

Engaging Volunteers in Invasive Species Management

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Resumen

Para aumentar el nivel de conciencia pública y incrementar el número de personas que están luchando en contra de especies invasoras, el Sistema Nacional de Refugios de Vida Silvestre, el Museo del Desierto Arizona-Sonora, y los Weedwackers del Desierto Sonorense están involucrando voluntarios en el monitoreo y control de plantas invasoras. Este artículo ilumina las experiencias de estas organizaciones e ilustra los beneficios y retos que se manifiestan cuando se trabaja con voluntarios en el manejo de especies invasoras que se encuentran en los refugios de vida silvestre y otras áreas de conservación en los Estados Unidos. Los resultados de estas programas incluyen un público con mejor educación, la colección de datos y la producción de mapas para el seguimiento de las infestaciones, la priorización de esfuerzos de control, y el monitoreo de los regímenes de tratamiento a través del tiempo.

Introduction

Engaging volunteers in the management of invasive species on both public and private lands can increase awareness and build public support for confronting the challenge posed by invasive species as well as provide additional labor for managing them. The number of established alien species and the rate of newly detected invasions across the globe have increased dramatically

over the last half of the twentieth century (Mooney 2005, Ruiz and Carlson 2003). In the United States National Wildlife Refuge System alone over eight million acres of land are infested with invasive plants and animals. In 2005, the Refuge System spent approximately \$8.1 million in its fight against invasive species, but \$107 million worth of proposed invasive species projects went unfunded. This paper looks at the experiences of three programs that integrate volunteers into invasive plant management on the lands they protect: The Cooperative Volunteer Invasives Monitoring Project of the National Wildlife Refuge System, U.S. Fish and Wildlife Service, the Invaders of the Sonoran Desert Region project of the Arizona-Sonora Desert Museum, and the Weedwackers project, an offshoot of the Arizona Native Plant Society.

Public awareness and support can significantly increase the success of projects designed to protect biodiversity (Wittenberg, 2005). During the 1980's and 1990's about fifty per cent of the overall population in the U.S. worked as volunteers making volunteerism a commonplace activity (McCurley and Lynch 1996). According to the recently issued "Friends and Volunteers Annual Report," nearly 34,000 volunteers donated almost 1.3 million hours to the National Wildlife Refuge System during fiscal year 2006, which represents the equivalent of more than \$23 million in work on behalf of wildlife conservation in the country (Refuge Update, Nov/Dec 2006). Individuals who participate as volunteers in natural resource management projects often care deeply about the land. They may be young people looking for opportunities to enjoy the natural landscape or retired folks seeking ways to make a meaningful contribution to conservation efforts.

Incorporating volunteers into management efforts helps raise awareness of natural resource challenges and develops a locally-based conservation ethic. In invasive species management, volunteers can be very helpful in the early detection of new and satellite infestations.

Eradication of incipient populations of invasive species is more cost effective than efforts to control large, well-established populations (Mack et al. 2000, FICMNEW 2003, NISC 2003). Complete eradication of a well-entrenched population can present a formidable and sometimes insurmountable challenge to land managers. Volunteers also provide a welcome source of labor in an economic environment of scarce financial resources and declining budgets.

No longer is it a question of whether or not volunteers can make a meaningful contribution to natural resource management activities, such as invasive species monitoring and control. Experience has shown that their contribution is significant (McCurley and Lynch 1996). The more pertinent questions to ask at this time are 1) how can volunteers contribute, and 2) what are the specific benefits that can be derived by engaging them in a given project. Programs must be carefully designed and based on both staff and volunteer input. A good place to begin is to determine the rationale or purpose behind their integration. Is the purpose to provide environmental education? Is it to raise local awareness about natural resource issues and develop a culture of conservation through community outreach? Or, is it to have the volunteers provide operational support and become citizen scientists trained to use tools that assist directly with management efforts. The clearer the purpose, as well as the goals and expectations, the more streamlined management of their efforts will be and the more meaningful the work for each volunteer.

