Erie National Wildlife Refuge
2023 Invasives Summary Report

Yianni P. Laskaris, Wildlife Biologist
Anthony M. Sellards, Biological Science Technician
Liam McCann, ACE Invasive Plant Intern

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2023 Prevention and EDRR Summary

- In 2023, we began to focus on wetland/aquatic invasives that were not the focus of efforts from prior survey years (2019-2022).
- The refuge split up upland and wetland areas into two separate management units for grid surveying in 2023, with each unit having its own grid cells, and those cells being of differing size (25 x 25m in wetland/aquatic habitats).
- Priority invasive species were chosen to monitor for within each habitat. Information on which species were chosen (and why) is here: https://ecos.fws.gov/ServCat/Reference/Profile/149361
- We identified new invasive aquatic species infestations for curly-leaf pondweed, Eurasian water-milfoil, and brittle naiad.
- We also identified an infestation of yellow iris of at least 11.8 acres in size. The infestation appears limited to a stream complex on the edge of the Seneca Division which terminates at the mouth of Muddy Creek.
- We continued treatment of a single giant knotweed infestation identified through EDRR in 2022

Inventory

General Updates

Our invasives monitoring dashboard was updated to include 2023's inventory, effectiveness monitoring, & treatment of invasive plants across the refuge. The dashboard also includes heat maps for priority invasive species, species occurrence mean category cover data, and most recent surveys/management actions: https://arcg.is/KOLO9.

Invasive species occurrences were split up between upland and wetland management units, and for upland and aquatic/wetland plants, however, there was some crossover for species that were detected in both upland and emergent wetland habitats, including common reed, yellow iris, purple loosestrife, and reed canarygrass.

Upland Invasive Surveys

Staff grid surveyed a total of 117.4 acres across the Seneca and Sugar Lake Divisions between May and July 2023 (Figures 1 & 2). Species occurrence for areas surveyed between 2019 – 2023 continues to be comprised primarily of 4 species: autumn olive, honeysuckle spp., multiflora rose, and reed canary grass. Average category cover for the top 9 priority invasive species in upland areas of the refuge are shown in Figure 3. An infestation of yellow flag iris (*Iris pseudacorus*) was identified in the northwest corner of the Seneca Division, along the edges of a stream flowing within forested wetland that runs parallel to Johnstown Road. Individuals observed flowering indicate the infestation is at least 3 years old.

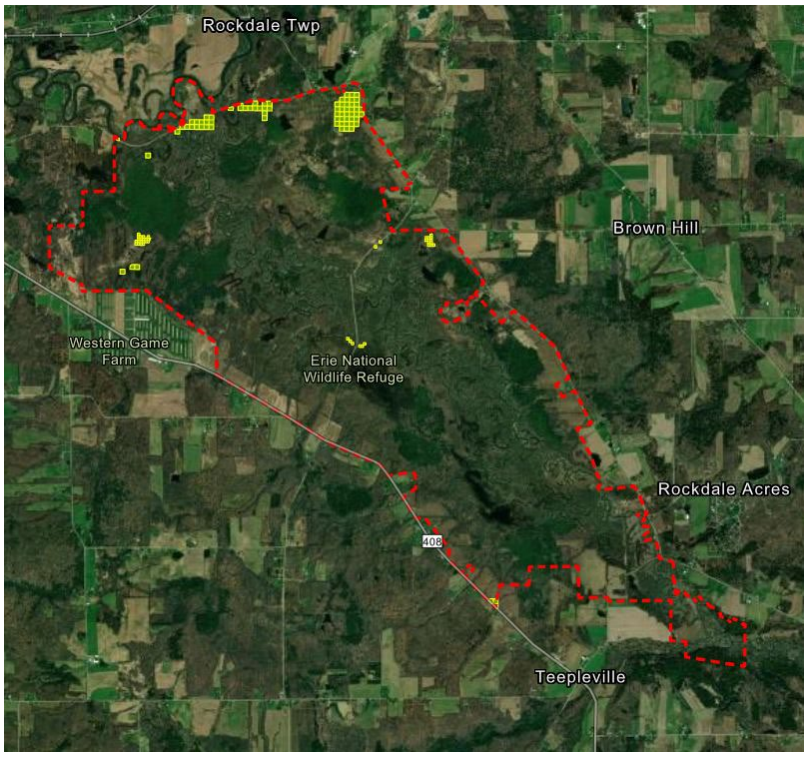

Figure 1: Grid cells surveyed across the Seneca Division in 2023.

