Project Period	04/01/2011 - 12/31/2012
Award Amount	$50,000.00
Matching Contributions	$50,500.00
Project Location Description (from Proposal)	Ridgefield National Wildlife Refuge and adjoining Columbia River floodplain, Clark County, Washington. On federal, state, private, county and city lands.
Project Summary (from Proposal)	Create a Columbia River floodplain Cooperative Weed Management Area. Conduct invasive plant survey, treatment, and revegetation on the Ridgefield National Wildlife Refuge, private and public lands.
Summary of Accomplishments	A Weed Management Area (WMA) was created within the 9,800-acre Columbia River floodplain landscape with a committee representing the Ridgefield National Wildlife Refuge, four public agencies, one nonprofit group, two large private landowners, the City of Ridgefield, and community volunteers. Annual committee meetings, seasonal knotweed coordination meetings, site visits, and boat search field trips with partners were conducted, and an Integrated Weed management (IWM) Plan was produced. Approximately 7,446 acres were searched for key invasive plants on ownerships within the cooperative WMA and target invasive plants were spot treated and hand pulled over 1,687 acres, incorporating IPM measures including best practices to encourage re-vegetation, reseeding, and replanting with native trees and shrubs. More than 2,550 native trees and shrubs were planted and protected to restore floodplain riparian forest and oak woodland. More than 857 volunteer visits contributed 3,495 hours. Volunteers were trained to survey and remove invasive plants, apply herbicide as licensed applicators, plant native trees and shrubs, and maintain new plantations. Volunteers and the community received outreach and were educated during field briefings and trainings on invasive plant issues and restoration goals and objectives. NFWF funds were combined with other contributions to achieve project objectives.
Lessons Learned	Early Detection/Rapid Response within the WMA proved, as expected, to be one of the most effective conservation practices. Surveys detected and treated new locations for 10 invasive plant species – 3 of these were new to the WMA and several occurrences found were of single plants such as purple loosestrife and Japanese knotweed. Significant reduction of target invasive plants within the WMA was achieved as anticipated, especially on some private lands which had not received attention until the WMA approach was implemented. Restoration plantings on the Refuge (for this project) and on other lands within the WMA have been very successful at establishing plants for the first 1-2 years in riparian areas and on oak woodland uplands. However a major challenge for long-term planting success will require much more effective beaver protection of plantings – the greatest impact to establishing tree and shrub canopy cover. Formation of the WMA has been a success. Participants responded postitively and participated willingly and sought advice from partners through meetings, email exchanges and combined field search outings. Production of the IWM plan proved much more useful even than predicted. Volunteer outreach and recruitment were very productive, setting near records. Interaction with other WMA's in the region was increased as a result of the project.

Conservation Activities	Survey 2,156 acres annually for key invasive plants
Progress Measures	Other (# of acres searched annually)
Value at Grant Completion	3,723
Conservation Activities	Treat key invasive plants across 616 acres of habitat annually
Progress Measures	Other (# of acres controlled annually)
Value at Grant Completion	843
Conservation Activities	Plant and protect 1,760 native plants
Progress Measures	Other (# of plants planted)
Value at Grant Completion	2,551
Conservation Activities	Form a Weed Management Committee/ produce an Integrated Weed Management Plan
Progress Measures	Other (# of WMA committees formed/# of IWM Plans created)
Value at Grant Completion	1/1
Conservation Activities	Recruit and train 300 volunteers/distribute 2 invasive plant fact sheets
Progress Measures	Other (# of volunteer visits/# of invasive plant fact sheets)
Value at Grant Completion	857/2

Final Programmatic Report Narrative

Instructions: Save this document on your computer and complete the narrative in the format provided. The final narrative should not exceed ten (10) pages; do not delete the text provided below. Once complete, upload this document into the on-line final programmatic report task as instructed.

1. Summary of Accomplishments

In four to five sentences, provide a brief summary of the project's key accomplishments and outcomes that were observed or measured.

A Weed Management Area (WMA) was created within the 9,800-acre Columbia River floodplain landscape with a committee representing the Ridgefield National Wildlife Refuge, four public agencies, one nonprofit group, two large private landowners, the City of Ridgefield, and community volunteers. Annual committee meetings, seasonal knotweed coordination meetings, site visits, and boat search field trips with partners were conducted, and an Integrated Weed management (IWM) Plan was produced. Approximately 7,446 acres were searched for key invasive plants on ownerships within the cooperative WMA and target invasive plants were spot treated and hand pulled over 1,687 acres, incorporating IPM measures including best practices to encourage re-vegetation, reseeding, and replanting with native trees and shrubs. More than 2,550 native trees and shrubs were planted and protected to restore floodplain riparian forest and oak woodland. More than 857 volunteer visits contributed 3,495 hours. Volunteers were trained to survey and remove invasive plants, apply herbicide as licensed applicators, plant native trees and shrubs, and maintain new plantations. Volunteers and the community received outreach and were educated during field briefings and trainings on invasive plant issues and restoration goals and objectives. The metrics for all projected activities were completed and many exceeded. NFWF funds were combined with other contributions to achieve project objectives.

2. Project Activities & Outcomes

Activities

- Describe and quantify (using the approved metrics referenced in your grant agreement) the primary activities conducted during this grant.
- Briefly explain discrepancies between the activities conducted during the grant and the activities agreed upon in your grant agreement.

NFWF Funds awarded were combined as planned with project match (volunteer in-kind contributions) and other non-match (Federal) source funding and in-kind contributions to achieve the specific project activities listed below.

1) **Survey 2,156 acres annually for key invasive plants.** (4,312 acres total)
The metrics for this activity were exceeded during the project. During the 2 seasons of the project, 7,446 acres total or 3,723 acres annually were searched for key invasive plants within the WMA. Acreages were higher than expected due to much greater than predicted volunteer recruitment. Volunteer invasive plant hunters and WMA partners searched 6,286 acres of the Ridgefield National Wildlife Refuge (Refuge) and 1,160 acres of other ownerships including Clark county wetlands, State of Washington shoreline, City of Ridgefield and small acreage private ownership along Gee Creek, and 2 large landowners – one hunt club and one large family-farm/forestry ownership. Searchers coordinated with other WMA partners and used a Refuge jet boat and a volunteer powerboat to search 16 miles of river and slough shoreline within the project area annually during each project year, including Lake River, the Lewis River, and the north end of Vancouver Lake. Other searches were conducted by canoe, ATV, ORV and on foot along 8 miles of Gee Creek, 6 miles of Campbell Slough, Campbell Lake, Post Office Lake, Carty Lake, the Columbia River, and other small lakes and ponds within the project floodplain. Due to extreme prolonged high seasonal floodwaters in 2011 early summer searches along tidal waters were delayed. When water levels receded, flooding had suppressed emergence of yellow flag iris (*Iris pseudacorus*) and purple loosestrife (*Lythrum salicaria*), obscuring some locations. Despite this, late boat surveys in 2011 found 2 new populations of loosestrife, including one within Bachelor Island which was treated, and

documented more than 15 new scattered occurrences of yellow flag iris. Searching returned to normal in 2012 and many locations of yellow flag iris were documented along tidal shorelines which were obscured the previous season, highlighting the importance of searching every year.

Searches produced a number of examples of Early Detection/Rapid Response (ED/RR). During the 21 month project, surveys detected and treated new locations for 10 invasive plant species – 3 of these were new to the WMA and several occurrences found were of single plants. Canoe searches found and treated the first location of Japanese knotweed (*Polygonum cuspidatum* and hybrids) in Campbell Slough, disjunct by 2 miles from other occurrences; Land and water searches found and treated new diffuse knapweed (*Centaurea diffusa*) and poison hemlock (*Conium maculatum*) locations, the first occurrence of a non-native bugloss (*Pentaglottis sempervirens*) along the auto access road, new occurrences of slenderflower thistle (*Carduus tenuiflorus*) 2 miles from known locations, a new occurrence of Scot's broom (*Cytisus scoparius*), a population of shiny geranium (*Geranium lucidum* – a new species for the refuge found on one basalt outcrop island in the floodplain), 5 new occurrences of purple loosestrife (4 on private partner lands), 2 new occurrences for ricefield bulrush (*Schoenoplectus mucronatus*) one in a new disjunct location), and many new occurrences of yellow water iris along state shorelines and in a new elevation zone following prolonged high floodwaters in 2011. Winter searches found 2 new locations for English ivy (*Hedera helix, Hedera spp.* and related cultivars). All locations found were mapped by GPS and search areas mapped. Volunteer search teams in both seasons included a certified canine search team with 2 dogs who were successfully trained to locate ricefield bulrush plants during 2011 and 2012.

1) **Treat key invasive plants across 616 acres of habitat annually.** (1,232 acres total)
The metrics for this activity were exceeded during the project. Invasive plants were treated over 1,687 total acres within the project area over 2 seasons or 843 acres annually. Volunteer applicators, the coordinator, an AmeriCorps members, and staff treated 1,200 acres of habitat for invasive plants on the Refuge, approximately 447 of which were hand pulled. Acreages were higher than expected due to much greater than predicted volunteer recruitment and volunteer applicator contributions. In addition, approximately 487 acres were treated on other land ownerships within the WMA – 15 acres of state and City of Ridgefield land, and 472 on private land ownership of Plasnewyyd Farms, LLC. On the Refuge, the coordinator with annual seasonal field leaders and AmeriCorps members led volunteer crews and applicators who pulled more than 29,000 ricefield bulrush plants and spot-treated key invasive plants with herbicide by boat, canoe, ORV, truck, and on foot. A private landowner partner treated and controlled invasive plants over 462 acres of their own floodplain lands, and the Coordinator pulled purple loosestrife from 10 acres of private hunt club land within Bachelor Island at a new location discovered in 2011. Four new volunteer herbicide applicators and 2 AmeriCorps members were trained and licensed, and two other applicators along with the Coordinator attended 2 annual recertification trainings.

In concert with the IPM approach, wetland areas treated were allowed to re-vegetate with grasses or other native wetland plants from existing seed sources. Two wetlands infested with ricefield bulrush which had been disked in 2010 and 2012 to flush out the seed bank were sprayed and pulled each season and the numbers of plants which emerged due to disking were monitored using 2 sample transects. Three sites were disked in 2012 and 1 new transect established. A Ricefield Bulrush Field Report was produced for each year of the project in 2011 and 2012 by the seasonal field leader. Areas of reed canarygrass and Himalayan blackberry treated as planting sites for 2011-2012 were replanted with native trees and shrubs to convert these areas to deciduous forest and shrub cover. Other areas treated were seeded with annual ryegrass in fall 2011 and spring 2012 as cover to help prevent weed establishment. Volunteers also cut and pulled Scot's broom in 2011 to eliminate seed production and open the stands for follow-up treatment. Gee Creek Enhancement Committee volunteers and landowners treated Japanese knotweed along more than 1.2 mile of Gee Creek within the largest population of knotweed in the watershed, in cooperation with the City of Ridgefield. The population of knotweed in this stretch of Gee Creek has been reduced by 90% over the last years by concerted partner effort. Native trees and shrubs were planted by volunteers on cooperating small-acreage private lands and City of Ridgefield lands. All areas treated during the project were mapped.

2) Plant and protect 1,760 native plants
The metrics for this activity were exceeded during the project. Community volunteers turned out in record numbers to plant more than 2,551 native ash, willow, red-osier dogwood, Oregon white oak and oak understory shrubs to restore floodplain forest and oak woodland in 2011-2012. Bare root plants were purchased as local native stock from local nurseries and native tree cuttings were taken from Refuge lands. Exceptional outreach and

recruitment efforts by annual AmeriCorps members and the first time addition of hot refreshments and warm waterproof gloves contributed to returning volunteers and a well-attended planting season. As a result of record turnout, volunteer match for the project and the number of trees and shrubs planted have exceeded expectations. Additional volunteer work days were held for repair and maintenance work in plantations, to conduct survival assessments, build and repair beaver fencing and tree cages, and maintain nursery stock.

3) **Form a Weed Management Area steering committee and produce an Integrated Weed Management Plan.**
The metrics for this activity were completed during the project. The Coordinator created and convened 2 annual meetings of the Ridgefield Columbia River Weed Management Area partnership, attended by 7 individuals representing Clark County Weed Management, Washington State Department of Fish and Wildlife, a private waterfowl hunting club –Bachelor Island Conservation Farms (Refuge inholding), and a private farm/forestry family – Plasnewyyd Farms LLC, in addition to the sponsor Friends of Ridgefield NWR and the Ridgefield NWR. Species of interest, control methods, and plans for the field season were discussed over maps of the project area. The coordinator circulated regular communications to members during the spring/summer/fall season to exchange search plans and results, new sightings, control mehtods, site conditions (high or low waters) and other pertinent information. Refuge and other invasive plant fact sheets and maps were shared with members. Summary maps of areas searched and treated by Refuge staff and partners were provided at season's end by the Coordinator. Two annual meetings were held of the knotweed coordination group of the WMA which focuses knotweed control and stream restoration efforts between The City of Ridgefield, Gee Creek Enhancement Committee volunteers, the Refuge, the Friends of Ridgefield NWR, and small acreage private landowners along Gee Creek upstream from the Refuge.

A 27-page Ridgefield Columbia River Floodplain Integrated Weed Management (IWM) Plan was produced in late 2012 by the Coordinator in cooperation with WMA partners. The plan describes the general integrated approaches for weed management within the WMA and describes and documents specific IPM practices used and recommended by local partners for the 22 target species identified in the WMA. Descriptions included best management practices from the Clark County Vegetation Management (noxious weed control) program - an authority in the project area. The plan also provides a list of online and printed references and resources for more detailed information. In addition to sharing the IWM Plan, the Coordinator circulated fact sheets for the 22 target species currently identified in the plan to all partners in the WMA. The coordinator also sent the IWM Plan to volunteer plant hunters and herbicide applicators, and to another WMA in the region – the Southwest Washington Cooperative Weed Management Area.

4) **Recruit and train 300 volunteers for invasive plant survey, plantings and control; create and distribute 2 invasive plant fact sheets.**
The metrics for this activity were well-exceed during the project. Due to successful outreach recruitment and retention efforts, a much larger number of volunteers than predicted came out for project restoration work during the 21-month project. More than 857 volunteer visits were recruited during the project for invasive plant survey, control, and restoration plantings, contributing 3,495 hours. The coordinator planned and held four, half-day trainings for 17 new and returning volunteer invasive plant hunters, trained and licensed 5 new herbicide applicators, and directed more than 80 spray application days. The Coordinator, annual summer field leaders, and annual AmeriCorps members recruited and trained volunteers to pull ricefield bulrush, dig iris, cut indigobush and Scot's broom, plant and protect native trees (including maintenance of beaver fencing) and repair plantings. More than 27,000 ricefield bulrush plants were pulled over two seasons – a major annual program effort on the Refuge.

Two new invasive plant fact sheets (on yellow water iris and ricefield bulrush) were produced and disseminated to weed group partners, volunteers, and the public in 2012. The fact sheets were added to monthly volunteer calendars and posted at Refuge entrance kiosks visited by more than 120,000 visitors annually. The fact sheets are visually-oriented summary sheets designed to introduce the public, especially those unfamiliar with invasive plant species issues, to invasive plants in a simple and direct manner.

Outcomes

- Describe and quantify progress towards achieving the project outcomes described in your grant agreement. (Quantify using the approved metrics referenced in your grant agreement or by using more relevant metrics not included in the application.)

- Briefly explain discrepancies between what actually happened compared to what was anticipated to happen.
- Provide any further information (such as unexpected outcomes) important for understanding project activities and outcome results.

Specific Outcomes Are:

1) **Early detection, rapid response, and increased control of key invasive plant species.**

Early detection, rapid response: Early Detection/Rapid Response (ED/RR) searches, including several miles of shoreline previously unsearched, detected new occurrences for 6 species (discussed in activities above) within the WMA which were immediately treated and contained with 100% control, preventing larger problems and much greater future resource costs. In addition, many new occurrences were documented for other species in known areas of infestation. New species were found on both private, state, and Refuge lands. Cooperating private partners learned about invasive plant searching due to help provided by the Coordinator and other partners. Searches conducted on waterways along the floodplain perimeter and adjoining ownerships documented sources of invasion within and beyond the larger WMA boundaries. Control was initiated on some of these outliers to further expand weed control within the wider floodplain area. Unexpected high floodwaters impeded the search season for wetland species along shoreline areas in 2011, but rescheduled searches as floodwaters withdrew revealed some invasive plant occurrences which had been suppressed by high water and were not easily detected. River searches in 2012 were executed as planned due to more normal high waters. In other areas, high floodwaters stimulated growth and made plants of some species like yellow water iris more visible along the extreme high water line where that number of plants had not yet previously been recorded. Many of these plants were usually obscured within tall grass cover inside the deciduous forest edge bordering wet floodplain pastures. Maps of areas searched are included with this report and illustrate the comprehensive accomplishments of this outcome.

