

# A Sustainable Chesapeake

BETTER MODELS FOR CONSERVATION

*Edited by David G. Burke and Joel E. Dunn*

THE CONSERVATION FUND



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# Effective Techniques for Invasive Plant Control and Wildlife Habitat Restoration

## *Integrated Vegetation Management at Eastern Neck National Wildlife Refuge*

With over 60% of the Eastern Neck National Wildlife Refuge infested by invasive exotic plant species, the Refuge and IVM Partners initiated an integrated vegetation management plan that successfully reclaimed more than 147 acres of Refuge habitat.

### CASE STUDY SUMMARY

Improvements to invasive species management in the Chesapeake Bay region are vital to biodiversity conservation and ecosystem restoration. In an effort to find new and more effective ways to remove exotic invasive plants, Integrated Vegetation Management Partners, Inc. (IVM Partners), a 501(c)(3) nonprofit

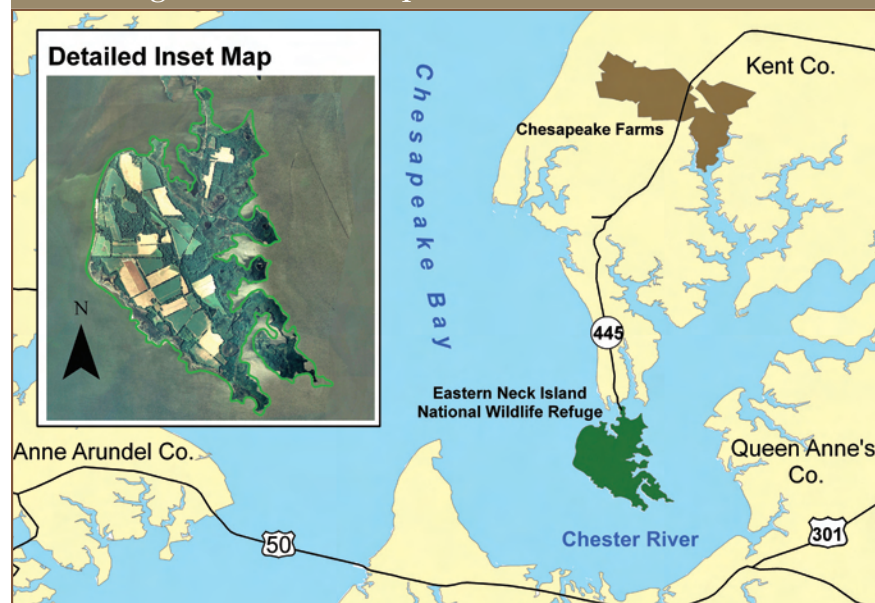
corporation, researched, developed and carried out an integrated vegetation management plan for the Eastern Neck National Wildlife Refuge. As a result, IVM Partners restored 100 acres of wetlands at the Refuge that were previously dominated by the invasive common reed (*Phragmites australis*) (hereafter referred to as *Phragmites*), and 47.6 acres of forest

habitat, allowing native plants and animals to return.

Eastern Neck National Wildlife Refuge is situated on a 2,285 acre island at the confluence of the Chester River and Chesapeake Bay in Kent County on Maryland's Eastern Shore. The island supports over 100,000 migrating ducks, geese and swans, as well as songbirds, shorebirds and resident bald eagles. The Refuge, as with other refuges managed by the United States Fish and Wildlife Service (U.S. Fish and Wildlife), was created to protect the lands and waters needed to conserve the region's fish, wildlife and plants. With 6 miles of roads and trails, as well as boat ramps, the Refuge provides year-round access to citizens for viewing, fishing and hunting its abundant wildlife. The road and water access also brings unwelcome visitors to the Refuge; namely exotic invasive plants, which threaten the Refuge's unique biodiversity and critical habitats.