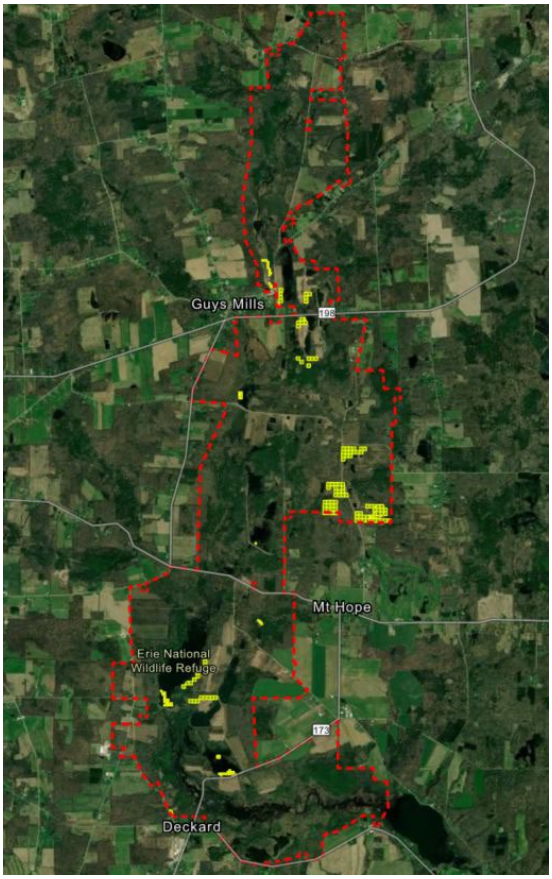

Figure 2: Grid cells surveyed across the Sugar Lake Division in 2023.

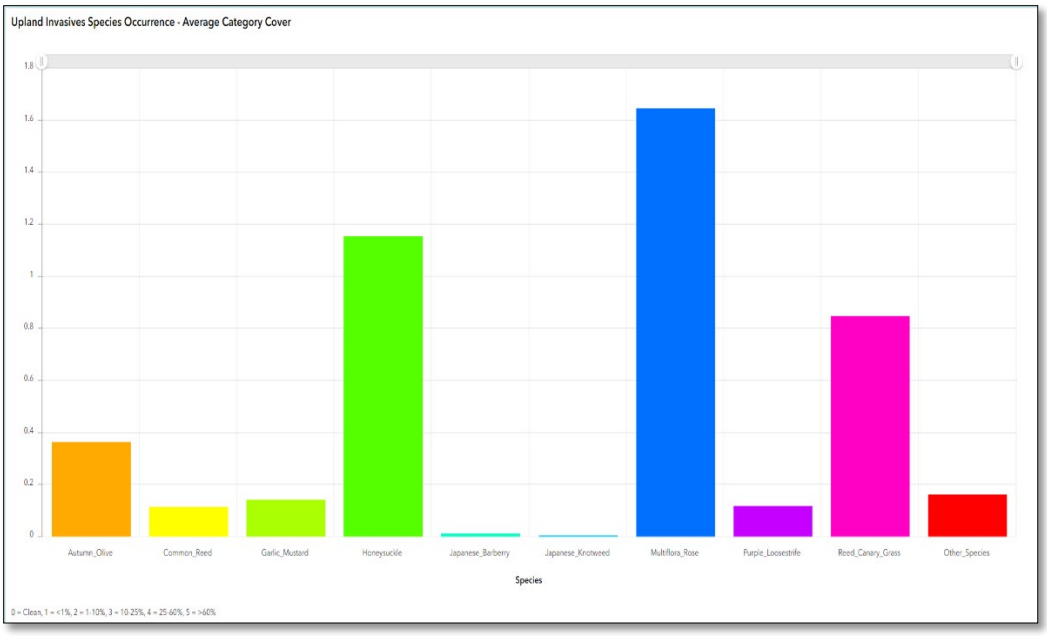

Figure 3: Upland Invasive Species Occurrence - Average Category Cover

Aquatic Invasive Surveys

Staff grid surveyed 17.5 acres of aquatic and wetland habitat and discovered 2 new aquatic invasive species during 2023's inventory. Efforts were focused on Pool 9 and Reitz Pond on 7/25/23 (Figures 4 & 5), as well as in Mohawk Fen and Ferris Corner Fen. Aquatic surveys in impoundments were performed with the help of Western Pennsylvania Conservancy (WPC) & Pennsylvania Natural Heritage Program (PNHP) invasive plant ecologist, Brian Daggs. During the survey, Eurasian water-milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*) were documented as growing in the lower reaches of Pool 9. No new invasive aquatic species were found growing in Reitz Pond.