Increased Control: The outcomes of containment and/or 60% reduction for invasive plants in areas treated were as planned. Containment was completed as planned for all 8 original target species and others and significant gains reduced 6 of the 8 target species over the majority of their areal extent. No species has shown a resurgence or increase due to the consistent, increasingly targeted annual control efforts made available by PTI funding. Photopoint comparisons, maps of areas treated, and estimates were used for all target species to measure success. GPS point counts, transects, and plot samples were also used to monitor ricefield bulrush. An approximately 60% reduction of key invasive plants in areas treated was achieved as expected overall, with higher success for some species than others. Ricefield bulrush, the most difficult species, was contained and all seed set prevented by thorough searches, spraying, and pulling of more than 29,000 plants over 2 years. The results of ricefield bulrush seed bank sample transects indicated that seed bank propagules can be depleted by stimulating germination with disk cultivation followed by removal of emerged plants through spraying or hand pulling. Comparing photopoints, fragrant water lily (*Nymphaea odorata*) was reduced from approximately 7 acres to 2-3 acres – a reduction of 66% during the project; Yellow flag iris showed 95-99% kill at patches sprayed, and treatment was applied over 2/3 of the areal extent of the population, reducing the occurrence area by approximately 2/3 (66%). Purple loosestrife was reduced by 98% and 80% in areas treated with count estimates from 40 and 10 plants at two different sites reduced to 1 and 2 plants, respectively, in the second year.

Japanese knotweed was reduced by 90% by comparing photos and visual estimates by Gee Creek Enhancement Committee volunteers in upstream locations within the City of Ridgefield, but only by an estimated 40% by number of occurrences and sizes of plants on the Refuge reach of the creek. Armenian (Himalayan) blackberry (*Rubus armeniacus)* was 90-95% % reduced on areas sprayed comparing photos; Indigobush (*Amorpha fruticosa*) was reduced 90% by spraying, as measured by flagging and observing shrubs treated. Indigobush occurs in small amounts within the interior of the WMA floodplain. English ivy was 99% reduced by hand pulling and cutting at sites treated with volunteer labor on the Refuge. Reed canarygrass (*Phalaris arundinacea*) the most widely established and dominant invasive plant on the floodplain was reduced 80-90% for one year only by spraying at 3 acres of floodplain planting sites. However, the results of spray treatment are short-lived and reduction in this species from overstory shading by tree and shrub canopy will take several ears, assuming successful control of beaver damage to new plants. Other species receiving containment treatment as accessory species as time and resources permitted included slenderflower thistle, milk thistle (*Silybum marianum*), diffuse knapweed, Scot's broom, and poison hemlock.

2) **Restored floodplain wildlife habitat condition and function and reduced invasive plant reinvasion.**
This planned outcome of 60% survival of tree and shrub plantings after 3 years is on track as planned. Establishment survival and annual assessments after the first growing season was used to measure survival success from 2011-2012 plantings under this project. More than 2,550 native trees and shrubs were planted on land previously held by invasive plants (Armenian blackberry and reed canarygrass) towards long- term conversion of these habitats to native deciduous forest. Past plantings have shown 90-95% survival in the first year and 60% long term survival (reduced due to the absence of re-sprouting after beaver use) after 4 years on floodplain sites. Floodplain plantings made for this project indicate a 90-95% survival after one year. Restoration of floodplain cover types will take 10-20 years if tree and shrub canopy can be successfully established. Beaver are prevalent on the Gee Creek floodplain, however, and premature beaver use continues to slow tree canopy establishment. Approximately 60% of trees planted over the past 6 years have shown harvest damage by beaver behind perimeter beaver fences. However, trees planted near the creek bank which have been protected with individual wire cages against beaver have shown 100% protection so far. Beaver damage is the greatest long-term threat to establishing tree and shrub cover on floodplain riparian sites. Future protection will be implemented to reduce premature beaver use on these sites, such as retrofitting perimeter fencing and using more individual tree cages along the many open water shoreline areas travelled by beaver. Oak upland plantings have shown an estimated 90% survival after year 1, no damage from voles, only trace browsing by deer, and no damage from beaver, so survival estimates will be higher on oak sites than on floodplain riparian sites after the planned 3 years.

3) **Expanded weed management partnerships; increased progress on floodplain invasive plant control, and**
4) **Increased communication and information exchange on invasive plant control**
Response was better than expected for the new WMA partnership from neighboring land managers and owners who showed interest and made the time to meet and discuss common issues. Partners have responded very positively, participating in an informal communication network which regularly shares information via email and phone. Although more meetings were anticipated by the Coordinator, a more efficient plan evolved for members to meet once or twice annually and add ad hoc field visits and annual boat searches with partners instead to see project work first hand. These more frequent exchanges initiated by the Coordinator have already benefited the Refuge and partners in the WMA with new information on invasive plant occurrences in the joint floodplain area, new details on control methods, and information on materials used and supply resources. Two private landowners were informed of new loosestrife occurrences on their properties- one rapidly responded with control applications the same season. The second owners permitted boat surveys and control work by the Coordinator to hand pull plants and later took the initiative on their own to treat yellow flag iris once informed of the threat of this second plant on their duck hunting club lands. The son of a private landowner commented that their control efforts on Armenian blackberry were noticeably more successful once they learned through the group about best application timing. The Clark County WMA partner responded positively to boat searches initiated by the Coordinator in 2011, asking to be included in 2012 in order to visit county lands along the search route. A knotweed coordination group made up of a subset of WMA partners within the City of Ridgefield met each spring and continued to help focus control efforts on Gee Creek and keep members informed. These and other indications suggest the WMA approach was having a positive effect by sharing information.

The overall result of the WMA project has been increased awareness and attention to invasive plant search and control within the partnership, stronger working relationships due to increased time spent getting to know each other, new control efforts on partner lands, and all partners learning from each other (including the Coordinator). The creation of the IWM Plan has already shown promise as a tool to facilitate and educate partners, as well as educate volunteer plant hunters, applicators, and other interested parties. The Plan also served as a tool to gather specific control information from partners and will serve as a reference to educate users about weed control planning and IPM methods and weed control planning, a topic often overlooked or explained piece-meal when working with partners, volunteers, or the public. The plan was also shared with another WMA (SW Washington Cooperative WMA) located in the lower Columbia region.

5) **Community volunteers engaged in invasive plant control and habitat restoration; increased public awareness of invasive plants, restoration issues and connections between the community, the Ridgefield Refuge, neighboring floodplain landowners, and the Columbia River.**
An extensive volunteer outreach machine built over the past several years was further updated with new tools in 2011 and 2012 and continues to effectively disseminate information and recruit for volunteer events within the

local metro community. Volunteer turnout for one tree planting season and two invasive plant control seasons during the project set records for annual volunteer hours over the past 6 years since the Coordinator began work on the refuge. Record numbers came out for restoration plantings including more than 80 people on MLK day in early 2012. New outreach includes updating more than 600 past volunteers with a monthly email calendar, posting events on new volunteer web sites such as Hands-On –Portland, Volunteer Match, a local Ridgefield area Blog and other internet sites where users looking for volunteer service can access opportunities at the last minute before a weekend event via internet and portable technologies.

Many volunteers also returned within each season which spoke well for retention efforts including the use of new gloves, boots, new refreshments (including bagels and hot drinks during cold and rainy winter plantings), and volunteer appreciation events (a barbeque and winter dinner) held by the Refuge twice a year. At each volunteer work day, a briefing explains the restoration issues and goals for the day and staff provides more details on the ecology of the site and why restoration work is taking place. Conversations also occur while working or during the refreshment/refueling break in mid-morning. Volunteers can visit areas normally closed to the public while working, and receive hands-on learning in wildlife conservation, habitat restoration, and invasive species while working in the memorable and influential setting of the Refuge. Outreach included seasonal mailings of spring and fall/winter schedules to area schools, colleges, and universities. More than 35% of volunteer participants annually were students under the age of 18, and increasingly included middle school, high school, and college students seeking to complete community service or senior projects. Nearly all of this outreach is coordinated by seasonal field leaders - a half-time annual AmeriCorps member for plantings and a seasonal invasive plant field coordinator (paid through other funding contributions) for summer work, both of whom are directed by the project Coordinator, leveraging additional project support and benefits.

Volunteer plant hunters and licensed applicators continued to maintain their numbers and these individuals were educated in greater depth during two annual plant search field trainings and two annual Washington pesticide applicator recertification trainings. Three applicators made up the core of the effort and were supplemented in 2011 by two new applicators and in 2012 by 2 seasonal staff with applicator licenses. In 2012, two new candidates expressed interest in becoming applicators. More outreach is planned to continue recruitment into these specialized volunteer positions.

3. Lessons Learned

Describe the key lessons learned from this project, such as the least and most effective conservation practices or notable aspects of the project's methods, monitoring, or results. How could other conservation organizations adapt their projects to build upon some of these key lessons about what worked best and what did not?

Lessons learned are summarized by project Activity:

- **Invasive Plant Survey (Early Detection/Rapid Response – ED/RR)**

  ED/RR within the WMA has proven, as expected, to be one of the most effective conservation practices. During the 21 month project, surveys detected and treated new locations for 10 invasive plant species – 3 of these were new to the WMA and several occurrences found were of single plants such as purple loosestrife and Japanese knotweed. Detecting the first individual plants to enter an area is the ultimate in ED/RR and underscores the importance of repeating surveys annually, even if it may seem the area was recently searched. Surveys also discovered many new locations for species already known to be in the WMA such as yellow flag iris, in part due to extreme water levels in 2011 which stimulated plants to emerge more fully where they could be easily seen. Surveys in areas difficult to access (canoe only) found new occurrences of slender-flower thistle widely disjunct from other know occurrences in the WMA and detected the first occurrence of shiny geranium - a Washington Class A noxious weed. Future projects will redirect even more emphasis on ED/RR to most effectively prevent and contain non-native plant invasions.

- **Invasive Plant Control**

  Significant reduction of target invasive plants within the WMA was achieved as anticipated, especially including some private lands which had not received attention until the WMA approach was implemented. For two plant

species, ricefield bulrush and reed canarygrass, goals during the project were simply to contain and work towards long-term reduction. For Ricefield bulrush, no seed set was allowed through proven annual spraying and determined hand pulling programs. Progress was made in reducing the bulrush population by disking three locations once each during the two years of the project to flush out the seedbank. The seedbank response on the first two sites confirmed that this approach would stimulate propagules to germinate from the seedbank, where the plants could be treated or removed. However, based on seedbank depletion in agriculture, it will take at least 5 years of seedbank depletion to demonstrate significant depletion of the seedbank so the 2 seasons of work on bulrush for this project work are part of a longer-term strategy. For reed canarygrass, although spraying of planting sites reduced the grass for one season, it quickly returned from root fragments and seed. Long term reduction will be dependent on establishing shrub and tree canopy cover to shade and thin grass cover. However, establishing canopy cover will need more effective beaver protection than the original perimeter fencing design which after 6 years has not performed to expectations. See the Restoration Plantings lessons learned section below for more on beaver fencing.

- **Restoration Plantings**

Restoration plantings on the Refuge (for this project) and on other lands within the WMA have been very successful at establishing plants for the first 1-2 years in riparian areas and on oak woodland buffer uplands from cuttings and bareroot stock. Protection from girdling by field voles has been nearly 100%, using 36" solid and some mesh tree tubes. Once established, growth rates on the floodplain are phenomenal for willow and ash on floodplain sites and appear unimpeded by un-mowed surrounding reed canarygrass cover, with the pacific willow growth reaching 6" in diameter and nearly 20' tall in just 5 years. Protecting the trees in the long run from beaver, however, continues to remain a challenge. The floodplain sites on the Refuge along Gee Creek have many waterways and bodies of water which provide access to plantings from all sides by beaver. In 2011, exceptionally high spring freshet floodwaters along the Columbia River allowed beaver to swim into portions of plantation sites formerly less accessible. As a result, many trees which had reached 4 years old and small tree stature were cut back to shrub height. Although known as vigorous re-sprouters which reinforced the choice of willow for plantings in beaver habitat, a significant portion (estimated at 20-40% in some locations) of the willows did not re-sprout, possibly due to the time of year they were taken (in summer drought) or due to complete submersion of the cut stumps by seasonal floodwaters. Individual beaver cages (cylinders of wire fencing 16" diameter X 48"tall) are proving nearly 100% effective but are more costly and create some aesthetic and removal concerns. As a post-award project, final trials and design retrofitting of perimeter beaver fence is underway and an experiment with a large-scale planting of individual cages should confirm the best options (of a very limited range of options) for future protection of plantings from premature use by beaver.

Experiments have been initiated to retrofit the partial perimeter fences, and completely encircle a site with perimeter fence in order to test the real cost and long-term potential of this approach. Individual tree cages, especially along creek banks and shorelines favored by beaver, are proving effective but implementation of this method to large plantings has only just been initiated with a recent post-project planting of 1400 trees - all with individual cages - along Gee Creek where beaver activity is very high.

- **WMA Committee and IWM Plan**

Formation of the WMA has been a success. Participants have responded postitively and participated willingly and sought advice from partners through meetings, email exchanges and combined field search outings. Fewer meetings seemed to be preferred by partners, not unexpected from busy land managers – but regular email info or phone calls were readily used to share specific information. Without funds for a Coordinator to facilitate the WMA and serve as a clearing house for information, the WMA would not continue at the same level reached through purposeful outreach and exchanges. Comments from land managers and private landowners indicate a positive interest and response to more information on invasive plant work and mentoring by the Coordinator. Without funding to continue the Coordinator role in coordinating members within the WMA, the effort would likely not continue, lacking a catalyst figure to take the initiative. This has also proven true in the project area with the volunteer Gee Creek Enhancement Committee, also directed by the Coordinator. Three new potential WMA Partners have already been identified and recommended by current partners, indicating the potential to expand the WMA approach.

Production of the IWM plan proved much more useful even than expected, requiring the Coordinator to organize, collect and articulate strategies and methods in writing – an excellent exercise which was educational and also filled information gaps. Besides circulating the Plan to WMA partners, the Plan has already been useful as an educational tool for training volunteer plant hunters and applicators, and besides best practices, outlines our overall strategies and goals for the invasive plant control program within the WMA.

- Volunteer Engagement and Outreach/Education

  Volunteer recruitment and response have been very successful for work on and off the Refuge within the WMA. Regular Refuge volunteer plant hunters and applicators also showed interest in helping conduct surveys or control work on partner (especially private) lands. The good volunteer turnout during the project was due to consistent outreach efforts led by an AmeriCorps member for plantings and a seasonal Invasive Plant Field Coordinator for ricefield bulrush work – both supported by other contributions but supervised and directed by the Coordinator using NFWF funds. The Volunteer program at the Refuge continued to build and strengthen during the project, employing new internet sites and adapting communications to reach a wider range of potential volunteers. Success has been cumulative built but does require designated time of at least 15-20% FTE. As mentioned earlier, volunteer retention has been improved by the addition of simple pleasures for hardworking volunteers such as warm gloves and hot drinks during rainy winter months and snacks and cold drinks during summer work. These were also added to remain competitive with other volunteer restoration venues in the metro area.

4. Dissemination
Briefly identify any dissemination of lessons learned or other project results to external audiences, such as the public or other conservation organizations.