In 2004, IVM Partners conducted research at Chesapeake Farms, a private agricultural and wildlife research

### ► Eastern Neck Island National Wildlife Refuge Location Map







*The forest floor of the Eastern National Wildlife Refuge covered by invasive exotic plant species.*

center owned by the DuPont Corporation near the Refuge, to determine the best available integrated vegetation management techniques, which reduce the need for herbicides, promote healthy ecosystems and provide measurable results, such as greater natural species diversity and better control of invasive species. These techniques may include chemical removal, physical (or mechanical) removal, biological control, and prescribed burning. In 2006, IVM was hired by the Eastern Neck National Wildlife Refuge to identify the highest priority habitats at the Refuge, develop a management plan, treat at least 75 acres using a combination of techniques, and monitor the managed areas to evaluate the results.

### RESOURCE MANAGEMENT CHALLENGE

Biologists estimate that invasive plants occupy approximately 60% of the Refuge's 2,285 acres. These invasive species destroy natural habitat and result in the local extirpation of native species of plants and the ani-

mals that depend upon them. Invasive species are directly responsible for approximately 42% of the species on the federal threatened or endangered species lists.<sup>1</sup> The loss of native species can negatively impact ecological processes and wildlife recreation activities, thereby threatening the original purpose of the Refuge.

The Refuge has confirmed the presence of the following invasive on the island: mile-a-minute (*Polygonum perfoliatum*), Japanese honeysuckle (*Lonicera Japonica*), wineberry (*Rubus phoenicolasius*), multiflora rose (*Rosa multiflora*), Japanese stilt-grass (*Microstegium vimineum*), autumn olive (*Cirsium arvense*), princess tree (*Paulownia tomentosa*), tree-of-heaven (*Ailanthus altissima*), Chinese lespedeza (*Lespedeza cuneata*), english ivy (*Hedera helix*), garlic mustard (*Alliaria petiolata*), Johnson grass (*Sorghum halepense*), Canada thistle (*Cirsium arvense*) and *Phragmites*.

Invasive species cause major environmental and economic damage

with national losses adding up to \$120 billion per year.<sup>2</sup> Although invasive exotic species control is often a priority for conservation management, the methods can be controversial<sup>3</sup> and may have detrimental impacts on non-target species.<sup>4</sup> With invasive exotic plants in particular, herbicides have proven to be effective at reducing the number of targeted plants, but their safe and effective use requires certification training and equipment designed for the task. With more than 200 exotic plant species in the Mid-Atlantic region of the United States, it is imperative that the conservation community devise methods that are safe, reliable, economic and effective at controlling these species.

### CONSERVATION VISION

The Refuge staff was aware of the invasive species problem on Eastern Neck Island, but didn't have the expertise to address it. After seeing IVM Partners' research at Chesapeake Farms, U.S. Fish and Wildlife contracted with them in 2006 to: conduct a site assessment; develop a management plan outlining the areas to be treated, their management and monitoring methods, and any public safety concerns; chemically treat at least 75 acres (mapped and prioritized by Refuge staff) and achieve an 80% efficacy of target plants; monitor management sites; and abide by a series of other safety and coordination agreements.

### IMPLEMENTATION RESOURCES

In 2004, IVM Partners was awarded a \$75,000 grant from National Fish & Wildlife Foundation to apply and study integrated vegetation management techniques on electric rights-of-way within the Pinelands of Southern New Jersey and expand their education efforts on a national level. The DuPont Corporation, which provided some matching funds

for the Pinelands grant, offered its wildlife and agricultural research acreage at Chesapeake Farms, near the Refuge, to IVM Partners as an area for conducting vegetation management research for utility and highway rights-of-way.

In 2006 and 2007, U.S. Fish and Wildlife allocated \$128,000 to contract with IVM Partners for treatment research and botanical documentation of 95 acres at the Refuge. IVM Partners reviewed the proposed treatment areas with three applicator subcontractors and awarded the work to Weeds, Inc., on a time and material basis, while Davey Resource Group provided GIS mapping in-kind services and Chesapeake Wildlife Heritage provided consistent botanical documentation.