Prior to 2023 grid surveys, a single stem of Eurasian water-milfoil was found by Brian Daggs in a pool of the emergency overflow area of Pool 9 on 9/6/2022, along with a few patches of brittle naiad (*Najas minor*) along the shallow, southwest reaches of Pool K. Brittle naiad was subsequently found in Pool 7S during IWMM vegetation surveys in September of 2023. A clump of curly-leaf pondweed was also incidentally discovered during freshwater mussel surveys performed along Muddy Creek, where it was growing among native pondweeds (*Potamogeton* spp.). These observations indicate that infestations of Eurasian water-milfoil, curly-leaf pondweed, and brittle naiad are more prevalent in emergent wetlands and impoundments on the refuge than originally thought, in part due to their ability to spread to new sites by hitchhiking on waterfowl.

Biological staff also surveyed for other aquatic invaders known to be spreading in Crawford County, and in northwest Pennsylvania, including hydrilla (*Hydrilla verticillata*) and European frog-bit (*Hydrocharis morsus-ranae*), but found no evidence of their presence (Figure 6). It is

likely the case that these infestations have been present prior to September of 2022, but never identified, as invasive grid mapping efforts have previously been focused on upland habitats. Staff made significant efforts to identify new infestations of common reed, which has begun popping up in small patches across the refuge and in managed impoundments, including Pools H, Reitz Pond, and Cooper's Marsh. A handful of patches were identified and treated in 2023, with plans to continue surveys and treatments in 2024.

Figure 4: Pool 9 Invasive Aquatic Survey Coverage

Figure 5: Reitz Pond Invasive Aquatic Survey Coverage

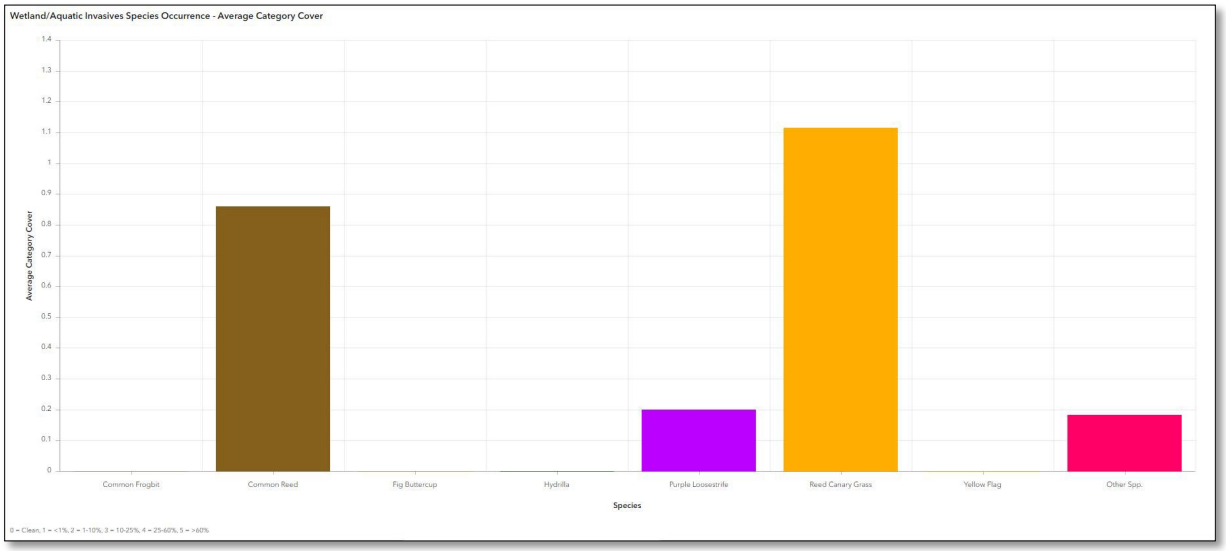

Figure 6: Wetland/Aquatic Invasive Species Occurrence - Average Category Cover

Assessing Invasive Infestations at Ferris Corners Fen and Mohawk Valley Fen

On August 9th and 10th, WPC/PNHP botanists Steve Grund and Jessica McPherson joined Erie NWR staff, along with Invasive Species Biologist, Lauren Cruz, and biological technician, James Ianni from IRQ, to relocate rare plant species previously identified as occurring within the fens