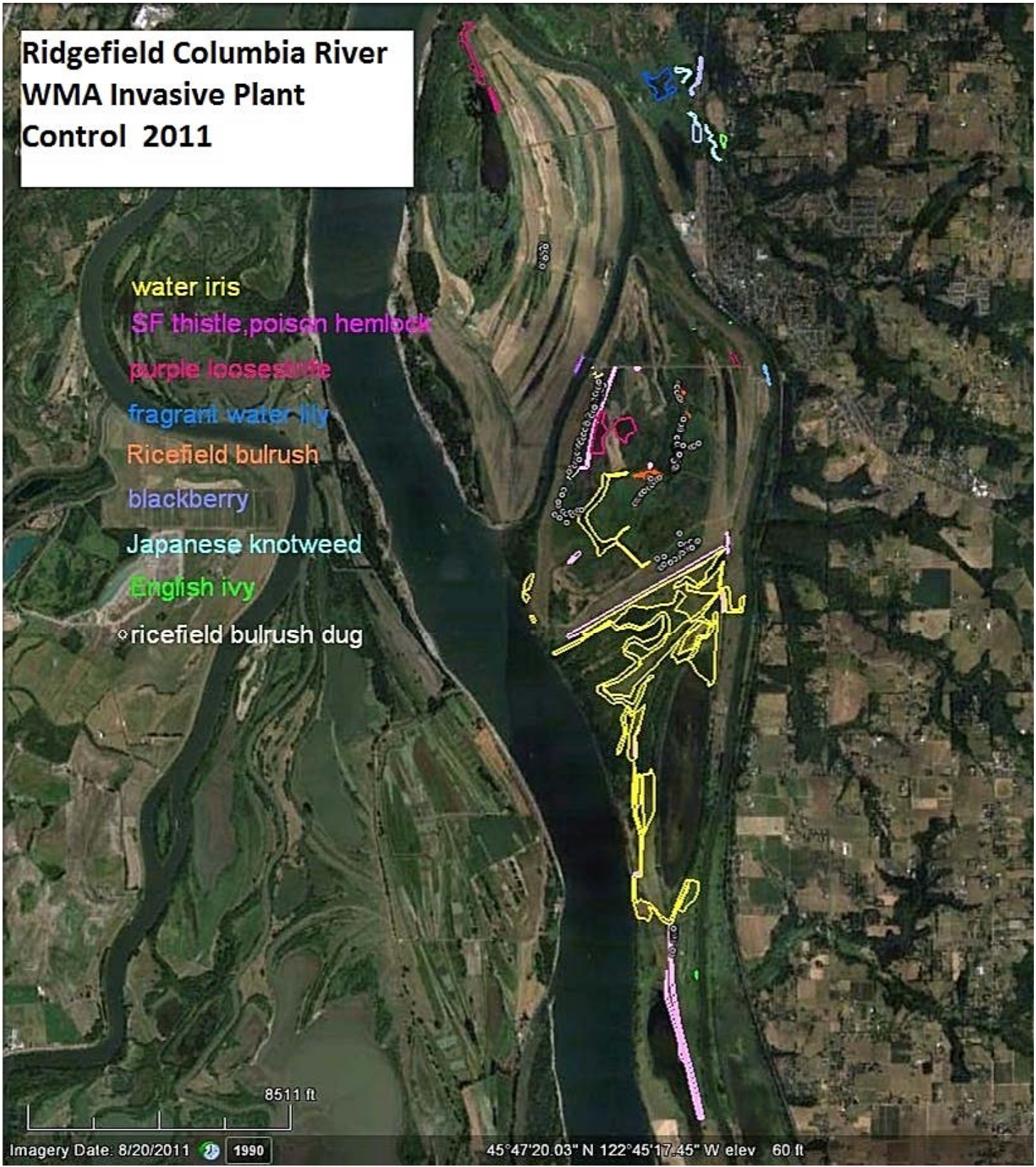
Information on restoration events, goals and practices and the 2 invasive plant fact sheets produced for the project were shared with partners in the WMA, with other agency practitioners, and with public community volunteers (including many middle, high school, and college students) during volunteer crew event days and a volunteer email calendar sent out monthly to more than 600 email addresses. Event schedule flyers and invasive plant fact sheets were also posted for the public on the Refuge and Friends websites, and at the two visitor access payment kiosks on the Refuge (including the popular 4-mile auto tour route loop) which collectively receive more than 120,000 volunteer visits each year.

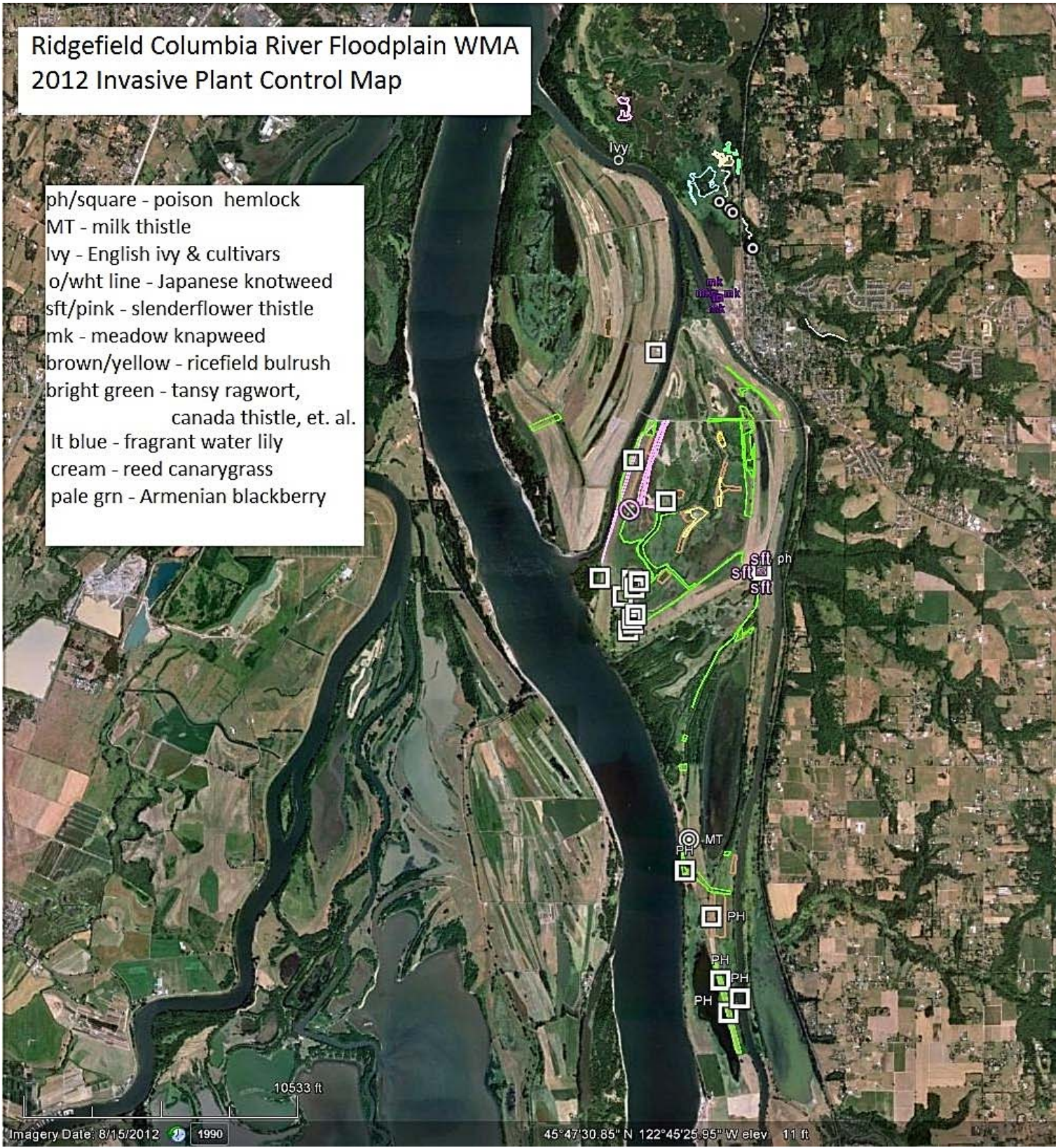
The Coordinator also began networking with other WMA's in the region during the project, sharing the IWM Plan with the Southwest Washington Cooperative WMA and the Columbia River Gorge CWMA.

5. Project Documents
Include in your final programmatic report, via the Uploads section of this task, the following:

- 2-10 representative photos from the project. Photos need to have a minimum resolution of 300 dpi and must be accompanied with a legend or caption describing the file name and content of the photos;
- report publications, GIS data, brochures, videos, outreach tools, press releases, media coverage;
- any project deliverables per the terms of your grant agreement.

POSTING OF FINAL REPORT: *This report and attached project documents may be shared by the Foundation and any Funding Source for the Project via their respective websites. In the event that the Recipient intends to claim that its final report or project documents contains material that does not have to be posted on such websites because it is protected from disclosure by statutory or regulatory provisions, the Recipient shall clearly mark all such potentially protected materials as "PROTECTED" and provide an explanation and complete citation to the statutory or regulatory source for such protection.*


Ridgefield Columbia River WMA Invasive Plant Control 2011
water iris
SF thistle,poison hemlock
purple loosestrife
fragrant water lily
Ricefield bulrush
blackberry
Japanese knotweed
English ivy
ricefield bulrush dug
8511 ft
Imagery Date: 8/20/2011
1990
45°47'20.03" N 122°45'17.45" W elev 60 ft


Ridgefield Columbia River Floodplain WMA
2012 Invasive Plant Control Map
ph/square - poison hemlock
MT - milk thistle
Ivy - English ivy & cultivars
o/wht line - Japanese knotweed
sft/pink - slenderflower thistle
mk - meadow knapweed
brown/yellow - ricefield bulrush
bright green - tansy ragwort,
canada thistle, et. al.
lt blue - fragrant water lily
cream - reed canarygrass
pale grn - Armenian blackberry
Ivy
mk
sft
ph
MT
PH
10533 ft
Imagery Date: 8/15/2012
1990
45°47'30.85" N 122°45'25.95" W elev 11 ft

VOLUNTEERS WANTED

RIDGEFIELD NATIONAL WILDLIFE REFUGE

Join us for volunteer work days in the wild and beautiful setting of the Refuge. Registration is encouraged but not required. Contact staff at 360-887-3883 or lynn_cornelius@fws.gov Special days may also be arranged for groups. All work days are from 9 am to 12:30 pm rain or shine. Wear waterproof footwear, bring gloves, and dress for the weather. Light refreshments will be provided.

HABITAT RESTORATION SCHEDULE FALL/WINTER 2011-2012

Date	Day	Activity	Meeting Place	Field Site
Oct 22	Sat	Shrub planting/site prep (oak site)	Carty Unit	Duck Lk
Nov 12	Sat	Shrub planting (oak site)	Carty Unit	Duck Lk
Nov 16	Wed	Tree caging	River S Unit	Bower Slough
Dec 7	Wed	Tree caging	River S Unit	Bower Slough
Dec 10	Sat	Tree planting	Carty Unit	Duck/Mid Lk
Jan 16	Mon	Tree planting	Carty Unit	Middle Lk
Jan 21	Sat	Tree planting	Carty Unit	Middle Lk
Jan 25	Wed	Invasives removal	River S Unit	Ivy Trees
Feb 4	Sat	Tree planting	Carty Unit	S plantation
Feb 8	Wed	Tree Planting Repair	Carty Unit	Oak/riparian
Feb 18	Sat	Tree Planting	River S Unit	Roth
Feb 22	Wed	Tree Planting Repair	Carty Unit	S plantation
Feb 25	Sat	Tree planting	Pierce Refuge	Hardy Ck
Mar 3	Sat	Tree planting	River S Unit	Roth
Mar 7	Wed	Tree Planting Repair	Carty Unit	Oaks-Wetland
Mar 17	Sat	Tree planting	Carty Unit	Middle Lk
Apr 4	Wed	Tree Planting Assess/Repair	Carty Unit	S plantation N
Apr 18	Wed	Planting Repair/Inv. Removal	River S. Unit	Roth/Dbl Dike

DIRECTIONS: Carty Unit: Exit 14 off I-5, west about 3 miles to stop light in downtown Ridgefield, right for one mile on Main to Carty Unit Entrance - lower parking lot. **River S Unit**: Exit 14 off I-5, west about 2.5 miles, left on Hillhurst (9th) Ave for ¾ mille to entrance gate on right, downhill and over wooden bridge to visitor kiosk. **Pierce Refuge: Meet at Rest Area at base of** Beacon Rock on Hwy 14 at Milepost 35, 35 miles E. of Vancouver to convoy to the Refuge 1 mile nearby. All volunteers must sign a volunteer services agreement (if under 18 signed by parent/guardian) which can be found at:

http://www.fws.gov/ridgefieldrefuges/ridgefield/getinvolved.html

For more info visit: Friends of the Ridgefield National Wildlife Refuge

Restoration projects are funded in part by grants from the National Fish and Wildlife Foundation.

Volunteers Wanted

Spring/Summer at Ridgefield National Wildlife Refuge

Wednesdays and Saturdays, April – September 2012

We will primarily be removing Ricefield Bulrush, and occasionally other invasive species. Ricefield bulrush is an invasive plant that is threatening the health of NW wetlands by pushing out native plants that wildlife need for food and cover. Due to volunteer efforts, ricefield bulrush on the refuge has reduced and has not been found anywhere else in the Pacific Northwest. Come out to the refuge and explore, meet good people, and do great things.

Wednesdays; 9AM - 12:30PM

June - 23, 30
July - 7, 14, 21, 28
August - 4, 11, 18, 25
September - 1

Saturdays; 9AM-12:30PM

April – 18 (Tree planting repair/ invasive removal
May – (Yellow flag iris removal)
June - 20, 27
July - 11, 18, 25
August - 1, 8, 15, 22, 29

All work days are from 9AM – 12:30PM; Rain or shine. Wear waterproof shoes and dress for the weather. Meet by the visitor kiosk in the River 'S' Unit. Gloves, snacks, and drinks will be provided to keep you fueled up and restoration ready. **Registration encouraged, but not required**. To register for an event or for more information contact Lynn Cornelius at lynn_cornelius@fws.gov or call (360) 887-3883.

Directions to River 'S' Unit: Take exit 14 off I-5 and head west about 2.5 miles. Turn left onto Hillhurst (9th) Ave, and continue for ¾ mile. Entrance will be on right, drive downhill and cross wooden bridge. The visitor kiosk is straight ahead.

Friends of Ridgefield NWR

Restoration projects are sponsored by the U.S. Fish and Wildlife Service, the Friends of Ridgefield National Wildlife Refuge, AmeriCorps Washington, and are funded in part by grants from the National Fish and Wildlife Foundation

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

Department of the Interior
U.S. Fish & Wildlife Service
Ridgefield National Wildlife Refuge
28908 N. Main Avenue
Ridgefield WA, 98642
Phone: 360/887-4106
Fax: 360-887-4109
http://ridgefieldrefuges.fws.gov

News Release

Date: **10/12/2011 For Immediate Release**
Contact: **Sarah Hill**
(360) 887-3883
Sarah_Hill@fws.gov

Volunteers Needed for Wildlife Habitat Restoration

What: Fall and winter habitat restoration events are starting at the Ridgefield National Wildlife Refuge and we need volunteers. Join us in our efforts to improve stream health and create wildlife habitat by planting native trees and shrubs, removing invasive species and maintaining our plantation sites. Our first kick-off event is **Saturday, Oct. 22**, where we will be planting native shrubs. Please wear waterproof footwear and appropriate clothing for fall/winter weather. Hot drinks and light refreshments will be provided.

This event is sponsored by the Friends of Ridgefield National Wildlife Refuge and the U.S. Fish and Wildlife Service. Restoration projects are funded in part by grants from the National Fish and Wildlife Foundation.

No experience necessary, just enthusiasm to restore wildlife habitat and protect our environment! All ages welcome. Everyone must sign a volunteer service agreement (available the day of the event, or online at http://www.fws.gov/ridgefieldrefuges/ridgefield/getinvolved.html); volunteers under 18 years of age must have their parents sign.

Where & When: All work days are from 9 am to 12:30 pm.

Meet at the Carty Unit kiosk of the Ridgefield National Wildlife Refuge for: Shrub/Tree Plantings: **Oct 22, Nov 12, Dec 10, Jan 16, 21, Feb 4, March 17**. Tree Plantation Repair: **Feb 8, Feb 22, March 7, April 4.** Directions: From exit 14 off I-5, head west on Pioneer St. /SR501 for about 3 miles to stop light in downtown Ridgefield, turn right and go 1 mile on Main to Refuge Carty Unit entrance on left.

Meet at the River 'S' Unit kiosk of the Refuge for Tree caging: **Nov 16, Dec 7**. Tree Planting: **Feb 18, March 3.** Invasive Species Removal: **Jan 25, April 18.** Directions: From exit 14 off I-5, head west on Pioneer St. /SR501 for 3 miles toward downtown Ridgefield. At the beginning of town, turn left onto 9th Ave/Hillhurst. The refuge entrance gate is about .7 miles ahead on the right. Follow the gravel road over the wooden bridge. Stop at the visitor kiosk.

Special Tree Planting at Pierce Refuge: **Feb 25.** Meet at rest area at base of Beacon Rock on Hwy 14 at Milepost 35, 35 miles E. of Vancouver to convoy to refuge 1 mile nearby.