Since the work varied from easily accessible roadside brush, to impenetrable wooded sites and dense stands of *Phragmites*, the application costs varied from \$100 to \$1,000 per acre. Due to the chemical resistance of some target plants, some sites required multiple herbicide treatments, which were applied in

successive years and with different types of herbicides. U.S. Fish and Wildlife provided the manpower and equipment for required mowing, guidance for management priority sites, expertise for conducting controlled burns and assistance in geographical information system (GIS) mapping and workshop hosting.

### CONSERVATION STRATEGY

#### Invasive Species Control Techniques:

There are four general techniques used to control invasive plant species in the Chesapeake Bay region: chemical removal, physical (or mechanical) removal, biological control, and prescribed burning.

The following descriptions were derived from U.S. Fish and Wildlife's website on invasive species management.<sup>5</sup>

► **Chemical methods** use herbicides to suppress or kill unwanted plants and are the primary methods used by managers to control invasive plants. These methods require judicious and safe applications, so as not to affect water quality and non-target organisms. Herbicides

are classified and chosen according to the following criteria: chemical structure, mode of action (systemic or contact), site of uptake (roots, shoots or leaves), site of action (location of biochemical process), mechanism of action (biochemical process affected), persistence, selectivity and application timing (pre-emergence or post-emergence).

- **Physical methods** are used to remove, kill, injure or alter growing conditions for unwanted plants. These methods allow managers to be highly selective with minimal environmental impact, but tend to be expensive and labor intensive. These methods include: pulling, hoeing, tilling, mowing, cutting, stabbing, girding, chaining, mulching, flooding, harvesting, and dredging.
- **Biological control** uses the natural enemies of invasive plants to control their populations. This method is used to suppress an infestation where other methods are not economically feasible. It requires careful preliminary work to insure that there are no unintended consequences of releasing another exotic species.
- **Prescribed burning** can mimic natural disturbance conditions in ecosystems. This method is widely used for habitat restoration, and under ideal conditions it can also be used to suppress and control populations of invasive plant.

#### Integrated Vegetation Management:

Integrated vegetation management allows for the pairing of various techniques that, when used together, can be more effective at eliminating invasive species from a site. Physical methods, such as annual mowing, are often used to maintain warm season prairie grass, but if one looks closely under the grass they may find a mixture of invasive weeds that are simply being cropped close to the ground. Prescribed burning is also

*IVM Partners demonstrate the use of herbicides as a part of an integrated vegetation management strategy to control invasive plants at Chesapeake Farms.*





Integrated Vegetation Management Techniques		
Target	Control Technique	Detailed Method
Invasive trees	Physical and chemical	Girdling and basal herbicide, or foliar herbicide to actively growing leaves.
Invasive shrubs	Physical and chemical	Mowing immediately followed by basal herbicide or foliar herbicide during next growing season.
Perennial woody invasives	Chemical and burn	Foliar herbicides during growing season, followed by a burn during dormant season.
Annual herbaceous invasives	Chemical and burn	Post emergent herbicide treatment during growing season and before seed production, or pre-emergent herbicides to prevent germination, followed by a burn during dormant season.
<i>Phragmites</i>	Physical, chemical and burn	Foliar herbicides during the growing season followed by a burn, mow or mulch during dormant season.

used for grass maintenance but does not always remove target invasive plants, since controlled burns seldom kill plant roots. If chemical methods are used, a periodic broadcast application may be relied on to wipe out the invasive infestation, only to have the remnant plants invade a few years later. At the Refuge, IVM Partners worked to implement a truly integrated strategy that paired methods to more effectively control invasive species.

IVM Partners initial research began in 2004 at Chesapeake Farms, where they experimented with different integrated vegetation management techniques to address management concerns of electric utility companies that maintain rights-of-way across public lands, and the government agencies that manage surrounding lands. In 2005, IVM Partners and Chesapeake Farms held a workshop at the farm to demonstrate their results and learn from others in the field of vegetation management. The workshop showed how best to control invasive trees (tree-of-heaven), invasive shrubs (autumn olive, multiflora rose), perennial woody invasives (Japanese honeysuckle, wineberry),

annual herbaceous invasives (Japanese stiltgrass, mile-a-minute, Chinese lespedeza), and *Phragmites*. Demonstrations were also conducted to show how to regenerate native prairie grasses through the release of dormant seed banks in the soil which can grow once rapidly spreading sweetgum (*Liquidambar styraciflua*) trees and invasive shrubs are controlled.