Three innovative programs

In fiscal years 2003, 2005 and 2006 the United States Congress appropriated \$1 million to the National Wildlife Refuge System (NWRS) of the U.S. Fish and Wildlife Service (USFWS) to design and implement projects to engage volunteers and NWRS Friends groups in the control and management of invasive species on refuge lands. Each year the majority of the

appropriation went directly to the field in the form of competitive grants to support individual refuges working with volunteers to carry out on-the-ground invasive species management efforts. In previous years, the results of an electronic survey conducted by the U.S. Geological Survey (USGS) had shown that many refuges are challenged by invasive species but few have quantitative data to illustrate the extent and distribution of infestations on refuge lands or the effectiveness of control measures (www.nwrinvasives.com). The national invasive species program of the NWRS used a portion of the appropriated funds to initiate a nation-wide project for mapping incipient and existing invasive weed populations on refuges. This project became known as the Cooperative Volunteer Invasive Monitoring Project (CVIMP). In fiscal year 2005 alone, the appropriated funding supported the involvement of 876 volunteers in the treatment, inventory and restoration of 72,931 acres of refuge land through the competitive grants program and 316 volunteers in the mapping, treatment and restoration of over 3,000 acres through the mapping program.

The CVIMP (www.refugenet.org/new-invasives/vimp.html) brings together a variety of partners that include the National Wildlife Refuge Association (NWRA), The Nature Conservancy (TNC), and the U.S. Geological Survey's National Institute of Invasive Species Science (NISS) to train volunteers to use handheld computers with attachable Global Positioning System (GPS) units to map infestations of invasive plants. These same volunteers are sometimes also involved in control and restoration efforts in conjunction with the collection of monitoring data. In addition to tracking infestations and the effectiveness of treatment regimes on individual refuges over time, the CVIMP shares the data produced with NISS to contribute to the development of a national, inter-institutional invasive species forecasting

system, which is being developed with assistance from the National Aeronautics and Space Administration (NASA) in Fort Collins, Colorado.

A second program, the Invaders of the Sonoran Desert Region project of the Arizona-Sonora Desert Museum, originated as an outreach component of the National Geographic Strange Days on Planet Earth series that aired on public television in the spring of 2005 (www.pbs.org/strangedays). The production company, Sea Studios Foundation, which was created to increase the public's understanding and participation in science and environmental issues, worked closely with the Arizona-Sonora Desert Museum (ASDM) to develop a consortium of museums, zoos and aquaria, which include the Lady Bird Johnson Wildflower Center, the Missouri Botanical Garden, the New England Aquarium, the North Carolina Museum of Natural Sciences, and the Woodland Park Zoo in Seattle.

The members of this consortium are collaborating to train and coordinate volunteers to become citizen scientists and use a specially developed Invasive Species Early Detection and Reporting Kit (www.desertmuseum.org/invaders/invaders_scientist.htm). With this kit, volunteers find, track, describe, photograph, and collect samples of invasive species and report occurrences to their affiliated institution. The Invaders project originated as an early detection and rapid reporting program to identify and document new invasions of alien plants and animals, and has expanded to include inventories of all established invasive species in the region. The data are delivered to the U.S. Geological Survey's NIISS website for data hosting, analysis, and mapping. Volunteers also have the opportunity to participate in implementation of control methods. The Invaders program empowers volunteers to take control of invasive species in their natural surroundings through understanding, information gathering, and management action. They contribute to a body of scientific knowledge with real world impacts.

At the local level, the Invaders project has trained about 40 volunteers including ASDM volunteers and Arizona State Parks staff and volunteers. Volunteers collect data and remove invasive species with the help of local program partners. These ASDM program partners include the Sonoran Desert Weedwackers, the National Park Service, Arizona Department of Agriculture, Arizona State Parks, Pima County, the Bureau of Land Management, the Sonoran Institute, the Cienega Corridor Conservation Council, the U.S. Geological Survey, the City of Tucson, and various nurseries and gardens around Tucson. As of the spring of 2006, 30 volunteers had participated in three-day training sessions and supervised field work.