News Release

Department of the Interior
U.S. Fish & Wildlife Service
Ridgefield National Wildlife Refuge
28908 N. Main Avenue
Ridgefield WA, 98642
Phone: (360) 887-4106
Fax: (360) 887-4109
http://ridgefieldrefuges.fws.gov

Date: 7/19/2012 **For Immediate Release**
Contact: **Tera Hinkley** **(360) 887-3883** **Tera_Hinkley@fws.gov**

A Weed Pulling Good Time at Ridgefield National Wildlife Refuge

What: The summer invasive plant control program is in full swing out at the Ridgefield National Wildlife Refuge. Volunteers have been searching for and removing slender flower thistle, scotch broom, yellow flag iris, as well as the noxious ricefield bulrush (*Scirpus mucronatus*). Ricefield bulrush is an invasive wetland plant that competes with native plants that wildlife need for food and cover. Ridgefield National Wildlife Refuge is the only known Northwest location of this highly invasive species, so its removal is of top priority. Since beginning the season in June, we have removed over 5,600 plants from 6 different wetlands. Summer is not over yet, we still need help to search all of the wetlands on the River 'S' Unit to ensure we are removing every sign of ricefield bulrush.

A diverse volunteer base has made it out for our summer restoration events including Girl Scouts, Boy Scouts, Master Hunters, retired folks, employees from local businesses, families, students of all ages, and those who simply enjoy nature. We have had many high school students use these events as a way to get a jump start on their senior project and community service hours for the upcoming school year. This is a great opportunity to get up close and personal with the refuge and to visit areas not open to the public. Volunteers can spend the morning restoring habitat and then afterwards drive the auto tour route and hike the Kiwa trail. This is a great way to spend a summer day!

Perks of joining us for our bulrush removal events are:

- Exploring areas of the refuge not accessible to visitors
- Learning more about wetland ecosystems and wetland plant identification
- Excellent wildlife viewing opportunities
- Snacks, drinks, and good company
- Making a positive impact on the lives of wetland plants and animals.

All ages welcome and no experience is necessary. Volunteers are required to sign a volunteer service agreement (VSA) which is available the day of the event or online (http://www.fws.gov/ridgefieldrefuges/ridgefield/getinvolved.html). Volunteers under age 18 will need a parent or guardian signature on their VSA. Volunteers should bring rubber boots if they have them. Tools for the event will be provided. Contact Tera Hinkley at Tera_Hinkley@fws.gov for more information or to pre-register for an event.

Where: Meet at the River 'S' Unit Visitor's Kiosk, 1071 S. Hillhurst Rd, Ridgefield, WA 98642
Directions: From I-5 take exit 14, head west on Pioneer St/SR501 for 2.5 miles toward downtown Ridgefield. Turn left onto 9th Ave/Hillhurst & head up the hill for ¾ mille, entrance gate on right. Travel down the gravel hill and over the wooden bridge to visitor's kiosk.

When: All work days are from 9 am to 12:30 pm, every Wednesday and Saturday through September 1st.
July: 21, 25, 28 August: 1, 4, 8, 11, 22, 25, 29 September: 1

*Habitat restoration projects are funded in part by a grant from the National Fish and Wildlife Foundation.

The U.S. Fish and Wildlife Service is the principal Federal agency responsible for conserving, protecting and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people. The Service manages the 95-million-acre National Wildlife Refuge System, which encompasses 542 national wildlife refuges, thousands of small wetlands and other special management areas. It also operates 70 national fish hatcheries, 64 fishery resource offices and 81 ecological services field stations. The agency enforces Federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies.

Department of the Interior
U.S. Fish & Wildlife Service
Ridgefield National Wildlife Refuge
28908 N.W. Main Avenue
Ridgefield WA, 98642
Phone: (360) 887-4106
Fax: (360) 887-4109
http://www.fws.gov/ridgefieldrefuges/ridgefield/

News Release

Date: **7/21/2010**
Contact: **Tera Hinkley**
(360) 887-3883
Tera_Hinkley@FWS.gov

Volunteers Needed for Wetland Restoration

What: Join us in our efforts to improve wildlife habitat by finding and removing invasive plant species from the Refuge. Ricefield bulrush (*Schoenoplectus mucronatus*) is an invasive Eurasian wetland plant that is threatening the health of Refuge wetlands by pushing out native plants that wildlife need for food and cover. Due in part to volunteer efforts, ricefield bulrush is currently contained to the Refuge and has not been recorded elsewhere in the Pacific Northwest. Preventing the escape of this noxious weed into our local ecosystems is a top priority. During our events, we may also cut or dig other wetland invasives such as yellow flag iris. This is a great opportunity to see areas of the Refuge normally off limits to the visiting public. Please wear water proof footwear (rubber boots preferred) and dress for the weather. Long pants are strongly recommended as well as sun protection. This event is sponsored by the Friends of Ridgefield National Wildlife Refuge and the U.S. Fish and Wildlife Service. Restoration projects are funded in part by a grant from the National Fish and Wildlife Foundation.

No experience necessary, just enthusiasm to restore wildlife habitat and protect our environment! All ages welcome. People under 18 years of age must have parents sign their volunteer service agreement (available the day of the event, or online at http://www.fws.gov/ridgefieldrefuges/ridgefield/getinvolved.html).

Where: Meet at the River 'S' Unit kiosk of the Ridgefield National Wildlife Refuge. Directions: From I-5, take exit 14, head west on Pioneer St/SR501 for 3 miles toward downtown Ridgefield. At the beginning of town, turn left up the hill onto 9th Ave/Hillhurst. The refuge entrance gate is a 0.7 miles at the top of the hill on the right. Follow the gravel road down the hill and over the wooden bridge. We will meet at the visitor kiosk.

When: Beginning June 22, 2011 work parties meet every Wednesday and Saturday until August 31, 2011 from 9 am to 12:30 pm.

The U.S. Fish and Wildlife Service is the principal Federal agency responsible for conserving, protecting and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people. The Service manages the 95-million-acre National Wildlife Refuge System which encompasses 542 national wildlife refuges, thousands of small wetlands and other special management areas. It also operates 70 national fish hatcheries, 64 fishery resource offices and 81 ecological services field stations. The agency enforces Federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state fish and wildlife agencies.

June 2011 Habitat Restoration Email Calendar Sent to Volunteer Email Contact List.

May was a very productive month fighting against the yellow-flag iris on the refuge. We will continue our invasive plant projects throughout the rest of summer. The ricefield bulrush project is starting June 22 and will continue every Wednesday and Saturday until August 31.

Ricefield bulrush (*Schoenoplectus mucronatus*) is an invasive Eurasian plant that is threatening the health of Refuge wetlands by pushing out native plants that wildlife need for food and cover. Due in part to volunteer efforts, ricefield bulrush is currently contained to the Refuge and has not been recorded elsewhere in the Pacific Northwest. Preventing the escape of this noxious weed into local ecosystems is a top priority. We may also cut or dig other wetland invasives such as yellow flag iris if we don't find as much bulrush as expected. Please wear rubber boots and dress for the weather. Long pants are strongly recommended as well as sun protection.

Night Hike events are occurring this summer during full moons on the Carty Unit once a month. May's event was very exciting, several bats and a Great Horned Owl with owlet were spotted. Contact Jill for more information or visit the Night Hike Flyer.

Visit our habitat restoration website for more information on future dates or our Spring/Summer Flyer.

Events for June:

June

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4 Invasive Species Removal, 9 am – 12:30 pm, Meet @ River "S" Unit Kiosk
5	6	7	8	9	10	11
12	13	14	15 Night Hike-8:30 pm Meet @ Carty Unit. Pre-register w/Jill Peoples	16	17	18
19	20	21	22 Ricefield Bulrush Removal, 9 am – 12:30 pm, Meet @ River "S" Unit Kiosk	23	24	25 Ricefield Bulrush Removal, 9 am – 12:30 pm, Meet @ River "S" Unit Kiosk
26	27	28	29 Ricefield Bulrush Removal, 9 am – 12:30 pm, Meet @ River "S" Unit Kiosk	30		

River S Unit Kiosk Directions: Ridgefield NWR, Ridgefield, WA 98642. Off S Hillhurst Rd. for ¾ mile. Refuge sign will be on right at the top of the hill. Follow the road down and park at the beginning of the auto tour route, across the bridge.
Contact for more information: Jill Peoples, (360) 887-3883, Jill_Peoples@fws.gov
Website: http://www.fws.gov/ridgefieldrefuges/ridgefield/getinvolved.html
Friends of Ridgefield NWR: http://www.ridgefieldfriends.org/index.php

Restoration projects are funded in part by a grant from the National Fish and Wildlife Foundation.

Please respond to this email with "unsubscribe" in the subject line if you don't want to be on this list.

Ricefield Bulrush - *Shoenoplectus (Scirpus) mucronatus*- Eradication
2011 Final Report

May 2, 2012 Lynn Cornelius
(Includes Bulrush Control Seasonal Field Coordinator Report 2011, Tera Hinkley)

Funded in part by a grant from the National Fish and Wildlife Foundation

This report summarizes ricefield bulrush (bulrush) control work on the Ridgefield National Wildlife Refuge in 2011. The report consists of this summary by the Habitat Restoration Coordinator, and the Bulrush Control Seasonal Field Coordinator Report 2011 by Tera Hinkley. Background information and field data is contained in the bulrush 2011 electronic file and Bulrush binder.

PROJECT SUMMARY

Maps 1-3 compile all historic mapped locations of ricefield bulrush at Ridgefield NWR, describing all known current and past locations where bulrush has occurred. These maps are used to insure comprehensive search and control work annually at past locations.

Survey and Control

All bulrush occurrences on the 8 wetlands found to contain ricefield bulrush were sprayed and/or hand pulled in 2011

Searching and Hand Removal: The seasonal Bulrush Field Coordinator led volunteer crews on foot in field searches and hand removal. All past and potential habitats on the River S, Bachelor Is., and Ridgeport Dairy units were searched and plants found were pulled or dug, repeating existing control protocols from 2007-2010. The coordinator, staff and trained volunteers also searched by ATV. Details of hand pulling and searching are summarized in the attached Bulrush Control Seasonal Field Coordinator Report 2011 by Tera Hinkley. The Season Comparison table from the Hinkley report is reproduced below. Comparatively little hand pulling was done in 2011 at wetland #6 and Canvasback as these were again the subject of a comprehensive spraying and disking treatment initiated in 2010. All work in 2011 was impeded due to high ground water levels and delays in draining wetlands due to the effects of prolonged high Columbia River levels 8 weeks (over 12' elevation) during annual snowmelt floodwaters in May and June.

Six (6) plants were re-discovered in South Big wetland which had been disked by Refuge staff in late summer 2010 as part of reed canary-grass control protocols. No plants had been reported from South Big since 2007. Eighty-three (83) plants were also re-discovered in Middle Lake (River S) wetland in front of hunt blind 13a following scraping of this site in late 2010 by heavy equipment to deepen the wetland. No plants had been reported here since 2004.

No plants were found in Rest Lake in 2011, following the discovery and removal of one very large plant along the south shoreline in 2010.

The numbers of plants pulled in Ruddy wetland in 2011 continued higher as in 2010 compared to relatively lower numbers during 2008 and 2009.

Season Comparison of Bulrush Hand Pulling counts, Ridgefield NWR

Legend
? = Plants found, unknown quantity
Blank = No Data
***** = Applied Herbicide

WETLAND	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
#6	?	?	810	2,956*	22,318*	13,280	26,304	1,113*	207*	3,047*
TEM	0	5,296	19,195	553*	13,680*	16,581	8,842	120*	20	390
PIM	0	492	7,383	656*	37*	389	909	56*	61	173
RUL	350	10,948	16,001	3,994	490	6,934	963	247	5,268	3,400*
SWL	1,016	2,246	366	2,173	2,983	62	88	22	0	0
CAN	1,700	2,863	370	1,165*	26,914	4,806	4,005	12,891*	427*	4,549*
FIN	0	106	0	0	0	0	0	0	1,974*	1,650
#11	?	?	5	0	0	0	0	0	187	284
REL	0	0			0		0	0	1	0
SOR	300	268	18	19	8	8	17	8	1	0
SBL	205	109	71	45	0	2	0	0	0	6
NQL	580	647	294	34	18	0	0	0	0	0
TRE-S	139	69		41	6	0	0	0	0	0
SOL	137	357	58	37	1	0	0	0	0	0
SQL	?	0		17	0	0	0	0	0	0
NMA	0	0		14	0	0	0	0	0	0
HOR	4	9		1	0	0	0	0	0	0
HAL	7	24	3	1	0	0	0	0	0	0
DPL	12	129		1	0	0	0	0	0	0
SEL	13	1	3	0	0	0	0	0	0	0
WEL	14	6		0	0	0	0	0	0	0
NEL	5	2		0	0	0	0	0	0	0
TRE-N	0	0	18	0	0	0	0	0	0	0
BUL	?	0		0	0	0	0	0	0	0
MIL	0	1		0	0	0	0	0	0	0
MID	248	22	10	0	0	0	0	0	0	83
#002	0	11		0	0	0	0	0	0	0
013-S	0	10		0	0	0	0	0	0	0
013-E	0	2		0	0	0	0	0	0	0
013-W	0	4		0	0	0	0	0	0	0
#006	0	24		0	0	0	0	0	0	0
SPP-S	0	0	373		0		0	0	0	0
SPP-N	0	5		0	0	0	0	0	0	0

Total Plants (including test plots)	5,028	23,934	44,978	11,866	68,962	42,245	41,295	14,496	8,152	13,582
Infested Wetlands	18	27		16	10	8	7	7	9	9
Wetlands Sprayed				4	3	0	0	3	3	3

Volunteer plant hunters (including the canine search team), the AmeriCorps member, and the Coordinator also searched wider areas on the refuge for all target invasive plant species, including bulrush. No new locations were noted. No canoe search was conducted along shorelines of the lower reaches of Bachelor Slough and Lake River in 2011. These areas were searched by canoe on September 2, 2010.

Spray Treatment:
Following a spray and disk plan initiated in early 2010, the Coordinator, AmeriCorps member, and volunteer applicators sprayed all areas of Canvasback and Wetland #6 on the River S Unit again when bulrush was largely emerged in early July, 2011. A third wetland – Ruddy, was sprayed in late summer (after hand pulling) along the west margin of the wetland following a resurgence of plants 2010 and 2011, possibly related to increased water levels and duration.

Wetland	**Spray Dates, 2011**	**Habitat Acres Treated**
#6, River S	7/7/11, 7/14/11, 7/20/11, 7/22/11, 8/4/11,	Entire wetland area as planted in 1999 2.0 ac with aquatic glyphosate (E ½ portion of wetland) and Imazapyr (west ½ of wetland)
Canvasback River S	7/20/11,7/22/11, 7/28/11 7/29/11, 9/6/11,	Entire wetland area as planted in 1999. 7 ac with aquatic glyphosate and Imazapyr/glyphosate mix except for strip along the east edge of narrow portion – glyphosate only
Ruddy	8/23/11	Western edge sprayed. 4 ac.
Application details are recorded on WSDA Pesticide Applicator Records for each date on file at Ridgefield NWR.		

Monitoring

General locations or groupings of bulrush pulled were marked by GPS following existing protocols. An overview map with locations of GPS points for 2010 follows. Detailed maps by wetland are in the Field Coordinator report for 2011.

Circular Test Plots were re-sampled in 2011, including 3 newer circular Spray Test Plots established at Teal marsh in 2010.

Circular Test Plots: Forty-nine (49), 1.5m circular test plots were originally established on 8 seeded wetlands in 2002. Plot centers were marked with 4-5' tall ¾" white PVC pipe placed over steel rebar. All test plot stakes were relocated in 2011 except for 1 test plot stake at Pintail which has been missing for the last few years and was not relocated again in 2011. All test plots for bulrush were re-sampled by the Field Coordinator in 2011 by counting and pulling plants found within a 1.5 m radius of each plot stake. (In some places this radius is given as 2.5 m)

Comparisons of bulrush circular test plot counts are given in the table below.

Bulrush Circular Test Plot Counts (Established 2002)

WETLAND	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
#6	1295	2763		61	2282	171	150	21	1	288
#11	38	6		0	0	0	0	0	0	0
CAN	382	422		11	4	5	11	1	0	18
PIM	231	126		12	37	1	3	0	0	0
RUL	356	703		1	0	1	0	0	0	0
SWL	114	45		3	0	0	0	0	0	0
TEM	298	283		71	184	5	3	17	1	0
Total	**2714**	**4348**		**159**	**2507**	**183**	**167**	**39**	**2**	**306**

Bulrush Sample Transects 2010: Two new sample transects to monitor bulrush density in response to spray/disk treatments established and sampled on July 12, 2010 were resampled on July 6, 2011 before site spraying and hand pulling. Comparisons between 2010 and 2011 are listed in the following table. Due to prolonged high water in Canvasback, which significantly delayed emergence, and extensive damage to bulrush and other vegetation in mid-summer by a flock of c. 80 white pelicans, no re-count could be made in the Canvasback Transect in 2011.