After the workshop, IVM Partners was asked to visit the Refuge to discuss management options for controlling invasive plants and restoring wildlife habitat. IVM Partners determined the density and number of invasive plants found on the Refuge would require substantial treatment and that the Refuge's standard control technique, of staff using backpacks to apply herbicide treatments, would be futile. With numerous invasive species reproducing across 60% of the Refuge, it was clear that they needed a professional partner and an innovative strategy.

IVM Partners entered into a contract with U.S. Fish and Wildlife to serve as a general contractor and coordinator of the integrated vegetation

management effort at the Refuge.

Their work involved: the drafting of the vegetation management plan; GIS mapping of treatment sites; contracting with Weeds Inc., a certified pesticide applicator company; development of herbicide mixes and application techniques prescribed to each invasive plant(s) and specific to forest floor, roadsides, agricultural fields or wetlands; and botanical and photo documentation of selected treatment sites.

Due to the extent of invasive species infestation and access difficulty, IVM Partners directed initial applications to the invasive plants that had the most deleterious impact to Refuge habitat and in locations 50-feet deep into the woods along targeted roadsides, trails, wetlands and agricultural field edges, with control areas left for comparison. If this proved successful on the initial application, then subsequent applications could be directed deeper into the forest. The benefit of having treatments along easily observed roads and trails is that it provided both Refuge staff and the visiting public with tangible examples of success at habitat reclamation.



The location of the Refuge at the confluence of the Chester River and Chesapeake Bay placed waterfowl habitat at the top of the priority list. This in turn placed control of *Phragmites* at the top of the vegetation management priority list, as control of this aggressive plant would allow restoration of native wetland plants, a crucial food source for migrating waterfowl of the Atlantic flyway.

In addition to the waterfowl habitat and the 50-foot deep treatments, Refuge biologists wanted to reclaim several wooded blocks from invasive infestations and see if native vegetation could return. To successfully treat these areas, mowing was needed to cut access lanes into the jungle-like growth of invasive plants. The contracted crews could then use the mowed lanes for spray vehicle access and broadcast treat the forest floor vegetation with herbicides applied through hydraulic hoses. Hydraulic applications are very similar to spraying water with a garden hose, only the water contains herbicides that will target the invasive plants. Blue dye is added to the water as a marker to note area treatment coverage.

In August and October of 2006, treatment areas, including wetlands, forests, fields, trails, and roads each had target species and were treated with a particular control technique. Certain techniques, such as combining the use of herbicides and physical removal, have proven to be more effective at killing the target species. In addition to mowing and spraying with a combination of herbicides, the Refuge vegetation management plan also called for controlled burning during the dormant season following a broadcast herbicide treatment. Chesapeake Wildlife Heritage established permanent transects to monitor plant community changes in the fields on the north and south ends of the Refuge.

Successful control of invasive plants invariably requires a follow-up herbicide treatment the following growing season, with periodic treatments as warranted by inspections. If a few stems of an invasive plant are allowed to exist, in a very short time they will out-produce the native plants and again dominate the site. Landscaping

with native plants is seldom necessary as their seeds are normally still viable and will germinate once the invasive plants, and their corresponding allelopathic chemicals, have dissipated.

