Alabama Congongrass Task Force
www.cogongrass.org/alabama

Alabama Invasive Plant Council
www.se-eppc.org/Alabama

Alaska

Alaska Committee for Noxious and Invasive Plants Management
www.uaf.edu/ces/cnipm

Alaska Invasive Species Working Group
www.uaf.edu/ces/aiswg

Arizona

Arizona Invasive Species Advisory Council
www.governor.state.az.us/AIS

Interagency Weed Action Group

Southwest Vegetation Management Association
www.swvma.org

California

California Interagency Noxious Weed Coordinating Committee
www.cdfa.ca.gov/phpps/ipc/CINWCC/cinwcc_hp.htm

The California Invasive Plant Council
www.cal-ipc.org

California Invasive Species Awareness Coalition
www.cal-ipc.org/policy/state/caliwac.php

California Noxious and Invasive Weed Action Plan
www.cdfa.ca.gov/phpps/ipc/noxweed info/pdfs/noxious_weed_plan.pdf

The California Forest Pest Council
www.caforestpestcouncil.org

California Oak Mortality Task Force
http://nature.berkeley.edu/comtf

Pine Pitcher Task Force
http://frap.cdf.ca.gov/pitch_canker

Southern California Caulerpa Action Team
www.sccat.net/#the-caulerpa-information-center-1e86c5

Colorado

Colorado Weed Management Association
www.cwma.org

Colorado's Strategic Plan to Stop the Spread of Noxious Weeds
hwww.cepep.colostate.edu/noxious.htm

Noxious Weed Management Program
www.colorado.gov/cs/Satellite/Agriculture-Main/CDAG/1167928159176

Connecticut

Connecticut Invasive Plant Working Group
www.hort.uconn.edu/cipwg

Connecticut Invasive Plants Council www.nbii-nin.ciesin.columbia.edu/ipane/ctcouncil/CT_invasive.htm

Delaware

The Delaware Invasive Species Council
www.delawareinvasives.net

Delaware Noxious Weed Program
dda.delaware.gov/plantind/noxious.shtml

Florida

The Florida Exotic Pest Plant Council
www.fleppc.org

Florida Pest Exclusion Advisory Committee
www.doacs.state.fl.us/pi/images/peac-full.pdf

Florida Invasive Species Working Group
www.iswgfla.org

Florida Invasive Species Partnership
www.floridainvasives.org

Florida Uplands Invasive Species Working Groups
www.dep.state.fl.us/lands/invaspec/3rdlevpgs/Workinggroupmain.htm

Georgia

Georgia Exotic Pest Plant Council
www.gaeppc.org

Georgia Invasive Species Council
www.gainvasives.org

Hawaii

Coordinating Group on Alien Pest Species
www.hawaiiinvasivespecies.org/cgaps

Hawaii Invasive Species Council
www.hawaiiinvasivespecies.org/hisc

Invasive Species Committees of Hawaii
www.hawaiiinvasivespecies.org/iscs

Idaho

Idaho Invasive Species Council
www.agri.state.id.us/Categories/Environment/InvasiveSpeciesCouncil/indexInvSpCouncil.php

Aquatic Nuisance Species Plan
www.agri.state.id.us/Categories/PlantsInsects/Images/Invasive_Species/Idaho%20Aquatic%20Nuisance%20Species%20Plan.pdf

Idaho Strategic Plan for Managing Noxious Weeds
www.idahoag.us/Categories/PlantsInsects/NoxiousWeeds/Documents/general/stratplan.pdf

Idaho Noxious Weed Program
www.agri.state.id.us/Categories/PlantsInsects/NoxiousWeeds/indexnoxweedmain.php

Idaho Weed Awareness Campaign
www.idahoweedawareness.org

Idaho Weed Control Association
idahoweedcontrol.org

Illinois

Aquaculture Advisory Committee

Illinois State Comprehensive Management Plan for Aquatic Nuisance Species
www.anstaskforce.gov/State%20Plans/ilansplan.pdf

Indiana

Indiana Invasive Species Task Force
www.in.gov/dnr/3123.htm

Iowa

Iowa ANS Management Plan
www.anstaskforce.gov/State%20Plans/Iowa-ANS-Management-Plan.pdf