Bulrush Density Counts - Spray/Disk Sample Transects					4/31/12 LC
Wetland	# of $1m^2$ plots	Total plants 7/12/2010 (after pulling)	Site Disked	Total plants 7/6/2011	Pls/m2
Canvasback	44 @2m spacing	3	9/29,30/2010	No count (site damaged)	No count
#6	42 @1m spacing	1	9/29,30/2010	2,418	57.5

Photomonitoring points were each established at Wetland #6 and Canvasback to track overview changes in vegetative cover over time. Photomonitoring points were also retaken at each new Bulrush Sample Transect established in 2010. Transect Photos were taken at eye height looking along the sample transect from each of the beginning (0m) and end stakes of the transect, centered on the base of a 1m stake placed 10 m from each stake along the sample tape.

Bulrush Phenology notes from 2009 are summarized below for use in annual planning. Emergence in 2011 was later due to a wet spring and prolonged water levels.

Bulrush Phenology 2009

5/28/2009	6" tall	#6	First ID of plants in 09
6/11/2009	some 18" tall early bud	Canvasback	Most plants 6-12" tall. See Bulrush Calendar 2009 for related water drawdown timing
7/8/2009	early bud/bud	Canvasback, #6	Spot -Sprayed 7/8/2009-7/10/2009 - #6, Canvasback, Teal - Imazapyr 5%
7/9/2009	most advanced plants in early green fruit/late flwr green	Canvasback	Stem tip not reflexed
7/10/2009	fruit	Canvasback	
7/22/2009	spray response	Canvasback Lk/#6 - sprayed plants	stem tips browning somewhat - buds arrested and browning some
8/4/2009	spray response	Canvasback Lk/#6 - sprayed plants	stems yellow-brown - traces green; treated and untreated plants separable for volunteer pulling

Review

A combination of spraying to reduce cover, re-spraying to target bulrush, disking to flush sprouting from the seed bank, and spraying to treat re-sprouting bulrush were executed at Canvasback and #6 wetlands in 2010/2011. Ruddy wetland was sprayed to reduce cover in late summer 2011.

Hand removal and searching by large numbers of volunteers with staff remains an important control method. Crews can find and remove outlier plants to prevent seed

production and spread, catching late or missed plants with ripe seed which will not be killed by late season foliar spraying. Hand removal by volunteer crews is more effective at finding and removing late plants in seed since more person-hours from volunteer crews than applicators can be employed in searching.

Actions Discussed For 2012

The following actions have been discussed by Refuge staff for consideration in bulrush project work in 2012:

Assess plant response to disk/spray methods. Resample spray disk transect at #6. Set up photopoints and sample transect at Ruddy before spraying and disking. Sample Canvasback transect before spraying. Photomonitoring points at #6 and Canvasback should be re-taken.

Blanket spray #6, Canvasback, and Ruddy for bulrush. Disk # 6 again and consider re-disking Canvasback. Disk the area sprayed at Ruddy. (The western edge of Ruddy was sprayed for all vegetative cover with imazapyr and some glyphosate (near trees) in late summer, 2012).

Insure thorough cleaning of tractor and disk before moving equipment to the next site using portable fire pump with water truck or in slough.

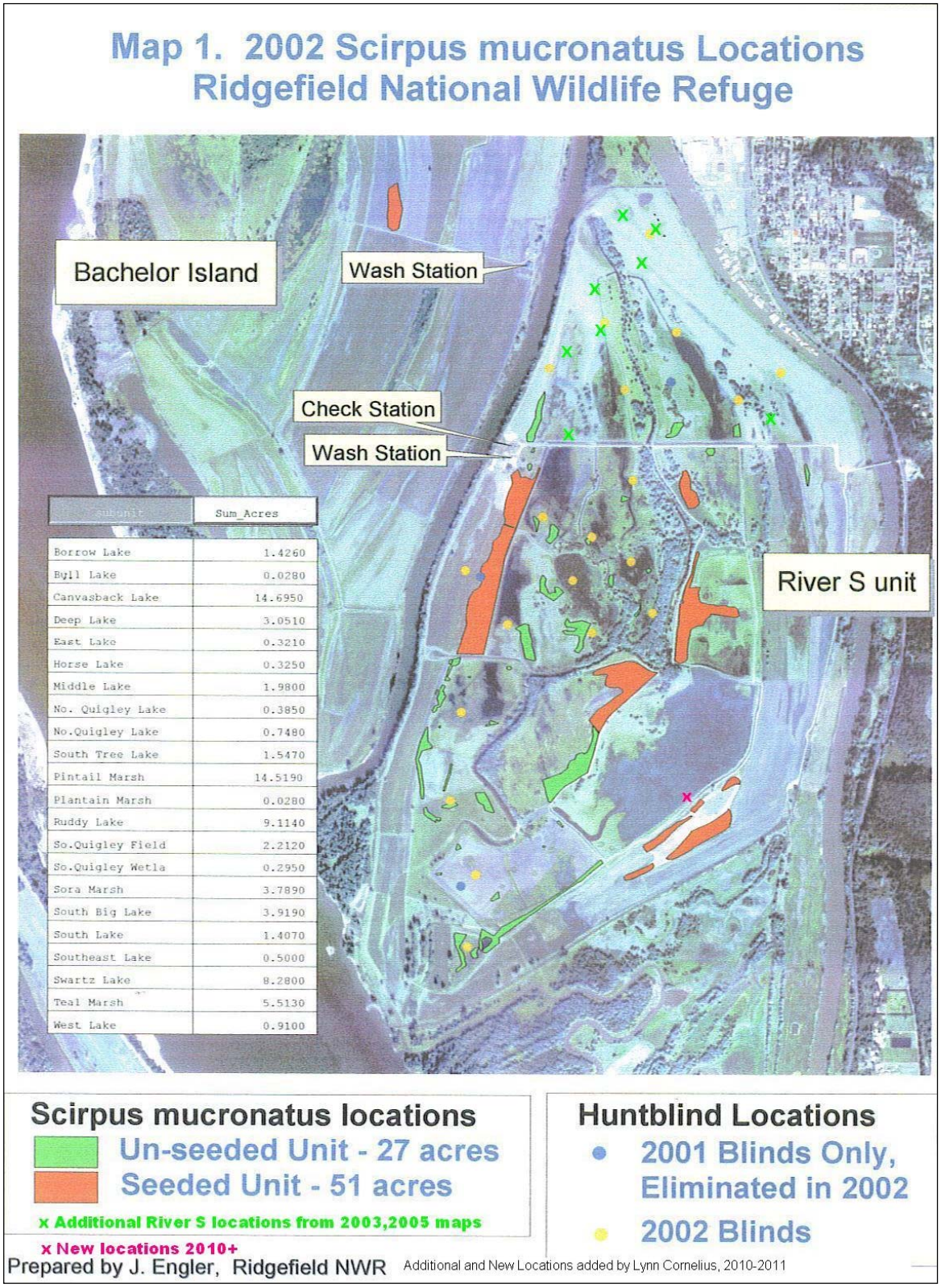
Create and implement a disposal plan. Meet and make a final decision on disposal/burying of the current bulrush dump site. If main dump is buried, maintain a temporary open second dump site next to the current site. If funding for purchase of incinerator and air quality permitting allow, implement incineration disposal. Avoid moving material with risk of spread. Experiment with using paper lawn bags in 2012 for plant removal to prevent incrementing more plastic bags.

Search Bower Slough, associated ditches, and shoreline areas outside the refuge downstream of expulsion pumps on foot and/or by boat again in 2012 for any off-refuge escape of bulrush. No plants were found off refuge in Oct/Nov 2002 and Sept 2010 searches.

South Big wetland and Blind 13a should be searched thoroughly due to scraping and disking treatments in 2010/11 and the re-emergence of plants in some areas in 2011.

Tape off all test plots and sample transects prior to volunteer crew work to avoid accidental pulling by volunteer crews prior to re-sampling.

Map 1: 2002 ricefield bulrush historic location map for River S Unit with additional Locations from 2003, 2005, & 2010



subunit	Sum_Acres
Borrow Lake	1.4260
Byll Lake	0.0280
Canvasback Lake	14.6950
Deep Lake	3.0510
East Lake	0.3210
Horse Lake	0.3250
Middle Lake	1.9800
No. Quigley Lake	0.3850
No.Quigley Lake	0.7480
South Tree Lake	1.5470
Pintail Marsh	14.5190
Plantain Marsh	0.0280
Ruddy Lake	9.1140
So.Quigley Field	2.2120
So.Quigley Wetla	0.2950
Sora Marsh	3.7890
South Big Lake	3.9190
South Lake	1.4070
Southeast Lake	0.5000
Swartz Lake	8.2800
Teal Marsh	5.5130
West Lake	0.9100

Map 2: 2002-03 bulrush location map for Bachelor Is. Unit, created Feb, 2011

2002-03 bulrush location map for Roth and Ridgeport Dairy Units, created Feb, 2011

I

Bulrush Focused Search Areas 2011 - by ATV & on foot.

Areas sprayed for bulrush and associated vegetative cover at Wetland #6 and Canvasback, 2011, yellow line; Areas disked in 2010: brown line.

Areas sprayed for remnant vegetative cover at Ruddy wetland, 2011: white line.

Location of Bulrush Wetland and Sample Transect Photomonitoring Points, 2010

Location of Bulrush Spray/Disk Sample Transect – Canvasback.
(Site not resampled in 2011 due to damage by pelican flock.)

Location of Bulrush Spray/Disk Sample Transect – Wetland #6

Ridgefield National Wildlife Refuge
U.S. Fish and Wildlife Service

Ricefield Bulrush (*Scirpus mucronatus*) 2011 Seasonal Field Coordinator Report

Report Completed: September 9, 2011
Season Coordinator: Tera Hinkley

Wetlands Affected: 9
Total Plants Hand-pulled: 13,582
Number of Volunteers: 110 (including canine team humans)
Average Number of Volunteers per Event: 5
Total Volunteer Hours: 384.5 (not including canine team hours)

Ricefield Bulrush Occurrence Season Summary:

Eight of the nine wetlands that were found to contain ricefield bulrush (*Scirpus mucronatus*) during the summer of 2011 were areas originally planted with the contaminated rice screenings in 1999. The ninth wetland, Middle Lake, had not hosted ricefield bulrush since 2004, however the soil in front of Blind 13a was leveled in the summer of 2010 contributing to the reappearance of bulrush. As expected, there was a resurgence of bulrush in Canvasback Lake, #6 Field (South Quigley Field), and South Big Lake after having their soils disked in the summer of 2010. The extremely wet spring and summer during 2011 led to higher than normal water levels in all of the Refuge wetlands. The wet season potentially contributed to higher population numbers in some more upland area, while also possibly causing smaller population amounts in lower regions that had held water unseasonably late this year.

Introduction:

As part of the wetland creation, restoration, and rehabilitation projects undertaken on Ridgefield National Wildlife Refuge, rice screenings from the San Joaquin Valley of California were planted within the borrow areas of eight wetlands that had been scrapped to mineral soil in September of 1999. The wetlands that received the screenings include six on the River “S” Unit, Teal Marsh, Pintail Marsh, Ruddy Lake, Swartz Lake, Number 6 field (South Quigley Field), and Canvasback Lake and one wetland each on Bachelor Island, Wetland 011, and the Ridgeport Dairy Unit, Fingers. The screenings were spread and harrowed into the wetlands in order to establish a seed source for moist-soil

vegetation where the seed bank was removed by scraping. Rice screenings are composed of seed and other non-rice vegetation remaining after cleaning and processing harvested rice. The screenings consisted primarily of wild millet and smart weeds that are considered high quality aquatic migratory bird food.

During the spring and summer of 2000, an unknown bulrush germinated in refuge wetlands. It was originally thought to be an Alkali bulrush, however this plant was subsequently identified as the invasive Eurasian species ricefield or rough-seed bulrush (*Scirpus mucronatus*). The identification was verified in September 2002 by Lawrence Janeway, Curator of the Biological Sciences Herbarium at California State University in Chico, California. This species had become ubiquitous in wetlands and rice fields of the Sacramento valley of California and is considered a problem weed (Barret, 1980).

The seedlings of ricefield bulrush have leaves with parallel veins and a shiny surface. The characteristics of the stem create ease in identification in part because they are located at 180 degree angles and are sharply three-angled with concaved sides. Mature plants generally are about 2 to 3 feet tall (60 - 90 cm). The plants generally produce flowers at the refuge from mid-July to September. The position of the flower also aids in identification as it is located about 1 to 2 inches below the tip of the stem. Plants were found in the summer of 2011 to be less than 1ft tall and in flower. Once fertilized, the stem above the flower reflexes as the seeds mature. In California rice fields, ricefield bulrush is described as a perennial that behaves as an annual (Fischer et al., 2010), it is debated as to whether this plant behaves as an annual or perennial at the refuge.

Since this bulrush has not been previously recorded in the Pacific Northwest, the infestation at the Refuge represents an introduction of a new invasive species. An aggressive eradication and control plan has been followed since 2002 because there is little known about the ecological impacts of this plant in the Pacific Northwest and it is a known invasive species.

Although we do not currently know the actual mechanism by which this bulrush has infested additional wetlands on the refuge, the pattern of infestation suggests multiple modes of dispersal along with water flow between units as the most significant dispersal method. All River “S” wetland units drain through Bower Slough and may be re-circulated through the northern one third of the unit before being pumped into the Columbia River by an expulsion pump. As of yet, ricefield bulrush has not yet been found growing along the Columbia River shoreline between the refuge and the mouth of the Lewis River, though a seed source may be present. There are other various mechanisms that may contribute to the dispersal of the seeds to new areas, including farm equipment and vehicles, attached to or

expelled after consumption by waterfowl (Brochet et al., 2010), and attached to humans such as refuge visitors, hunters, and refuge staff.

The purpose of the position of ricefield bulrush project coordinator is to ensure that a complete and organized search schedule is applied to the eradication of this invasive species from the refuge each summer. This position includes recruiting volunteers, organizing open volunteer work parties, and following the record keeping system in which all wetlands are searched.

Methods and Materials:

Volunteer Outreach

Several different methods of recruiting volunteers have been established. There is an excel spreadsheet containing contacts that have been helpful in the past for reaching potential volunteers. This information is found in the "Outreach" folder, as the excel file called "Contacts". The spreadsheet contains a list of people who have volunteered for habitat restoration at the refuge on the "Monthly" tab. Use this "monthly" list to send out an email of our volunteer events for the upcoming month. There is also a tab titled "Online Postings" which contains a list of internet sites to that have been used in the past to post events to along with any login/password information. The "Media" tab lists newspapers to send press releases to, or to post volunteer events to their online calendar, as well as contacts that need to be emailed every week to post events in their respective weekly paper. Some papers need the weekly email, some do not. Don't be afraid to contact the journalist and ask questions. If you are appreciative and attempt to develop a working relationship with the journalists, they may reward you with a front page spot in the paper/section. Many volunteers have been generated from newspaper spots. There are examples of what to send in the monthly email, to post to sites online, and to send to newspapers in the "Outreach" folder. The "Colleges" and "High Schools" tabs are school contacts that will be used most by the AmeriCorps member during the school year. Generating volunteers from the school contacts tabs can be somewhat futile during the summer months. Over the course of the season, it is important to keep all of the information up-to-date, editing emails or contact names as necessary.

Another method to recruit volunteers is to post flyers at various high-people traffic locations such as libraries, schools, community centers, and grocery stores. Generally the AmeriCorps person begins working in September and has already created and began posting a flyer or two for the bulrush events in the community before the start of the new bulrush coordinator. Several examples of previous flyers can be found in the "Outreach" folder.

We're always looking for new contacts and ways to bring in new groups for volunteer hours. Many businesses will pay employees to volunteer. Past groups

from businesses have included Wells Fargo and Optum Health. Don't be afraid to contact businesses that may be able to donate things like donuts, coffee, or other treats for volunteers. In the past, coordinators have used Safeway and Starbucks for donation. Margurite Hills from the Friends of Ridgefield Wildlife Refuge has also had great success with food and beverage donations. The New Seasons Market in Fisher's Landing may also be a great contact for donation. Be sure to take advantage of contact groups/people you know already in the community and see if they want to volunteer. Also, stay flexible with work days for large groups, if groups want to come out on non-volunteer days it may be beneficial to accommodate them.

Test Plots

Test plots were established in 2002 and are located in Ruddy, Swartz, Canvasback, Teal, Pintail, and #6. Each test plot is marked by white PVC pipe and may or may not contain additional flagging on or above the piping. The purpose of these plots is to record the effect hand-pulling has in specific areas. The location for these test plots are found in the Google Earth kmz file titled "Test Plots -2011" or can be viewed in the Google Earth jpg for the wetlands.