## RESULTS

At Eastern Neck National Wildlife Refuge, the combination of the efficiency

### DEFEATING *PHRAGMITES AUSTRALIS*



*Phragmites* is a perennial grass that primarily spreads by rhizome roots and can advance rapidly through all types of growing material. Although the species is native, scientists believe that an aggressive non-native genotype was introduced to North America.<sup>6</sup> Once established, *Phragmites* develops into a monoculture of dense stems that crowd-out native plants by blocking sunlight, consuming nutrients, and exuding allelopathic chemicals, particularly gallic acid that turns into mesoxalic acid when degraded by the sun's ultraviolet rays, which attacks the proteins in the roots of competing plants.<sup>7</sup>

To successfully defeat *Phragmites*, one must not only kill the roots of the plant using herbicides, but also remove the dead plant material from the site, especially if it has built up a thick thatch layer over the years. In 2005, IVM Partners and Chesapeake Farms applied Habitat (imazapyr) and Accord (glyphosate) herbicides with surfactant to an area of *Phragmites* using a hydraulic sprayer. The phragmites debris was then removed with a controlled burn in the winter of 2006. A selective backpack application using the same herbicides was performed the summer of 2006 to the few remnant live stems of *Phragmites*. The result was a release of 36 native wetland plant species whose seeds were lying dormant just waiting for the chance to germinate.

► Eastern Neck National Wildlife Refuge  
Rock Hall, Maryland\*



\*Map does not include information about wetland control efforts.

of the application crews, and cooperative mowing access by Refuge staff, resulted in the treatment of a total of 146.7 acres in 2006, nearly twice as much acreage as the IVM Partners contract required. Approximately 100 acres of *Phragmites*-dominated wetlands were successfully controlled. In addition, approximately 47.6 acres of forested areas were treated to remove several species of invasive plants.

Native plants regenerated on their own at the treatment sites after controlling the invasive weeds. Sites formerly dominated by *Phragmites* now have native wetland plants, which have attracted native birds

and mammals back to the Refuge. Wooded sites formerly overrun with invasive plants that were mowed and treated with herbicides, now have naturally regenerating loblolly pines (*Pinus taeda*) at a density of 3 per square meter.

IVM Partners and the Refuge determined that controlling invasive species across the Refuge is a high priority and a major challenge requiring significant funding and time. This conclusion led the Refuge staff to initiate the revision of their Comprehensive Conservation Plan for the Refuge, which will update management priorities to include use

of integrated vegetation management techniques to control invasive species.

Control of the invasive plants was only part of the project's results. The project allowed IVM Partners and the Refuge to learn more about best management practices for restoring critical habitat from invasive weed infestation and share the results with others. The Refuge now functions as an outdoor classroom for vegetation management education and innovation. Refuge treatment sites continue to be a major educational centerpiece for workshops and presentations that have included participants from numerous federal agencies, corporations and nonprofit conservation organizations.

Lastly, the integrated vegetation management workshop in 2005 helped convince federal land management agencies and Edison Electric Institute to sign a memorandum of understanding to adopt integrated vegetation management as the preferred management process for all electric rights-of-way crossing federally managed lands.

**KEYS TO SUCCESS**

**A truly integrated approach:** To successfully control non-native invasive plants one must use an integration of control techniques, including: chemical, physical, biological, or prescribed burning. At the Refuge this included mowing, fire, and a combination of judicious herbicide applications. The choice of control technique(s) is based on effectiveness, environmental impact, site characteristics, worker and public health and safety concerns, security and economics.

**Multiple types of herbicides:** The Refuge learned not to rely solely on one type of herbicide for management. Rodeo (glyphosate) was previously the chemical of choice for



Eastern Neck National Wildlife Refuge Upland Treatment Areas, Targets and Applications		
Location	Species Targets	Applications
Forest Block 1	Mile-a-minute, Japanese honeysuckle, multi-flora rose, autumn olive, wineberry, and Japanese stiltgrass.	Geoboy to mow access lanes; Garlon 3A (triclopyr), Escort (metsulfuron) Roundup (glyphosate), Plateau (imazapic) and Aquacap (pendimethalin)
Field 1	Sweet gum suppressing growth of native loblolly pine and other invasive plants.	Oust Extra (sulfometuron and metsulfuron)
Road Edges & Trail Edges	Mile-a-minute, Japanese honeysuckle, multiflora rose, autumn olive, wineberry, Japanese stiltgrass and <i>Phragmites</i> .	Habitat (imazapyr) and/or Rodeo (glyphosate), controlled burn
Field Edges	Sweet gum, mile-a-minute, Japanese honeysuckle, multiflora rose, autumn olive, wineberry, and Japanese stiltgrass.	Garlon 3A (triclopyr) and Escort (metsulfuron)
South End	Mile-a-minute, Japanese honeysuckle, wineberry, multiflora rose and Japanese stiltgrass	Oust Extra (sulfometuron and metsulfuron), Plateau (imazapic) and Aquacap (pendimethalin)