Kansas

Kansas Plant Protection and Weed Control Program
www.ksda.gov/plant_protection

Kentucky

Kentucky Exotic Pest Plant Council
www.se-eppc.org/ky/index.htm

Kentucky Invasive Species Working Group
www.ca.uky.edu/invasives/index.html

Louisiana

Louisiana Non-Indigenous Aquatic Species Advisory Task Force
doa.louisiana.gov/osr/other/mjf02-11.htm

Louisiana Aquative Invasive Species Management Plan
is.cbr.tulane.edu/docs_IS/Louisiana-AIS-Mgt-Plan.pdf

Maine

The Interagency Task Force on Invasive Aquatic Plants and Nuisance Species
www.maine.gov/dep/blwq/topic/invasives/interagency_task_force/index.htm

Maryland

Maryland Invasive Species Council
www.mdinvasivesp.org

Maryland Marsh Restoration/Nutria Project
www.dnr.state.md.us/wildlife/invnutriaproj.asp

Massachusetts

Aquatic Invasive Species (AIS) Working Group
www.mass.gov/czm/invasives/partners.htm

Michigan

Michigan Invasive Plant Council
invasiveplantsmi.org/

Michigan Aquatic Nuisance Species Council
www.michigan.gov/deq/0,1607,7-135-3313_3677_8314-60394—,00.html

Minnesota

Minnesota Invasive Species Advisory Committee
www.mda.state.mn.us/plants/pestmanagement/misac/default.htm

Invasive Species Exclusion Unit
www.mda.state.mn.us/plants/pestmanagement/invasives.htm

Minnesota Department of Natural Resources' Invasive Species Program
www.dnr.state.mn.us/eco/invasives/index.html

Mississippi

Mississippi Aquatic Invasive Species Council
is.cbr.tulane.edu/MississippiANS.html

Mississippi Exotic Pest Plant Council (state affiliate of the Southeast Exotic Pest Plant Council): www.se-eppc.org/mississippi)

Missouri

See Midwest Invasive Plant Network below under "Regional Task Forces"

Montana

Montana Weed Control Association
www.mtweed.org

Noxious Weed Awareness and Education Campaign www.weedawareness.org

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Nebraska

Nebraska Weed Control Association www.neweed.org

Riparian Vegetation Management Task Force www.agr.state.ne.us/riparian/riparian.htm

South Dakota/Nebraska Purple Loosestrife Management Committee www.state.sd.us/DOA/das/PLS.html

Nevada

Nevada Coordinated Invasive Weed Strategy agri.nv.gov/nwac/PLANT_NoxWeedPlan.htm

The Nevada Invasive Species Initiative www.nv.blm.gov/invaders

Nevada Weed Management Association

New Hampshire

New Hampshire's Invasive Species Committee www.nh.gov/agric/divisions/plant_industry/plants_insects.htm

New Hampshire Restricted Invasive Species List www.nh.gov/agric/divisions/plant_industry/documents/list.pdf

New Jersey

Invasive Species Task Force

New Mexico

New Mexico Interagency Weed Action Group

New Mexico Noxious Weed Advisory Group

New York

Invasive Plant Council of New York State www.ipcnys.org

Invasive Species Task Force www.dec.ny.gov/animals/6989.html

Preventing the Introduction and Spread of Aquatic Invasive Species www.dec.ny.gov/animals/50121.html

North Carolina

Carolinas Beach Vitex Task Force www.beachvitex.org

North Carolina Exotic Pest Plant Council (state affiliate of the Southeast Exotic Pest Plant Council) www.se-eppc.org/northcarolina

North Dakota

Invasive Species Project www.ndrcd.org/?id=107&page=Invasive+Species+Project

Ohio

Ohio Aquatic Nuisance Species Prevention, Control, and Abatement Plan www.anstaskforce.gov/State%20Plans/Ohio%20Comprehensive%20Management%20Plan.pdf

Ohio Emerald Ash Borer Task Force www.agri.ohio.gov/eab

Ohio Invasive Plants Council www.oipc.info

Oklahoma

Oklahoma Invasive Plant Council www.biosurvey.ou.edu/invasive/invasive.htm

Oregon

Oregon Invasive Species Action Plan oregon.gov/OISC/docs/pdf/oisc_plan6_05.pdf

Oregon Invasive Species Council oregon.gov/OISC

Oregon's State Weed Board www.oregon.gov/ODA/PLANT/WEEDS/oswb_index.shtml

Pennsylvania

Governor's Invasive Species Council of PA www.invasivespeciescouncil.com

Pennsylvania Invasive Species Management Plan www.invasivespeciescouncil.com/PlanComprehensive.aspx