in 2006, and to assess the degree of invasive plant infestations at both fens. A report from PNHP detailing the findings of this botanical survey is forthcoming.

Mohawk Valley Fen

Staff had previously grid mapped most of the Mohawk Fen complex in the summer of 2022, but were able to complete the remaining un-surveyed grids in 2023. Grid mapping efforts from 2022-2023 identified 3 large common reed stands within the complex, along with several dozen monotypic stands of reed canarygrass in various sizes. Areas in drier portions of the fen, and along the fen's edges hosted clusters of multiflora rose, velvet grass, colt's-foot, non-native honeysuckle spp., and Japanese barberry. An isolated patch of purple loosestrife was also identified in the center north edge of the fen.

The "good" news which came out of the botanical and invasive surveys at Mohawk Fen is that the majority of infestations for the most problematic species (common reed, reed canarygrass, purple loosestrife) were outside of the fen's "core area" situated in the complex's southwest corner. The core area, did however, have infestations of colt's-foot (*Tussilago farfara*) and watercress (*Nasturtium officinale*), and creeping thistle (*Cirsium arvense*).

Ferris Corners Fen

Ferris Corners Fen was also found to have colt's-foot, ribwort plantain (*Plantago lanceolata*), patches of multiflora rose, and non-native honeysuckles. There is also an extensive patch of common reed growing along the edge of the wetland complex on the southwestern edge of the fen.

Management

General Invasives Management

During the 2023 field season, refuge staff worked together to target areas with multiflora rose, autumn olive, honeysuckle spp., and reed canary grass, and worked to identify and treat areas with *Phragmites* while also enrolling treated areas into PAMF's monitoring framework. Treatment of other species was incidental to priority species noted above.

The biology team worked to biologically control multiflora rose in 4.2 acres of upland forest through goat grazing, released *Galarucella* beetles for purple loosestrife on 0.40 acres of wetland, mechanically pulled invasives from 5.3 acres, and used herbicide to chemically treat 10.3 acres of invasives in upland forest, old fields, emergent marsh, and managed impoundments. In total, 6.19 gals of AquaNeat, 2.68 gal of RoundUp Pro, and 0.66 gals of Garlon3A were used to treat invasives. The bulk of the species treated were those designated as priority species for the refuge's invasive inventory (see Figures 3 & 6).

Staff continued to treat an infestation of giant knotweed (*Reynoutria sachalinensis*) identified in 2022 off Route 27. Staff mechanically pulled 0.15-acres of giant knotweed and returned to perform stem injections over the same area one month later. Common reed discovered in Reitz

Pond was also treated, both chemically and mechanically, with a 0.05 acre patch cut, and mature plants with seed heads bagged, to thin out the stand for continued chemical treatment in 2024. In late summer, staff treated invasives along a corridor from the adjacent State Game Land property through to Mohawk Valley Fen to gain increased access to the core fen area for future invasive control efforts. Additionally, on September 19th, Ecological Field Services was contracted out to treat one of the large patches of *Phragmites* identified in Mohawk Fen during grid mapping efforts.

Biological and maintenace staff also created 28.3 acres of early sucessional forest habitat, cut in lanes/strips to promote ESH-dependent wildlife, but these actions also provided increased access to areas with thick concentrations of honeysuckle spp., autumn olive, and MFR that can now be more easily treated. Staff plan to use these lanes to more effectively treat invasives in 2024.

Goat Biocontrol of Multiflora Rose

The refuge partnered with the nonprofit organization, Allegheny GoatScape, for the 5th year to reduce invasive multiflora rose via grazing at our East Oil Creek Rd site. Team Diamond (Figure 7), comprised of 12 goats and their miniature donkey herd leader, worked to remove invasives for 4 weeks from 6/28/23 to 7/28/23. The herd reduced invasives in 10 sub-units totaling 4.2 acres. The biology team also applied herbicide to two units (Units 8 and 9), for an additional 0.63 acres treated. Though multiflora rose was the primary target, the goat herd also removed other undesirable invasives, like garlic mustard, from the area.