Data is collected from these areas by searching the 1.5m radius around each plot. There is a wood stick with white string attached to it in the Bio Bay that measure 1.5m long. This tool is very useful for measuring the 1.5m radius around each test plot. Attach the white string around the PVC pipe and walk around the plot in a circle. Count and record the number of plants that are located within the circle and remove the plants after counting them.

The test plots need to be searched before allowing volunteers to pull plants in the areas around the plots. If unable to search these areas before a volunteer work day, flag off the area and tell volunteers to not pull any plants from those locations.

ATV Searches

Materials needed for ATV searches include a troll/shovel, at least one contractor garbage bag, maps of the wetlands i.e. water control maps, hunt locations maps, Google Earth maps, or any other refuge map, a GPS unit, and proper riding equipment (helmet, gloves, eye protection). When driving through a field it is best to make tracks that are about 10 feet apart as you zigzag across the area. If searching with another rider, it is best to stay at least 10ft distance for safety. Take care while searching for bulrush to look at the terrain ahead of you and look for clues pools of water. If searching a damp area be sure to stop and look to see how much water is along the tires. The deeper the water, the more likely it is to get stuck. It is also important to watch for changes in the vegetation because ditches and uneven ground can be hidden by vegetation. Go slow in areas with low visibility and ask the mowers to mow dike roads and hunt blind accesses as necessary. Large bunches of

Canadian rush and damp reed canary grass with a thick thatch layer can be difficult to drive over. If traction is lost from mud or thick vegetation, try rocking yourself out of the situation by reversing and moving forward in an attempt to find some traction. If all else fails, keep a list of employee phone number list with you at all times and call someone for help.

Volunteer Work Day Searching and Hand-pulling

The work days are generally scheduled from 9 am to 12:30 pm on Wednesday and Saturday. The volunteer group meets at the Visitor Kiosk in the beginning of the auto tour route. For documents that help outline supplies and procedures on these days check the "Work Party Day Documents" folder for "Work Party Day Supply Checklist" and "Bulrush Removal Day Procedure". These documents can guide you as to tools to bring, a rough introduction to present to volunteers, and a time schedule to follow on event days. Basically, the most pertinent materials for volunteer events are contractor trash bags, hand tools (trowels), gloves, beverages, snacks, volunteer service agreement forms, clipboards, pens, GPS unit, extra batteries, data sheets, bug spray and sunscreen.

All wetlands on the "Bulrush Project Checklist" document need to be checked thoroughly. Volunteers are best used in areas that previously have had high bulrush numbers and also in areas that are so large it would take a whole day for you to search on your own. It is best to check out the location you will take volunteers the day before the event, especially early in the season since water levels can change quickly. This also allows you to decide on if you need to bring additional rubber boots or bug spray, or if there are any geologic features or pools of water to have volunteers avoid. It may also be helpful to find any bulrush look-alike plants from the site that you can introduce your volunteers to and site depending, to mark with flagging a couple bulrush plants from the sites. Also, back-up locations should be decided on for each day in case things change in the wetland overnight such as a surge in the water level or in case you finish a site more quickly than you had anticipated. Keep in mind the physical ability of volunteers and possibly adjust the searching area as necessary. The more you can prepare volunteers for the site, the more smoothly your volunteer day will go.

In order to search an area with volunteers in a through and orderly fashion, it is best to use the search method called the snake. This method has volunteers weave across the wetland. Have volunteers line up about an arm's distance away from one another along the edge of the wetland. Mark the end of the volunteer line with flagging. Have volunteers walk forward and search across the length of the wetland. Once the volunteers have walked across, have the group line up again to search the other side of the flagging you have set up and proceed to again cross the wetland. It can be difficult to maintain the straight line with volunteers, so just do your best to make sure all areas are searched.

If plants are found have volunteers tell you so you can collect a GPS point of the locations the plant(s) were found. The number of plants per waypoint should be recorded. One waypoint, in general, will suffice for plants found in a 20ft radius. In areas with high population numbers, periodically record the number of plants volunteers remove.

It is also important to record other attributes about the wetland including soil moisture, range in plant height, and seed development progress. There is a form titled "Blank Bulrush Wetland Data Sheet" that is helpful recording this type of information. During the 2011 season a laminated version of this form was used and recorded with sharpie. Sharpie can be removed from the form with alcohol swabs, break cleaner, or anything else that contains ethanol.

Canine Search Team

In 2009, a group consisting of 3 volunteers and 2 search and rescue dogs began training to search for purple loosestrife; in 2010 they began training to find bulrush. Every year a new permit will be written outlining the locations the dogs and trainers can search. In 2011, canine searchable areas included South Lake, Pintail Marsh, Sora Marsh, Teal Marsh, Fingers, Hillocks, and Bachelor Island wetlands: 011, 013E, 013W, 013S, Shop, 006 and 002. It may be beneficial to have Lynn send you a copy of the new permit so you have an idea as to where the dogs can search. For most of the 2011 season the canine team included Patty Crandell and her dog Stella. They came out almost every Saturday and Sunday to train/search. Keep in close communication with Patty and let her know where you plan to take volunteers on Saturday so to avoid searching the same location. Patty was great about emailing information about her search weekends, such as where they had searched and if they found any bulrush. She would flag the plants they found and I would collect the plants and take a GPS waypoint of their location. Another good use of the canine team is to have them double check for any missed plants after you have finished searching a wetland with volunteers. Patty also may periodically contact you about setting aside a bag of fresh bulrush plants that she needs to train with. The canine search team was invaluable for the 2011 season.

Data Recording

Keep a field notebook and record daily changes in water levels, locations searched, vegetation encountered or anything else that may seem pertinent. The information in your field notebook can be used in the season's final report.

There is a spreadsheet in the "Volunteer Hour Reporting" folder titled "Pre-registration & volunteer attendance". Format the form to the current year and use it to organize volunteer RSVPs as well as volunteer attendance on workdays. Knowing how many people are pre-registered can help with planning work day locations as

well as a rough amount of snacks, beverages, and work supplies to bring. This form can also be helpful to track the hours for volunteers who need to fill out a "Volunteer Timesheet". Additional tracking of volunteer hours is recorded in the document titled "Habitat Work & Volunteer Hours" in the "Volunteer Hour Reporting" file. Information recorded includes adult vs. youth attendance and work conducted. This document is helpful to track volunteer hours and is easily sent to Lynn or Josie as needed for applying for and complying with grants.

The data collected on volunteer days can be typed up on the "Blank Bulrush Wetland Data Sheet" and saved. At the end of the 2011 season, all of the bulrush wetland data sheets were combined into a document titled "Scirpus count and habitat report by wetland". It may also be helpful for you to organize all of the bulrush wetland data sheets in a fashion similar to "Scirpus count and habitat report by wetland".

All volunteer service agreements (VSA) that were filled out by volunteers should be complied into the "Blank VSA Contact Info for Josie" document found in the "Volunteer Hour Reporting" folder. Only information on the datasheet should be included. At the end of the season be sure to email Josie this data sheet. On volunteer days make sure the VSA was filled out correctly by volunteers. Volunteers often forget to sign the back or even print their name on the form. Conduct a quick scan of every form that is turned in, even with large groups. This form is for their protection and helps cover incidences that may happen while volunteering at the refuge. Volunteers who include their email on these forms should be added to the "Monthly" tab of the "Contacts" datasheet found in the "Outreach" folder. At the end of the season, all VSAs need to be filed at the main office.

The attendance/sign-in sheet should be collected in a folder and given to Lynn at the end of the season. These forms are proof that volunteers did in fact contribute the stated volunteer hours and are important part for various grants. The method for recording individual volunteer hours may have been updated after this report was written. Check with Lynn for details.

The GPS unit used for the 2011 season was a Garmin Etrex. Coordinates were for this season in UTM but can be changed to Latitude and Longitude if necessary. For a quick introduction on UTM coordinates, see the word document "A quick guide to using UTM coordinates". Adjust the "Blank Bulrush Wetland Data Sheet" depending on the coordinate method the GPS unit is using.

Google Earth is currently the primary method used to map collected GPS points of plant locations. Lynn can help introduce you to the program if you are unfamiliar with it. There are also many tutorials online that can help with any program issues. [Saving file name]

Importing GPS waypoints into Google Earth

Plug GPS into the computer with the USB cord

Turn on the unit
Open Google Earth
Click “Tools”, then “GPS”
The device is “Garmin”, check/uncheck “waypoints”, “tracks”, “routes” as necessary, then “Import” (the points will download)

Manipulate the waypoints as needed by right-clicking and opening “properties”. Once there is a yellow square around the point, you can move the point to the correct location by dragging it across the screen. “Properties” also will allow you to manipulate the characteristics of the marker and change the point name.

Other methods to download GPS waypoints:

Retrieving data from GPS using Garmin Software
Plug in the GPS to the computer with the USB cord
Turn on the unit
Open DNR Garmin on the computer desktop
Go to Waypoint and click Download
Highlight all the data that you would like to copy (Lat/Long/Date/Waypoint)
Go to Edit and click Copy

Inputting GPS Data in Excel program
Open Excel table you have created with season data points with plant info
Paste the GPS data into desired locations
Add the characteristics of plant samples afterward

GPS points were recorded in three formats, within Google Earth they were saved in “My Places”, the points were than saved as a kmz file within Google Earth to a data folder, and the points were recorded by saving the image of an area as a jpg. It may be helpful to record waypoints that will help outline the search area of a particular wetland. A polygon can also be created within Google Earth if necessary. This can be helpful to track how much of an area has been searched.

Results:

Table 1 outlines the number of plants hand-pulled by staff and volunteers from each wetland. The table is organized by year and includes data from 2002 until present. Some data is missing, either the number of plants hand-pulled was not recorded or we are unsure if any plants were located in a particular wetland. Beginning in 2005, herbicide application was used in areas that contained a large number of plants. Areas that received herbicide have been documented and are included in Table 1. Specifics as to the type of

herbicide used, the amount applied, and the dates of the application were not included in this report. See Lynn for additional information about herbicide application.

Table 1. Season Comparison of S. mucronatus Hand-pulled from Field by Wetland.

Legend
? = Plants found, unknown quantity
Blank = No Data
* = Applied Herbicide

WETLAND	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
#6	?	?	810	2,956*	22,318*	13,280	26,304	1,113*	207*	3,047*
TEM	0	5,296	19,195	553*	13,680*	16,581	8,842	120*	20	390
PIM	0	492	7,383	656*	37*	389	909	56*	61	173
RUL	350	10,948	16,001	3,994	490	6,934	963	247	5,268	3,400*
SWL	1,016	2,246	366	2,173	2,983	62	88	22	0	0
CAN	1,700	2,863	370	1,165*	26,914	4,806	4,005	12,891*	427*	4,549*
FIN	0	106	0	0	0	0	0	0	1,974*	1,650
#11	?	?	5	0	0	0	0	0	187	284
REL	0	0			0		0	0	1	0
SOR	300	268	18	19	8	8	17	8	1	0
SBL	205	109	71	45	0	2	0	0	0	6
NQL	580	647	294	34	18	0	0	0	0	0
TRE-S	139	69		41	6	0	0	0	0	0
SOL	137	357	58	37	1	0	0	0	0	0
SQL	?	0		17	0	0	0	0	0	0
NMA	0	0		14	0	0	0	0	0	0
HOR	4	9		1	0	0	0	0	0	0
HAL	7	24	3	1	0	0	0	0	0	0
DPL	12	129		1	0	0	0	0	0	0
SEL	13	1	3	0	0	0	0	0	0	0
WEL	14	6		0	0	0	0	0	0	0
NEL	5	2		0	0	0	0	0	0	0
TRE-N	0	0	18	0	0	0	0	0	0	0
BUL	?	0		0	0	0	0	0	0	0
MIL	0	1		0	0	0	0	0	0	0
MID	248	22	10	0	0	0	0	0	0	83
#002	0	11		0	0	0	0	0	0	0
013-S	0	10		0	0	0	0	0	0	0
013-E	0	2		0	0	0	0	0	0	0
013-W	0	4		0	0	0	0	0	0	0

#006	0	24		0	0	0	0	0	0	0
SPP-S	0	0	373		0		0	0	0	0
SPP-N	0	5		0	0	0	0	0	0	0
Total Plants (including test plots)	5,028	23,934	44,978	11,866	68,962	42,245	41,295	14,496	8,152	13,582
Infested Wetlands	18	27		16	10	8	7	7	9	9
Wetlands Sprayed				4	3	0	0	3	3	3

Table 2 outlines plants pulled within a 2.5m radius of test plot by season. The number of test plots varies by wetland. Table 3 is a list of the number of test plots for each wetland. The increase in the number of plants pulled from wetlands #6 and Canvasback Lake from 2010 to 2011 can be contributed to the disking that took place in those areas in the summer of 2010.

Table 2. Test Plot Summary.

WETLAND	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
#6	1295	2763		61	2282	171	150	21	1	288
#11	38	6		0	0	0	0	0	0	0
CAN	382	422		11	4	5	11	1	0	18
PIM	231	126		12	37	1	3	0	0	0
RUL	356	703		1	0	1	0	0	0	0
SWL	114	45		3	0	0	0	0	0	0
TEM	298	283		71	184	5	3	17	1	0
Total	**2714**	**4348**		**159**	**2507**	**183**	**167**	**39**	**2**	**306**

Table 3. Number of Test Plots by Wetland.

WETLAND	Number of Test Plots
#6	**3**
#11	**2**
CAN	**11**
PIM	**10**
RUL	**9**
SWL	**3**
TEM	**8**

Table 4 contains the legend that was used in Google Earth to mark the number of plants pulled from each waypoint. There are numbers which follow both red and green under each symbol, these numbers reference the color used for the icon in Google Earth.

Table 4.

Google Earth Plant Count Legend (For pull maps)

○	0-4 plants (red 255, green 255)	●	60-99 plants (red 170, green 0)
●	5-14 plants (red 255, green 170)	●	100-199 plants (red 170, green 85)
●	15-29 plants (red 255, green 85)	●	200-499 plants (red 85 green 0)
●	30-59 plants (red 255, green 0)	●	≥500 plants (red 0, green 0)

Ricefield Bulrush Locations:

Ruddy Lake (RUL)
Test Plots: 9
Total Plants: 3,400

Ruddy has had fluctuating population numbers over the years. The past two seasons there have been a high number of plants that were found along the western shore in areas that were originally seeded with bulrush. The western shore also happens to be a great area to take new volunteers since the ground is relatively flat and the area dried out fairly early in the season. Ruddy is a large wetland so it can take up to three volunteer days to thoroughly search the western shore, depending on volunteer turnout.

Many plants were found in pockets of open areas within the thick reed canary grass (*Phalaris rundinacea*) and also hidden within the edge of reed canary grass and upland

meadow herbs. Typically reed canary grass is thought to be such a prolific competitor that it is near impossible for both reed canary grass and bulrush to cohabitate; however bulrush was found in patches of reed canary grass where the ground was still visible. It seems that areas that do not contain a layer of reed canary grass thatch can still be bulrush habitat. Search areas with a thick thatch layer grass quickly as you are unlikely to find bulrush here.

After searching the western shore early in the season, the entire western shore was researched in the middle of August. The plants found later in the season were easier to spot, even in heavy reed canary grass, due to the appearance of seed heads. These plants tended to be taller and slender possibility due to reduced light availability as the reed canary grass began to tower over them later in the season. Since we found such a higher number of plants along the western shore the second time around we decided to spray the western shore with herbicide. The hope with the herbicide application is to reduce the reed canary grass and open up more the bulrush habitat here. It is possible that for the 2012 season this area could contain more bulrush than previous years as there will be less competition and more light in these areas for the seeds contained in the soil bank.
The water inflow stream stayed full of water until the middle of the season. Thick reed canary grass contributed to the difficulty of searching even the shoreline of this area, thus only take experienced volunteers to this portion of Ruddy. Be sure to reference the map that show the originally seeded areas and check these locations thoroughly, including the swathe that is just south of the water inflow area. Plants were found in the swathe in both the 2010 and 2011 seasons. The eastern shore never dried out enough to become ATV searchable so this area was mostly searched on foot and with binoculars from the dike roads. Most of the test plots in Ruddy are surrounded by reed canary grass and Canadian rush ??(*Juncus canadensis*) and currently are not bulrush friendly habitat, which could change if the reed canary grass ever thins out.