all *Phragmites* treatments by Refuge staff, but this can damage loblolly pine trees. In addition, glyphosate is an amino acid inhibitor and can be much more effective when combined with another amino acid inhibitor, Habitat (imazapyr). Imazapyr also offers flexibility in treatment methods when attacking *Phragmites* over open

marshland that is not easily accessed from ground vehicles. Plateau (imazapic) and Aquacap (pendimethalin) were used effectively in some locations to prevent germination of mile-a-minute and Japanese stiltgrass.

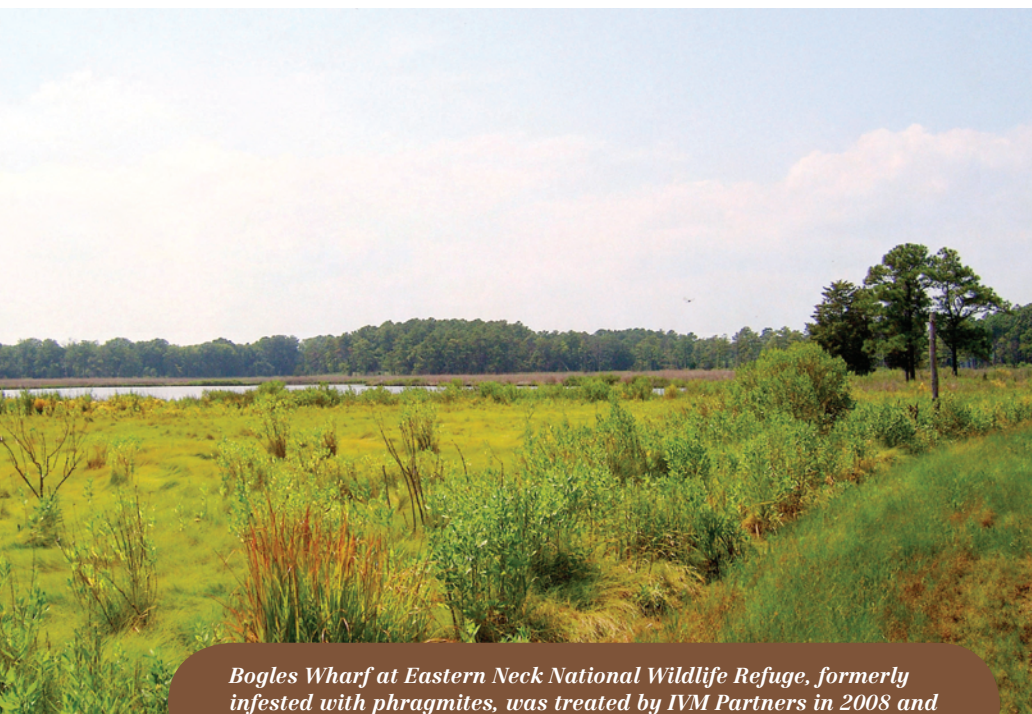
**Partnership between stakeholders:**

In many circumstances the relation-

ship between industry, conservation and public agencies can be adversarial instead of cooperative. This project was successful because a non-profit corporation acted as a liaison between chemical manufacturers, applicators, U.S. Fish and Wildlife, and other groups to provide a forum for learning and applying the best IVM techniques for habitat restoration.