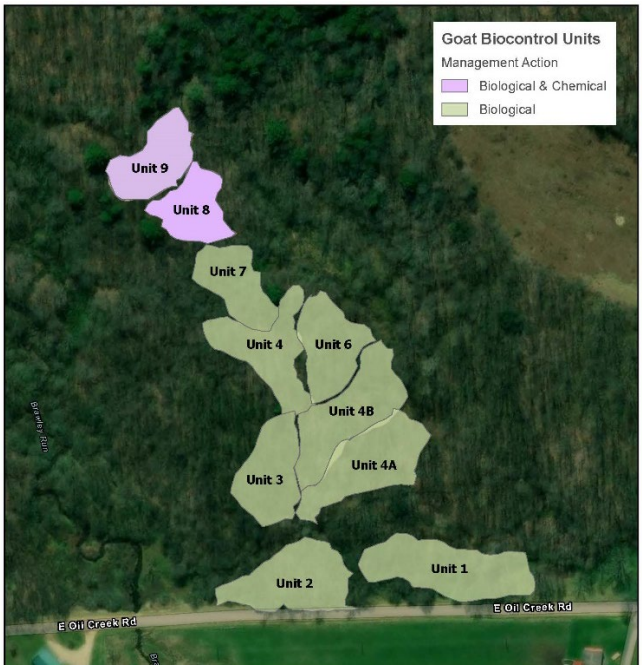

Figure 7: Goat Biocontrol Area on E. Oil Creek Rd

Deploying Galarucella Beetles for Purple Loosestrife Biocontrol

On June 11, 2023, the refuge biology team was able to obtain ~3000 *Galarucella* beetles collected by Iroquois NWR staff and released ~500-1,000 beetles across 4 sites (Pool 4, Pool C, Dead Creek, and Sugar Lake at the terminus of Lake Creek) where purple loosestrife had been identified by invasive grid surveying in past years. Staff released the beetles over patches of loosestrife totaling 0.40 acres. Staff also hand-pulled purple loosestrife from two locations (Johnstown Rd, Dead Creek bridge) where the plant appeared to be growing in isolation and in small enough numbers to hand-pull.

Effectiveness Monitoring

Goat Project Area

As part of effectiveness monitoring within the goat project area, ACE invasive interns grid mapped cells prior to 2023 treatments to obtain percent cover estimates for multiflora rose. These values were compared with values obtained from grid mapping efforts in 2020. Results from this comparison were somewhat of a mixed bag, indicating that multiflora rose did not always decrease within the treatment areas (Figure 8). It's possible that this comparison was not an accurate depiction of management success, as grid survey methods may not be assessing fine-scale changes in multiflora rose cover, specifically with regards to decreases in stem density attributed to goat grazing.

Figure 8: Multiflora Rose Percent Cover Change (2020-2023)

The goat project area was also visited on October 17, 2023 by our partner, Dr. Rich Bowden at Allegheny College, and his forestry class, to obtain updated information on goat grazing impacts to trees within the treatment area. This study was a follow-up to data collected by Dr. Bowden's class collected after the first season of the goat project in 2019. Students measured tree diameter (DBH), diameter of browsed (or girdled) area on each tree, tree species, and health (healthy,

experiencing dieback, dead). A comparison of the percent of trees damaged across three categories of goat browsing between 2019 (Y1) and 2023 (Y5) is shown on (Figure 9).

Dr. Bowden's class concluded that half of the trees in the goat grazing area remained healthy, with 23% being completely dead. The impact of goat browsing on trees was dependent on tree species, with goats preferring to eat red maple, sugar maple, and ironwood, and less impact on lesser-preferred species like black cherry and shagbark hickory. These results will certainly inform any subsequent efforts to reduce invasives via goat grazing on the refuge, so that areas with tree species of ecological importance are avoided in favor of forested areas with trees of "lower" ecological importance.