#6 Field (NO6)
aka South Quigley Field
Test Plots: 3
Transect: 1
Total Plants: 3,047

This area is one of the 8 wetlands that was originally planted with bulrush and because of this has proved from the beginning to hold a large number of plants. The area was disked late in the summer of 2010 in attempt to encourage bulrush germination and to

eventually exhaust the seed bank. This summer we saw the dominating plant species after the disking to be great water plantain (*Alisma plantago-aquatica*), small flowered forget-me-not (*Myosotis laxa* Lehm.), and ricefield bulrush.

Number 6 proves to be easy for new volunteers and the shoreline was searchable early in the season. In the center of the wetland the ground was very soft due to disking and was not an ideal place to take volunteers until the ground dried. We spent the entire first volunteer day of the season hand-pulling plants along the west shore before deciding that the numbers were too great and that the area would be best managed with herbicide application. The wetland was sprayed twice, once early-on and then after the water finally drained out. About two weeks after the last spraying, volunteers were brought in to hand-pull any plants that had been missed by the herbicide. The dense water plantain along the eastern shore made it was difficult to spray some of the bulrush so this was the primary focus of the second visit by volunteers. After hand-pulling this second time, the entire area was sprayed again with herbicide. It will be interesting to see in the 2012 season the effects of disking and spraying in this wetland. In all hopes, this area will have dramatically reduced numbers telling us that the disking and spray regiment was a great management technique.

Canvasback Lake (CAN)
Test Plots: 11
Transect: 1
Total Plants: 4,549

Not to be confused with Canvasback Lake on Bachelor Island, Canvasback on the River "S" Unit was another high number ricefield bulrush location. This area was also disked in the summer of 2010 creating soft muddy conditions and an explosion of ricefield bulrush population numbers. The leg portion stayed full of water through much of the season but this did not stop the number of ricefield bulrush in the area. This area is easy for volunteers once the footing is solid. Early in the season it was extremely mucky.

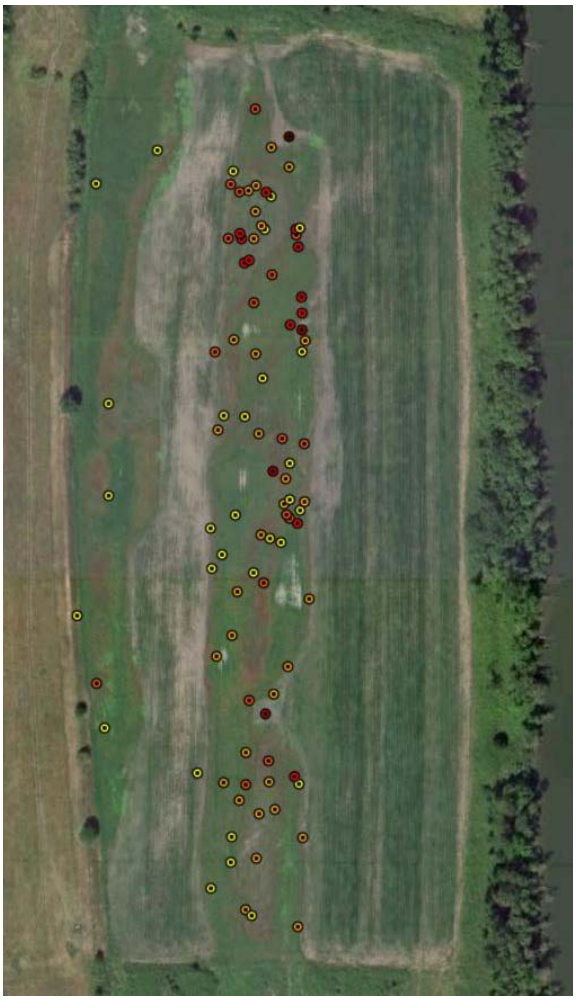
Water levels over 1.5ft is not ideal for ricefield bulrush but it was not unusual to find one or two culms of ricefield bulrush daintily sticking out of the water. As water levels allowed, the shore lines were hand pulled and the bulk of the area was sprayed. Heavy water plantain was synonymous with ricefield bulrush appearance in many of the areas that experienced soil disturbances such as disking, this area is no exception. If Canvasback has a high number of water plantain in the 2012 season, search those areas carefully, water plantain does a great job at concealing bulrush. White pelican frequented both Canvasback Lake and South Big Lake for about a month during the 2011 season. We found some interesting occurrences of uprooted and fully intact bulrush in the leg portion of Canvasback while there was still a fair amount of water in there. It almost looked as if a boat had driven through some areas and uprooted the vegetation with its propeller. Given that a boat with a propeller was not taken to Canvasback this season, the reason for the uprooted vegetation is thought to be due to the bottom feeding habits of the white pelican. We are unsure of the effect the pelicans had on the population numbers in the leg portion (maybe we should have counted their volunteer hours). Hopefully the pelican's contributed to reducing the population numbers in Canvasback, rather than carrying bulrush from wetland to wetland. Plants were not flowering while pelicans were on the refuge.

We assumed that high water levels in the leg portion of Canvasback had shut down the production of bulrush in this area for the season, however late in August our assumptions were proven wrong. A large number of plants were found in this area, especially along the western shore of the leg. There were some interesting features about many of the plants found here including plants cemented to the ground with mud (presumably due to the rapid drop in the water level) and culms of plants that were as short as 3inches tall with flower. In general plants that are from two to three feet high are thought to be mature thus producing flowers. These short culms that were in flower appear to be a last ditch effort to reproduce before the end of the season. Volunteers were brought in to hand-pull plants that were in seed or flower, followed by herbicide application. Watch the shoreline in this area as some plants were found up higher on the bank in the reed canary grass.

Google did an excellent job capturing the areas that were disked in the 2010 season. From the Google Earth image it is obvious that most of the plants found this season were found in those disked areas. The increased numbers of plants found in the test plots compared to prior years is due to the disking. It will be interesting to see in the 2012 season if more plants appear in the leg portion test plots since we had such high water for so long this season. There was surprisingly little vegetation growing in the center leg portion other than a few scattered water plantain plants and bulrush. If the 2012 season is not as wet as the 2011 year, the number of plants in the test plots may actually increase despite herbicide application since many plants in the seed bank may not have germinated this year. The transect was not counted this year but photo points were taken by Lynn towards the end of the season.

There was only one location were a few plants were found just outside of this area, the reason for this is unknown. Much of the area around the southernmost test plots is dominated by creeping spike rush (*Elocharis palustris*), a rhizomatous plant that is great at outcompeting bulrush for habitat. Often where this plant is found bulrush is not. The location of the plants in this area was not within the creeping spike rush but just outside of it. This area is one to search carefully.

One last note about Canvasback is to search. There is one area that is somewhat circular on the map above that contains a thick patch of water plantain. Plants were difficult to find here because the water plantain was so dense and the plants were beginning to seed. This area was not sprayed because of the density of the water plantain, so search this area with care. Plants were also found just south of this water plantain patch in more open areas that contained short (non-reed canary) grass.



Fingers (FIN)
Total Plants: 1,650

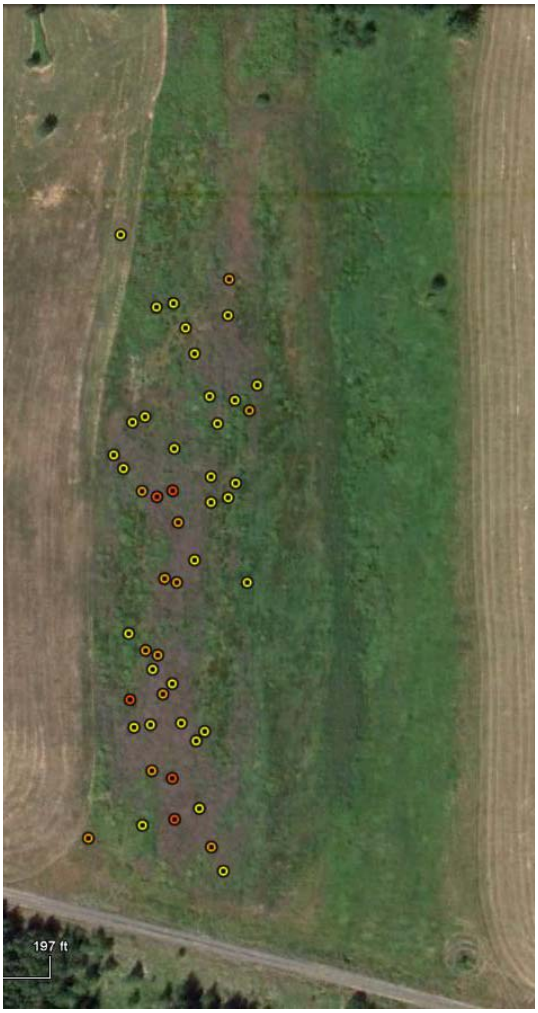
Though an originally seeded location, Fingers was not searched regularly until 2010. Corn was planted in the upland areas of Fingers during the summer of 2009 (or 2010?) causing a resurgence of bulrush. Plants were found mostly in the northern most portion of the west finger near the water outflow. There is a huge risk of bulrush moving into Finger's northern neighbor Hillocks and possibly escaping into the Columbia River system during a flood event. Both Fingers and Hillock's water levels correlate closely to the water levels of the Columbia River, so both of these areas contained a large amount of water late into July 2011.

Late in the 2010 season, much of Fingers was sprayed with herbicide after finding a large number of plants in the northern portion of the west finger. This area was set to be the focus area of volunteers searched by volunteers in 2011 but was still filled with water so the western corn field was searched instead. This area was found to contain the remnants of corn stalks, thistles, and blackberry. Searching this area was not enjoyable and rather than walking through the thorny mess, it may be best to do a quick search from outside the thick weed area. Both the upland west and east cornfields contained the same types of vegetation and since there were not any plants found in the west corn fields, the east cornfield was quickly searched by ATV.

The majority of the plants found were around the eastern lowland in between the two corn fields. Early in the season, plants were found with only one or two culms sticking up through the water starwort (*Callitriche* spp). The water starwort made it difficult to effectively pull out the roots as the stems easily broke off while trying to remove them from the tangled mess. As the season progressed large and healthy plants were found outside of the water starwort range. By the end of August Fingers contained three morphology types. The first type was yellow-green in color, with one to three culms that were 6-10in tall and no signs of flowering found mainly in the water starwort. The second was a larger plant that was light green to yellow and was slightly taller at about 14-24in with 4-5 culms in flower found outside of water starwort area. The third type was large at about 18-26in tall, dark green in color, and was found along the shoreline in short reed

canary grass. Water plantain popped up more heavily in the eastern lowlands compared to the western lowland. Much like the other soil disturbed wetlands, the water plantain concealed scattered plants that were of the second and third morphology type listed above. There was one strange occurrence on many of the shorter rushes and bulrush in Fingers. One to six shiny black casing of a recently metamorphosed invertebrate was found on the tops of many plants in this area. It's unclear what the affect this invertebrate had on the growth and development of the bulrush and rushes in the area. The only bulrush that contained this casing were of the first morphology type, though not all plants of this morphology type contained this feature.

Fingers is an easy site for volunteers as it is relatively flat and the footing is good once the water drains. The downside to this location is that is takes 20-30mins to reach the site. Since there is so much travel time associated with visiting this extremely large site, it is more beneficial to take large groups here. Keep track of how far away you are from the truck and how close it is to break time. There were many times where we had to walk 15mins back to the truck for a quick break before heading back out. I never figured out a remedy for this issue (maybe bring the cooler and snacks to the middle of the site?). This site was visited by volunteers on five occasions and was searched one last time on ATV. Using the ATV search method was extremely useful to spot plants that had been missed and to drive through thick patches of water plantain.



Wetland #11
Test Plots: 2
Total Plants: 284

#11 is the only Bachelor Island location that was originally seeded with bulrush seed in 1999. Water management in this wetland may have contributed to the lack bulrush from 2005 to 2009 as this area remained relatively dry. A resurgence in bulrush occurred in 2010 after the water management changed and water began to be pumped into the area again. Areas that contained bulrush in the 2010 and 2011 season were located in the originally seeded location.

The south portion dried out completely before any other wetland and was searched first by the canine team. The high numbers and success of the canine team was followed by volunteers experiencing equally high numbers in the area of the wetland just south of the Himalayan blackberries (*Rubus armeniacus*) and trees. #11 was checked in the beginning of the season and then again in early

August since the plants began to show beginning seed heads. It was easy to miss plants before development of the seed head because the plants in this area were yellow-green in color and bended well with the lighter green reed canary grass. Be sure to check all open areas carefully as plants were found along and within reed canary grass bunches making them easy to miss. This area is flat and very easy to walk with new volunteers.

The northern portion of the wetland was searched by ATV and was found to be full of water by the outflow drain and heavily filled in by reed canary grass. The dense cover of the reed canary grass in the northern portion makes this an unlikely area to host ricefield bulrush though there is a risk that the increased frequency of water in this wetland could pull seeds north, expanding its occurrence in this area.

Teal Marsh (TEM)
Test Plots: 8
Total Plants: 390

Water was kept in this wetland well into the middle of the season to help control some of the excess reed canary grass. The southern portion of this wetland is prime bulrush habitat, whereas the northern area is mostly dense reed canary grass. Trained volunteers worked best in this area since there were many small plants (<7inches tall) that could be easily looked over with an untrained eye.

Many plants were found just outside of the test plot areas on the higher mud flat area. In both the 2010 and 2011 season, this raised muddy area contained many small plants that popped up as soon as the water drains. Some larger plants were found along the western shore in upland grass areas. The higher than normal water levels this year appears to have pushed out the bulrush growing zone. The field along the western shore was mowed up to the very edge of the wetland and a few bulrush plants that had been cut down were found by the canine search team. Take special care to search along that western edge, there are some small opening in the reed canary grass that contained a few plants. The openings along the

western edge would have been easily hidden had it not been for the mower exposing the edge. Also keep in mind that the bulrush dump is just to the north and west of this wetland, it is entirely possible that seeds could be migrating from this area and into the marshlands of Teal.

Pintail Marsh (PIM)
Test Plots: 10
Total Plants: 173

After finding bulrush in this location in 2003, the hunt blind that used to be in this area was moved out into the grass lands just west of here. Pintail was drained and twice searched a few weeks before Teal. The western edge is where most plants were found and can be a good place to take new volunteers (water level depending). In the northwest corner of the marsh there were some large patches of bulrush, with smaller and more scattered patches heading south along the western edge. The eastern side is more difficult to search and is best done with experienced (and willing) volunteers. Be sure to check around edges of the large bunches of rush and reed canary grass. The canine team attempted to search this area but Stella was distracted by the smell of bulrush in Teal because of the southern flow of the wind. There is tons of red osier dogwood growing in the center and is possibly contributing to a reduction in bulrush habitat.

South Big Lake (SBL)
Box Blind 19 and Pit Blind 18
Total Plants: 6

There was still about 1 to 1.5 feet of water around both blinds when they were searched in early August. Much of the areas around both blinds contain reed canary grass with a heavy thatch layer. There are pocket of open areas, some of which are difficult to see until you are walking right on top of them. South Big was disked in

the summer of 2010 and even though a large amount of water plantain and simple-stem bur-reed (*Sparganium emersum*) there was only one location of bulrush in the northwest corner. The plants were found in one small patch late in August. Historically the ditch that runs along the eastern side of South Big contained bulrush. Unfortunately the ditch was not searched until after finding the small patch in the north corner and the area began refilling with water. Extra searching is recommended in the disked regions for the 2012 season since there was only a small amount of bulrush found. It is possible that the high water levels this season kept the numbers in this wetland down thus resurgence is entirely possible.

Middle Lake (MID)
aka Tule Lake
Blinds 13 and 13a
Total Plants: 83

Not to be confused with Middle Lake of the Carty Unit, this location had not seen ricefield bulrush since 2004. Plants were found during a routine search in front of Blind 13a. Fortunately the reason for this reoccurrence was due to work conducted in 2010 including leveling and scrapping off about 6inches of soil in front of Blind 13a. The soil scrapped from this region was piled just to the north of Blind 13A, so was not removed from the area. Conveniently, Google Earth has a nice image from August of 2010 showing the area that was leveled in this area. The ricefield bulrush was scattered amongst heavy water plantain and wapato (*Sagittaria latifolia*). The wapato made it especially difficult to search since the emerging leaves tend to look a bit like bulrush. This area was searched by volunteers twice by volunteers.

Blind 13 is visible from the Kiwa trail but is not easy to get to. The direct route to it is through mud that was up to 12inches deep. Blind 13 is best accessed from the Kiwa trail boardwalk and should only be searched by experienced and physically able volunteers. Much of Middle Lake is dominated by Tule (*Schoenolectus acutus*) and to avoid confusion with Middle lake in the Carty Unit should change its name to Tule Lake. Note this is also the area that attendants of the basket weaving workshop will go to collect Tule for their basket weaving needs.