Rhode Island

The Rhode Island Invasive Species Council www.rinhs.org/what-we-do/invasives/riisc

South Carolina

Carolinas Beach Vitex Task Force see North Carolina

South Carolina Aquatic Invasive Species Task Force www.dnr.sc.gov/water/envaff/aquatic/ais.htm

South Carolina Aquatic Plant Management Council www.dnr.sc.gov/water/envaff/aquatic/apmcouncil.html

South Carolina Aquatic Plant Management Plan www.dnr.sc.gov/invasiveweeds/plan.html

South Carolina Aquatic Plant Management Society www.scapms.org

South Carolina Exotic Pest Plant Council
www.se-eppc.org/southcarolina

South Dakota

South Dakota/Nebraska Purple Loosestrife Management Committee

Tennessee

Tennessee Exotic Pest Plant Council
www.tneppc.org

Texas

Invasive Riparian Plants and Texas Water Task Force

Texas Aquatic Plant Management Society
www.tapms.org

Texas Invasive Plant and Pest Council
www.texasinvasives.org/tippc/index.php

Texas Noxious Weed Working Group

Utah

Memorandum of Understanding among various agencies responsible for the conservation and protection of Utah water resources from the invasion of Aquatic Nuisance Species
ag.arizona.edu/azaqua/extension /ANS/ANSmodel.htm

Utah Noxious Weed Act
www.utahweed.org/PDF/weed_act.pdf

Utah Weed Control Association
www.utahweed.org

Vermont

Vermont Invasive Exotic Plants Committee
www.vtinvasiveplants.org

Virginia

Invasive Species Workgroup
www.dcr.virginia.gov/natural_ heritage/vaisc/about.htm

Washington

Pacific Northwest Invasive Plant Council
www.pnw-ipc.org/edrrgeneral.shtml

Washington Aquatic Nuisance Species Coordinating Committee

Washington Aquatic Nuisance Species Management Plan
wdfw.wa.gov/fish/ans/2001ansplan.pdf

Washington Aquatic Nuisance Species Planning Committee

Wisconsin

Council on Invasive Species
dnr.wi.gov/invasives/iscouncil.htm or
invasivespecies.wi.gov/awareness/index.asp

Invasive Plants Association of Wisconsin
www.ipaw.org

Statewide Aquatic Nuisance Species Plan
dnr.wi.gov/invasives/pdfs/compstateansplanfinal0903.pdf

Wisconsin Wildlife Action Plan
dnr.wi.gov/org/land/er/wwap/plan

Wyoming

Wyoming Weed and Pest Council
www.wyoweed.org

Wyoming Weed Management Strategic Plan
www.wyoweed.org/Documents/DocumentPage/Wyoming StateWeedPlan.pdf

Regional Task Forces

Mid Atlantic Exotic Pest Council
Includes Delaware, Maryland, New Jersey, Pennsylvania, Virginia and West Virginia.
www.ma-eppc.org

Midwest Invasive Plant Network
Includes Montana, Missouri, Iowa, Illinois, Indiana, Minnesota, Michigan, Wisconsin and Ohio. mipn.org/aboutMIPN.html

Southeast Exotic Pest Council
Includes Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee
www.se-eppc.org

Sources: Environmental Law Institute and Invasive Species & the National Invasive Species Information Center

Resources & References

Organizations, Agencies & Programs

The Aquatic Nuisance Species Task Force is an intergovernmental organization dedicated to preventing and controlling aquatic nuisance species, and implementing the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. www.anstaskforce.gov

The Center for Aquatic Nuisance Species focuses on scientific research, education programs and policy development that help engage people in the cooperative effort to reduce spread of invasives. They offer workshops and a newsletter. www.stopans.org

CitSci.org is an invasive species mapping program that allows citizens, school groups and professionals to enter invasive species observations into a global database. www.CiSci.org