The third program, the Sonoran Desert Weedwackers, is an offshoot of the Arizona Native Plant Society and a partner in the Invaders project (aznps.org/html/exotics.html). The Weedwackers project started in 2000 with a small group of committed individuals whose objective was to remove buffelgrass (*Pennisetum ciliare*) and fountain grass (*Pennisetum setaceum*) from Tucson Mountain Park, owned by Pima County. Over the last six years, the Weedwackers have become well-known in the invasive weed management community for their successful removal of large quantities of invasive grasses from the Tucson Mountains and other areas. The tasks performed by Weedwackers fall into three categories: reconnaissance (species identification and exploring new sites), eradication, and revisitation of the site to check for regrowth. Members of the group perform monthly surveys with GPS devices to document the presence of both buffelgrass and fountain grass and take note of areas that require management attention. Within a week of the initial survey, a larger team returns to priority areas to remove the invasive grasses with digging bars and trash bags. The refuse is transported and disposed of in a nearby landfill.

Weedwacker teams are composed mainly of local residents and often include other community groups, such as the Boy Scouts of America, the Rotary Club, college students, and Sierra Club service groups. In the last six years, the Sonoran Desert Weedwackers have removed an estimated 35 tons of invasive grasses primarily from Tucson Mountain Park making the area safer from fire and protecting the unique Sonoran Desert plant community. This project serves an important outreach function to educate the public about what they can do to encourage natives and discourage invasive plants in their neighborhoods.

Challenges of working with volunteers

In addition to the rewards and benefits of working with volunteers, a number of challenges can arise. Among these the following five challenges will be discussed: 1) Selecting individual volunteers based on quality versus quantity, 2) training volunteers to identify invasive species correctly and detect new invaders, 3) knowing where to send volunteers on the landscape, 4) being conscious of quality control in data collection, and 5) making the experience of the volunteer meaningful.

Quality versus quantity: Early in the project, designers of the CVIMP project envisioned multitudes of volunteers combing the landscape for invasive plants. As the project got underway, however, it became evident that the type of volunteer who can perform this work most effectively must be carefully selected and is not usually available in large numbers. Volunteers may have the interest and dedication required, but may not have other important qualifications, such as being able to handle long hours in sometimes harsh, buggy environments. Additionally, using GPS units and handheld computers for mapping can be challenging for individuals that are not technologically inclined. For the CVIMP project the USFWS veered toward quality versus quantity in selection of volunteers. Refuge staff and project trainers were

specifically interested in volunteers who had existing knowledge or a willingness to learn about GPS technology, ability to walk long distances, and were capable of spending a lot of time outdoors.

To facilitate the selection of suitable volunteers, the Invaders project has developed a position description and interest forms that identify necessary qualifications and request information from prospective volunteers about their level of experience. These forms have helped staff evaluate and train candidates with greatest potential for success. Requirements include the ability to walk on uneven terrain and work in all weather conditions, ability to use (or be willing to be trained to use) digital cameras, GPS units, handheld computers, and online databases, as well as a preferred background in natural history with emphasis in plant and/or animal identification.

Species identification: When working with invasive species it is important to understand what they are and what they look like, to be able to correctly identify the species of concern in a given area. Alien or exotic species are defined with respect to a particular ecosystem. They represent any species including its seeds, eggs, spores, or other biological material capable of reproducing a species that is not native to a given ecosystem. However, not all alien or exotic species are invasive. An invasive species is an alien species that is likely to cause economic or environmental harm or harm to human health (E.O. 13112, February 3, 1999). When working with volunteers it is important to provide high quality identification materials that are carefully checked by knowledgeable biologists and reflect the best science available. Many lists exist at both the national and state levels that identify these species. The Invaders program is concerned with 74 invasive plant species identified on the Arizona Wildland Exotic Plant Working Group list. Volunteers with the Invaders program are trained in how to identify these species.