**An adaptive management approach:**

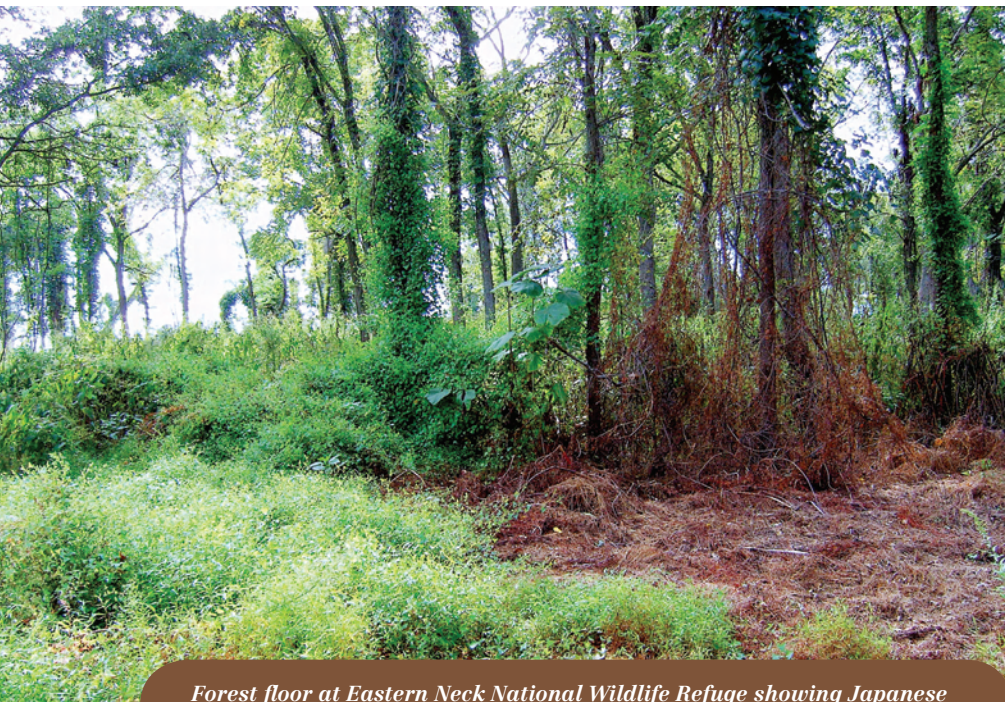
The project succeeded by learning from mistakes, adapting to changing situations, and being willing to try multiple approaches instead of entering into the process with preconceived ideas of what was right and wrong. U.S. Fish and Wildlife solicited comments from wildlife experts to define management objectives; they allowed professional contractors to conduct the initial herbicide treatments; pesticide use permits were obtained for using several herbicide products; and third party botanical and photo documentation provided unbiased assessment of successful techniques. The parties were also committed to a multi-year process to monitor how plant communities changed over time.



*Bogles Wharf at Eastern Neck National Wildlife Refuge, formerly infested with phragmites, was treated by IVM Partners in 2008 and has since recovered with native species.*







Forest floor at Eastern Neck National Wildlife Refuge showing Japanese stiltgrass infestation (left) and treated area (right).

**An actively engaged public:** U.S. Fish and Wildlife took special steps to involve and inform the public, and was rewarded with a standing ovation at a community meeting for having restored native plant communities not seen for many years.

#### PHOTOS AND FIGURES

Page 271: Photo, IVM Partners; figure, Burke Environmental Associates/The Conservation Fund, using Google Earth image

Page 272: Photo, USFWS, Eastern Neck National Wildlife Refuge

Page 273, 277, 278: Photos, IVM Partners

Page 275: Photo, Chesapeake Bay Foundation/cbf.org

Page 276: Figure, USFWS, Eastern Neck National Wildlife Refuge

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<sup>6</sup>Saltonstall, K. 2002. Cryptic invasion by a non-native genotype of the common reed, *Phragmites australis*, into North America. *Proceedings of the National Academy of Sciences*. 99(4):2445-2449.

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Integrated vegetation management and ecosystem management studies and workshops are proposed for various regions of the country to determine the best integrated vegetation management practices necessary for restoration of ecosystems unique to these geographic areas. Dates for workshops and summaries of photo and botanical documentation of these projects are available online at: [www.ivmpartners.org](http://www.ivmpartners.org).