Environmental Law Institute (ELI) makes law work for people, places, and the planet. ELI seeks to improve invasive species prevention, control and eradication worldwide by promoting and strengthening local, state, national and international legal authorities that directly address invasive species and by harmonizing legal and management authorities that affect the environments that are vulnerable to impairment by exotic species invasions. www.eli.org

The Global Invasive Species Team is part of The Nature Conservancy's response to abating the damage caused to native biodiversity by the human-facilitated introduction of non-native, harmful invasive species. This web site provides many resources designed to help all conservationists deal most effectively with invasive species. www.invasive.org/gist

Growing Native is a year-round volunteer project that collects hardwood seeds and plants trees to help restore and protect rivers and streams in the Potomac River watershed. Growing Native is a project of the Potomac Watershed Partnership, which is managed by Potomac Conservancy, and made possible by the generous support of its partners and sponsors. www.growingnative.org

The National Biological Information Infrastructure (NBII) is a broad, collaborative program to provide increased access to data and information on the nation's biological resources. The NBII links diverse, high-quality biological databases, information products and analytical tools maintained by partners and other contributors in government agencies, academic institutions, non-government organizations and private industry. www.nbii.gov

The National Invasive Species Information Center (NISIC) was established in 2005 at the National Agricultural Library to meet the information needs of users including the National Invasive Species Council. The webpage serves as a reference gateway to information, organizations and services about invasive species. www.invasivespeciesinfo.gov

Protect Your Waters is a site for recreational users who want to help stop aquatic nuisance species. www.protectyourwaters.net

Articles, Reports & Programs

California's reaction to Caulerpa taxifolia: a model for invasive species rapid response. By Lars W.J. Anderson, USDA-ARS Exotic and Invasive Weed Research. Published 2004. This case study shows how an effective rapid response to an aquatic invasive species was carried out. ddr.nal.usda.gov/bitstream/10113/8713/1/IND 43792195.pdf

Evaluating an Invasive Species Policy: Ballast Water Exchange in the Great Lakes. By Christopher Costello, John M. Drake, and David M. Lodge. This report develops a model of assessing the efficacy of invasive species policy. While focused on the Great Lakes, the findings can apply to all watersheds. dragonfly.ecology.uga.edu/drakelab/reprints/2007%20Costello%20ballast%20water.pdf

Exotic Species: an ecological roulette with nature. By Radika Bhaskar and Judith Pederson, MIT Sea Grant College Program. This Coastal Resources Fact Sheet gives a brief but detailed overview of the impacts, causes and basic strategies for ridding an ecosystem of exotic species. massbay.mit.edu/resources/pdf/factsheet.pdf

Invasive Plant Species by Barbara H. Mullin, et al. This report lists the identified (as of 2004) invasive plant species across the United States, evaluates the current invasive plant programs and legislation, offers multifaceted recommendations of how to use our resources to eradicate invasive plant species, and includes many case studies of specific species. www.cast-science.org/websiteUploads/publicationPDFs/nnpl_ip.pdf

The ***General Guidelines for the Evaluation of Invasive Species Early Detection & Rapid Response Systems*** (ED&RR) were approved by the National Invasive Species Council in June 2003. They serve to provide information to those who wish to establish or evaluate ED&RR systems for invasive species. They are based on the work of the federal and non-federal members of the ED&RR Subcommittee of the Invasive Species Advisory Committee of the Council. www.invasivespecies.gov/global/EDRR/EDRR_index

Update on the environmental and economic costs associated with alien-invasive species in the United States. By David Pimentel, Rodolfo Zuniga and Doug Morrison, College of Agriculture and Life Sciences, Cornell University. This report undertakes the difficult task of estimating, in dollars, the damage that ANS have done to our nation. This covers environmental damage and crop, pasture and forest loss and associated control costs; livestock pests; and human diseases. www.plantright.org/library/pdfs/Pimentel-et-al2005.pdf

Listservs

Invasive Species News provides current invasive species related news generated from an RSS feed of external news sources, and also provides access to several Invasive Species Weblogs. feeds.feedburner.com/invasivenews

The **Stop Aquatic Hitchhikers News** and campaign empowers recreational users to become part of the solution to stopping the transport and spread of harmful hitchhikers. Visit www.protectyourwaters.net and scroll down to the subscription box on the bottom right to sign up to receive their news by email.