Laminated identification cards are available for use in the field and identification criteria and images are posted on a website (<http://www.desertmuseum.org/invaders/>). Until volunteers have proven their knowledge and are considered experts, they are required to submit photos taken with a digital camera for each record they create when conducting mapping work. In addition to taking photos, volunteers are encouraged to bag and bring in species for identification.

One of the greatest benefits of including volunteers in invasive species work is the addition of more observers to scout the landscape. While mapping infestations or conducting control operations volunteers can be on the look out for species that might be new to the area where they are working. These species may be present in the overall region but not previously seen on the land the volunteers are helping to manage. Early detection and rapid response to incipient infestations is a more cost effective approach to management than waiting until an infestation takes root and becomes established (Mack et al. 2000, FICMNEW 2003, NISC 2003). While mapping infestations of perennial pepperweed (*Lepidium latifolium*) at San Pablo National Wildlife Refuge in the San Francisco Bay Area volunteers caught site of a small cluster of giant reed (*Arundo donax*) in one of the tidal marsh restoration sites. This tall perennial grass species is highly invasive and can be difficult to control once established, however because of this early sighting refuge staff was able to completely eradicate the infestation before it became established.

Know where to send volunteers: Knowing where to send volunteers on large landscape scale management units can be particularly challenging. It is important to prioritize areas before sending volunteers out to survey and map. Predictive modeling can be used to identify locations that may be vulnerable to invasion, facilitating monitoring for new infestations. Modeling can increase understanding about the susceptibility of certain vegetation types to invasions by

specific species. The U.S. Geological Survey's Fort Collins Science Center (FORT) is partnering with NASA, and Colorado State University (CSU) to develop a national invasive species forecasting system for management of invasive species on U.S. Department of the Interior holdings and surrounding lands and waters (www.niiss.org). USFWS refuge system land managers are using the predictive models developed by FORT and CSU, along with land cover data generated by NASA, to create regional assessments of invasive species patterns and identify vulnerable habitats (Barnett *et al.* 2006). The end product will be an adaptable system for generating electronic and paper maps of hot spots for potential alien species invasions, including plants, animals, and pathogens. These maps can be used to prioritize specific areas on refuge lands for more detailed on-the-ground mapping efforts by volunteers. Within the Refuge System predictive models have been created for Hart Mt National Antelope Refuge in Oregon, National Elk Refuge in Wyoming, and Kenai National Wildlife Refuge in Alaska.

The Invaders program takes a partner-driven approach to selecting mapping sites and deciding where to send volunteers. Program staff members work with partner organizations to identify specific areas that contain invasive plant infestations. While focusing primarily on plants, Invaders volunteers work with local nurseries to conduct monitoring for presence of the larvae of the invasive cactus moth (*Cactoblastis cactorum*), an invertebrate that consumes the prickly pear cactus (*Opuntia* spp). Originally introduced as a biological control agent in Australia, the moth was first detected in Florida in 1989. Pheromone traps are being used to track the edge of the infestation across the southeastern coastal states. The threat posed by the cactus moth is considerable, especially in the southwestern U.S. where prickly pears are important components of desert scrub landscapes, and in Mexico where the *tunas* (fruit) and

nopalitos (tender young pads) are commonly eaten by people and livestock (Simonson *et al.* 2005).