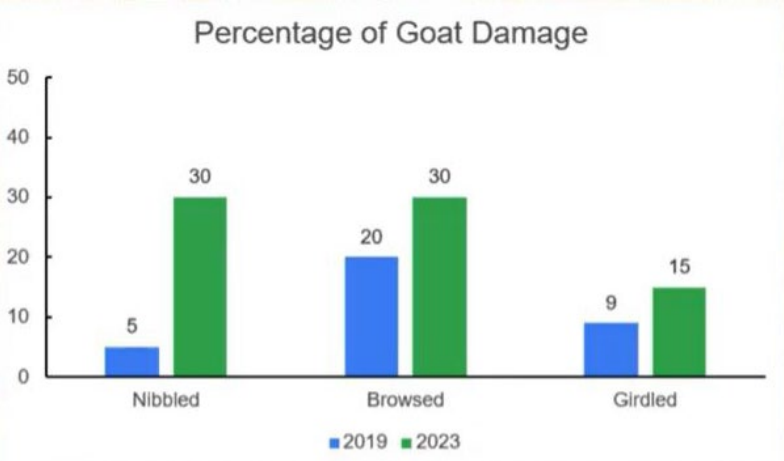

Figure 9: Percent of trees damaged by goat browsing within goat grazing treatment area, 2019-2023 comparison.

Continuing to Implement the Phragmites Adaptive Management Framework (PAMF)

In 2023, the refuge continued to monitor *Phragmites* infestations within the Great Lakes Phragmites Collaborative PAMF framework, which monitors phragmites patch response to herbicide treatment. The PAMF framework tracks management of *Phragmites* across years through the monitoring of plots generated across a transect within designated units (or patches). These units are surveyed for stem count, stem diameter, and other metrics like visible stress. Data collected from this framework is used to generate guidance for management using data submitted from over 80 management practitioners across the Great Lakes region. This guidance allows habitat managers to choose from a suite of management strategies specifically tailored to their unit.

Five monitoring units were added to Erie's monitoring framework in 2023, for a total of 8 units being managed across the refuge. Of those 8 units, 6 units were monitored during the month of July. The remaining 2 units were not monitored in 2023 due to time constraints on staff. Five of the 6 monitored units had management actions performed between August and September, consisting of glyphosate treatment. Cutting and bagging of seed heads was done at the Reitz Pond site to thin out stands for future treatment and to limit additional spread from seeds.

Using data provided for each management unit, the PAMF model provided guidance for optimal management actions, which in most units was to apply glyphosate+ during the translocating

period, and to perform mechanical actions during the dormant phase (cutting and leaving biomass). We may also have other options for management (like flooding to stress *Phragmites*) that will be considered during the 2024 field season, specifically in Pool H, where we are able to manipulate water levels.

Volunteer Activities

A crew of 1 biological intern and 2 invasive plant interns were brought on during the spring and summer of 2023 through ACE. The focus for invasive plant interns was to map out invasive species cover across priority habitats (old fields, forested uplands), facilitate the goat biocontrol project, and to treat invasive species found through chemical, biological, and mechanical control. ACE invasive plant interns also assisted with surveying for aquatic invasive plants at Pool 9, Reitz Pond, Mohawk Fen, and along Dead Creek within the Seneca Division.

A crew of 5 YCC members contributed greatly to the refuge's goat biocontrol project by helping to clear 3-ft wide lanes out of thick, brushy vegetation across the management unit so electrical fencing could be placed without issue. The crew also assisted with moving the herd and their shelter supplies between units, mowing along the fence line and clearing any potential hazards in the units. The YCC crew also assisted with mechanical pulling of great mullein on the 4.7-acre field west of Pools C and D.

Lastly, we had assistance from several volunteers with removing garlic mustard on a 0.42-acre patch located on the eastern entrance/parking lot area of the Trolley Line trail. This was done following a spring wildflower walk event on May 7, 2023, that was hosted in conjunction with The Foundation for Sustainable Forests.

Photos of 2023 Invasives Work

Figure 10: ACE invasive intern, Ella Walden, tending to goats and their guardian donkey, Diamond

Figure 11: ACE biological intern, Maddie Reim, release Galarucella beetles at a site with invasive purple loosestrife.

Figure 12: Ella Walden, Yianni Laskaris, and James Ianni help survey Mohawk Valley Fen for rare plants and invasive plant species. Credit: Lauren Cruz/USFWS