Data management and quality control: Producing good data starts with a reliable data management system and comprehensive training in how to use the system. It also requires consistency of oversight and quality control measures. The CVIMP project uses a data collection and organization system called the Weed Information Management System (WIMS), which was originally developed by the Bureau of Land Management (BLM) and later adapted by TNC. WIMS is a Microsoft Access relational database application that resides on a desktop or laptop computer. It keeps track of three types of data records: Occurrences, Assessments, and Treatments records which are stored as points, lines and polygons. It operates with ESRI's ArcPad software on handheld units and can import shapefiles to ArcGIS for creating and printing maps. The Refuge System is in the process of developing a geodatabase called Refuge Lands GIS (RLGIS) that will enable the mapping of multiple parameters in addition to invasive species, such as fences, signs and other structures, wildlife populations, management units, and all types of vegetation. In time, RLGIS may replace WIMS as the weed mapping system on refuges.

Make it meaningful: There are a number of ways involvement in invasive species management can be made meaningful for volunteers. The Sonoran Desert Weedwackers focuses primarily on control efforts because they find there's nothing like the immediate sense of satisfaction that comes from seeing the results of hard-earned labor. In January, 2006, a team of 28 Weedwackers, which included members of a local Rotary group, filled ninety 55-gallon trashbags with buffelgrass and fountain grass with three hours of work, climbing over the arroyos and mountainsides of Tucson Mountain Park. After an event such as this, Weedwackers celebrates their accomplishment. The opportunity to socialize and celebrate an accomplishment

is an important way to build team spirit. The cooperative, *esprit de corps* that exists among Weedwackers is encouraged with consistent communication including email messages and photos of progress, invitations to bring others into the group, consistency in scheduling meetings and events, and opportunities to socialize.

Protecting key species can be a point of interest for volunteers and can add meaning to their experience in invasive species management. With the recent rediscovering of the ivory-billed woodpecker (*Campephilus principalis*) at Cache River NWR in Arkansas, volunteers working with invasive species management have a chance to improve habitat that may well increase the likelihood of survival for the ivory-billed. Although the favorite wood-boring food of the ivory-billed is mainly found in the flooded areas of the refuge where mature bottomland hardwood trees dominate, leading experts (Eric Johnson, USFWS, pers. comm. Martjan Lamertink, Cornell University) suggest that the woodpecker has the ability to fly long distances and could someday use the higher elevation fields that the refuge is restoring to hardwoods forest. However, aggressive infestations of kudzu (*Pueraria montana* var. *lobata*) currently hamper the development of future forests on non-flooded ground, so refuge staff members are working hard to control these infestations. During the first field season of the CVIMP, at Cache River NWR it took two volunteers about ten days to map a total of eighty seven acres of kudzu.

Involving volunteers in more than one phase of invasive species management especially when these phases build on one another can also make their experience more meaningful. At San Pablo Bay NWR volunteers have surveyed over 1,460 acres of tidal marsh and mapped 47 acres of perennial pepperweed (*Lepidium latifolium*). The mapping data has been used by refuge biologists to prioritize areas for treatment and restoration. At the suggestion of one of the volunteers, a Yahoo group was established to facilitate communication and information sharing.

The mapping data was also used in the preparation of proposals to fund a nursery for propagation of native plants. Grant funding covered the materials to build a greenhouse and a shade house in addition to purchasing other necessities such as propagation benches, pots, soil, irrigation, and tools. Ninety per cent of the labor to build the greenhouse was provided by volunteers. During its first season the nursery nurtured three thousand young plants representing twenty-two native species. When the young plants are ready for removal from the greenhouse, volunteers will place the plants in areas where invasive species have been removed.

Conclusion

A well developed training program for volunteers can increase interest, understanding, and participation in scientific efforts that help reduce the profound ecological and economic consequences of invasive species. However, if we are to succeed in meeting the invasive species challenge we must intensify cooperation across traditional political and social boundaries. Scientific communities in all countries must work more closely with land managers, and land managers must work more closely with local citizens. Based on the experiences highlighted in this paper, volunteers can play a critical role as citizen scientists trained to use tools and provide operational support that directly contributes to management efforts. Hopefully these experiences will inspire others and, in so doing, continue to increase awareness of the serious ecological and economic impacts of invasive species.

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