Areas that were not inhabited by ricefield bulrush:

Swartz Lake (SWL)
Test Plots: 3
Total Plants: 0

This is the only location that was originally seeded with bulrush and yet there have not been plants here for the past two seasons. The northernmost portion is filled with heavy reed canary grass and thatch possibly keeping bulrush at bay. This area also contained a deep pool of water well into the end of August. Google earth has an excellent photo of this area depicting the pool. Be wary of taking volunteers into this location as the water very quickly reached the top of our knee boots.

The thick reed canary grass and cattails can make much of Swartz difficult to search with volunteers. Walking through thick reed canary grass consumes a lot of energy and easily will leave you unmotivated. An ATV search late in the season seemed to be the best method for the 2011 season. The area around the two most western test plots is a great place to search as the vegetation is open and seemingly ricefield bulrush friendly habitat.

Plantain aka Hall Lake (HAL)
Pit Blind 4

Plantain and Hunt Blind 4 are surrounded by a thick reed canary grass and a heavy thatch layer. It can be difficult to search this area because of the reed canary grass but if the perimeter is mowed it can be much easier to access the blind and may even be searched with volunteers. In previous years, this wetland dried out quickly, however the high water level of the Columbia River during the summer of 2011 maintained a

water level that was too deep for knee boots until the end of July. There are pools in the middle of plantain that contain deeper water and a large amount of creeping spike rush (*Elocharis palustris*), water-purslane (*Ludwigia palustris*) and a few other rush species, these places should be checked with extra care as it may be easy to overlook a hidden bulrush. The perimeter was searched by ATV and the middle portion was walked because of prevalent water. Millet and Plantain are often mowed on the same day so be sure to check these two at the same time to avoid missing a search opportunity. Bulrush has not been found at this location since 2005 but be sure to check the three previous bulrush locations with extra care.

The previously unnamed drainage pond just to the north and east of Plantain was named Tera Pond (TEP) in the summer of 2011. This pond has steep slopes and is surrounded by reed canary grass. It contains water throughout the summer and is an unlikely place for bulrush to grow.

Bull Lake (BUL)
Pit Blind 1

The perimeter of Bull Lake near the blind was searched by ATV. Areas surrounding Blind 1 and the rest of Bull Lake were searched by walking. The southern portion around the outflow holds water late in the season, making the ground around it soft and difficult to walk in. This area had about 4inches of water when it was searched. The northern portion dries out much quickly and is easy to walk. The vegetation in this area is dominated by water plantain and creeping spike rush. There is one previous bulrush location on the western shore; however bulrush has not been located here since 2002.

North Quigley Lake (NQL)
Hunt Blinds 1a, 2, and 3

Vegetation is dominated by wapato, creeping spike rush, bunches of Canadian rush, and reed canary grass. Blind 1a is easy to find and blind 2 is on an island. The thick field of wapato around blind 3 and +4inches of mud made it difficult to get to. In front of blind 3, where reed canary grass is present, so is a thick thatch layer of the grass. Open pockets in the grass there is water pursalane and wapato. Just north of Blind 2 is a nice high area filled with simple-stem bur-reed that looks like it

could host bulrush. There are two locations that had bulrush up until 2006 that should be searched with care.

North Tree Lake (TRE-N) – Box Blind 7 and Pit Blind 7

Most of the water in North Tree Lake is dominated by cattails (*Typha latifolia*)). There are many rush species and Tule (*Scirpus tabernaemontani*). The box blind is fairly easy to find since it is right off of the road in between North and South Tree. The pit blind is much more difficult to find as it was covered by reed canary grass. The west side of North Tree can be searched quickly by ATV but the east side is probably best to search by foot. After many attempts at locating the pit blind, the mowers were finally able to locate it while mowing the western field along both Tree Lakes. The perimeter can be searched on foot in areas that still contain water, be sure to peek in the open areas of the cattails, looking for favorable ricefield bulrush habitat. The eastern side of North Tree is dominated by reed canary grass and cattails and had some small pockets of opening containing creeping spike rush. There is one previous bulrush location from 2004, take special care in this area.

The pit blind was very difficult to
beginning of August and 30ft in front
This area mostly contains wapato,
spike rush. Take special care in the
2005. This area, water level
volunteers to increase search

North Mantrap (NMA) – Pit Blind 6

find. Searched the blind in the
of the blind was 3inches of water.
water plantain, tule, and creeping
two former bulrush sites from
depending, can be searched by
thoroughness and speed.

South Mantrap (MAL) – Pit Blind 5

The pit blind is easy to locate since it is out on its own island, however reaching this island can be difficult when the water levels are still high. The blind was not searched until mid-August and even so late in the season, the blind island was still difficult to reach. The mud in this area is deep, from 4 to 8inches, and very slippery in some areas. Most of the area was searched from the shore with binoculars because it was so difficult to walk through the mud. There are no previous bulrush locations in this wetland, probably due to the high water level. The wetland is dominated by wapato, simple-stem bur-reed, reed canary grass, Canadian rush, and Tule.

Deep Lake (DPL) – Box Blind 14

Most of the area is reed canary grass with a thick thatch layer. There are patches of lily pads with a radius of about 7inches. There are lots of willow trees, simple-stem bur-reed, red-osier dogwood, and Canadian rush sprinkled throughout the ever present reed canary grass. The blind is pretty hard to find, it is hidden behind some red-osier dogwood that is surrounded by Canadian rush. If you see the patch of water lilies and willows, the blind is just south and west of there. There is tons of the horsetail (species?) in the big pools. Along the open areas of reed canary grass along the west side is water purslane and its subsequent thatch layer. Most of the previous bulrush area in this wetland is covered by a thick layer of reed canary grass thatch. This area

should be watched carefully, if there is another wet year, the thatch could dwindle down allowing bulrush to reappear.

South Lake (SOL)
Blind 16
This is a difficult wetland to search. The ground is very uneven and it's hard to tell if the thick thatch layer will give way to water or hard ground. The thatch layer seemed many layers thick in most areas. The thatch does open up to pools that contain water purslane (*Ludwigia palustria*). The blind can be found by spotting the barbed wire fence post and going just south of it to a patch of willows. Directly south of the blind is some bunches of Canadian rush, followed by a patch of wapato and water plantain. 2006 is the last year bulrush was found here probably due to the reed canary grass growing in so thick along the west side of the wetland.

Millet Lake (MIL)

The south portion of Millet contains a heavy amount of reed canary grass with some scattered cattails and some Canadian rush. There is a thick thatch layer of reed canary grass making this area an unlikely place to find bulrush until the reed canary grass and duff layer thins out. The middle to northernmost area contains some bulrush favorable habitat because of the shorter reed canary grass however most of this area also contains a thick duff layer. The area surrounding the water outflow control area has patches of open areas that could potentially host bulrush. Millet has one recorded occurrence of bulrush in 2003 but has not seen its return since then.

Horse Lake (HOR)

Long Lake (LNG)

South Quigley Lake (SQL)

Hillocks (HIL)

North Sand Pit Pond (N-SPP)

South Sand Pit Pond (S-SPP)

Bachelor Island Wetlands

013 East Wetland

013 West Wetland

013 South Wetland

006 Wetland

002 Wetland

Shop Wetland

Canoe Searches

Canoe Searches were not conducted in Bower or Bachelor Sloughs due to time constraints.

	Field Notes
15-Jun	Coordinator Start Date
16-Jun	#6 was tilled summer 2010, now has lots of S. mucronatus and at least 8in water. Tilling stirred up lots of water forget me not and water plantain. Found very few S. mucronatus in RUL did find one plant that was 16in tall. About 6-8in water in RUL. CAN, TEM, PIM all have lots of water. Cannot reach Roth Unit because Columbia river is at flood level and covered road with water.
17-Jun	Printed maps and created work calendar.
18-Jun	Explored Bachelor Island. Lots of water around Widgeon Lake.

21-Jun Bachelor Slough dropped about 1 foot of water. GPS Blind 11, 7, and 8. Most other hunt blinds were surrounded by water. TEM and PIM still lots of water until Columbia river level drops.

22-Jun Volunteer Day at #6 and SWL. Started at #6 west shore, plants were 6-15in tall in water up to 1ft deep. Searched NW side of SWL had about 1.5ft of water. SBL lots of water. RUL had 1 board removed and should be searchable for Sat.

24-Jun CAN test plots are surrounded by water, lots of S. mucronatus around shore and towards center of foot of CAN. Marked off test plots at RUL because planning to search west shore with volunteer on Sat.

25-Jun Volunteer Day at RUL. Started in south end heading north while keeping to the west side. Muddy on bank, 2-6 in water, swathe was not searched because of 2ft of water. Plants were 6-9in tall. Found some larger 18in tall plants wih beginning seed head, they were hidden amongst emerging cattails. Canine search team trained at #11.

28-Jun Columbia river hydrologic level: 11.12ft, RUL swathe is over 1ft deep, with deepest area around inflow water control unit. West side of CAN 6-8in deep with about 2in mud. Found a good dry spot just South of Kiwa trail parking lot to take volunteers Wed, lots of S. mucronatus.

29-Jun Columbia river hydrologic level: 10.84ft. Volunteer day at CAN. Plants found were 3 to 16in tall, no beginning seed heads, found some big patches that will have to be sprayed later. Muddy prints covered some plants, lots of water, and lots of mud make anything but north shoreline unsearchable.

30-Jun Columbia river hydrologic level: 11.01ft. SWL has 16+in water on N. side so could not count test plots. Got oriented with Roth and Dairy Units. FIN, HIL, Campbell lake and both N. and S. Sand Pit Ponds are very full of water.

1-Jul Went searching for Blind 4 but lots of reed canary grass made pit blind near impossible to find. +1.6ft of water in HAL, had to walk around dike as HAL was too deep to cross with knee boots. Explored Mantrap & dike, found Blind 7 but could not find associated pit blind. RUL water level is dropping. NW side of RUL is dry enough for volunteers.

6-Jul Volunteer Day at RUL. Started in NW corner and worked our way south. <1in water, plants were 14 -18in tall and found in openings in reed canary grass.

7-Jul Counted test plots at #6, RUL, and attempted CAN but most in leg area had too much water. Jill and Lynn sprayed #6.

8-Jul Columbia river hydrologic level: 9.79ft. Counted #11 Test plots.

9-Jul Volunteer Day at RUL. Started at tree in middle and worked our way south, did not find any S. mucronatus down middle swathe, turned around at deep ditch in eastern protion of RUL. Plants found were 16-20in tall, some with beginning seed head. Canine team searched #11 and found at least 30 plants.

12-Jul Columbia river hydrologic level: 8.9ft, pulled and mapped canine found S. mucronatus in #11. Attempted to count TEM and PIM test plots but too much water. WSL very full of water. Counted SWL test plots but still too deep for volunteers to search.

13-Jul Volunteer Day at #11 and CAN. Dry soil but wet grass from rain. Plants were scattered along SW side. Plants were taller with beginning seed heads, this wetland dried out first before any other wetland. Stopped at black berry bushes and turned around down eastern side. Searched NE shoreline of CAN, no seed head developlement, very muddy shoreline 2-4in mud and up to 8in deep!

14-Jul Widgeon lake was 14in 10ft off shore. Too deep to dig iris. HAL had 8in water, Millet has more than 1ft water, Blind 2 need hip waders to reach, searched Blind 1a.

15-Jul RUL inflow water control unit has 2ft water. SE RUL has cattails, spike rush, reed canary, and lots of water, though water level is dropping. SQL has lots of water but board was pulled day before so water levels are dropping. SQL has lots of cattails, bittersweet nightshade, and water plantain, a very unlikely place to find S. mucronatus. REL very full of water and coots. SWL cannot cross north portion in knee boots. SBL has lots of water, reed canary, and water plantain. NE corner at inflow has the least amount of water.

16-Jul Volunteer Day at RUL. Plants ranged in height from 12 to 24in, very few with beginning seed head. Found many plants hidden at edge of meadow herbs and reed canary grass.

19-Jul Columbia river hydrologic level: 8.07ft. TEM 10ft off eastern shore water is 1.5ft deep. If rain ever stops, should be able to count test plots in a few days. West shore has 2in water. Counted PIM test plots. West shore of PIM is ready for volunteer search. Checked FIN and found access in S. area, high middle area can be searched, and can search around shorelines of fingers.

20-Jul Volunteer Day at FIN. Middle high ground where corn was planted contained thistle and blackberry but nothing else. Found S. mucronatus in NW finger shoreline, hidden in water plantain and mats of water starwort.

21-Jul Checked water level at CAN in leg area, still 1.8ft deep. Will hand pull areas in thick water plantain but most of CAN will be sprayed tomorrow, water and weather depending.

22-Jul

Checked out wetlands in Northern portion of River "S" unit. S. Tree Lake = 1.2ft water. Found Pit Blind 7 because it was mowed and is in a field of reed canary grass. Blind 7 can be searched off shore but N. Tree is too deep to search. S. Mantrap is too deep to search. N. Mantrap has a beaver dam and cannot find Blind 6. Plantain is backup location for Sat Volunteer group but it still has 1.5ft of water in deepest areas. Area sourrounding Plantain has been mowed. MIL has about the same water level as Plantain. NQL and Blind 2 have too much water to search. Blind 1 has 1.4ft of water in front of it. SWL deepest area was 1.1ft. N. East lake has drained significantly and is almost ready for search. Sora and Deep lake are still much to deep to search anywhere except around the edges.

23-Jul Volunteer Day at PIM. Ground was dry to moist with up to 3in water in some spots. Found many plants along west side ranging in height of 10-14in tall. Some plants had early stages of beginning seed heads.

26-Jul

Checked water level at HAL. Some pools are as deep as 1.6ft, though most areas are less than 3in deep. Reed canary grass in basin is short and should be relatively easy to search. MIL has squishy ground to 3-7in water but water is >1.3ft near water control structure. Finished CAN test plots before they spray again this week. most test plots in leg portion have 6-1.1ft of water. SWL along East side ranged from 7 to 9in water.

27-Jul Volunteer Day at SWL and PIM. Started at SWL but basin of SWL in northern portion was over 1.7ft deep. Moved to PIM where ground was mostly dry to <2in water near outflow.

28-Jul Counted test plots in TEM. Found blinds 8 and 6. Blind 8 is ready to be searched.

29-Jul

Columbia river hydrologic level:5.58. Cannot reach blind 5 in S. Mantrap, >1.3ft of water. Walked most of northern portion of MIL, need to finish with volunteers. Searched edge of HAL with ATV. Unnamed ditch pond in NE corner of River S unit just east of HAL is now known as Tera Pond abbreviation TEP. Can search rest of HAL with volunteers. Blind 16 is surrounded by deep water still. SOR and DEL is too deep to search. SBL to much water to try to walk shore. Could not find Blind 19.

30-Jul Volunteer Day at #6. Cleaned up RB in water plantain that was missed during spraying. Will return to finish cleaning up #6 two weeks after it is sprayed again.

2-Aug

Collected and took GPS of Canine team's flagged plants in TEM. TEM was dry along the west side but was still relatively deep in the south and up along the east side. SOR had low water levels in north leg portion but south pool was still too deep to search. SOL water levels have dropped and are very low in SE corner but the east side still has lots of water. CAN outflow still has about 1ft of water that is slowly flowing out. Leg portion of CAN water levels are dropping ~3in water. SBL water levels are also dropping and has low water levels around west side and in the north. The east side has the majority of the water.

3-Aug Checked Hunt Blinds 19 and 18 with Lynn and Jill. Blind 19 had about 1ft water in front of the blind. Blind 18 had lots of water surrounding it, did not finish north side.

4-Aug Searched Blind 7, had a pool in front of it that was about 1.5ft deep. Area mostly contains cattails, rushes, and reed canary grass. Walked perimeter of North Mantrap and peeked into open areas of cattails. South Mantrap has too much water to be searched yet >1.5ft water. Searched north portion of #11. Area is almost entirely a solid field of reed canary grass. The outflow swathe was still found to contain lots of water. Did a quick search of southern portion of #11 and found three bulrush with seed heads. Will search #11 on upcoming volunteer day since Alex wants to fill #11 with about 3in water soon.

5-Aug Searched Blind 6 in North Mantrap. Blind 13a was found to contain bulrush, need to carefully search this area with volunteers. Also, searched Blind 8 and Blind 1. Blind 11 was found to have too much mud to search, will have to check back to see if condition improve after some hot weather.

6-Aug Volunteer Day at #11 and TEM

9-Aug Searched area of thick water plantain in CAN just south of sprayed area. Found plants beginning to set seed. Need to check this area with volunteers.

10-Aug Volunteer day on westside of RUL

11-Aug Searched Blinds 1a, 2, 3 and finished searching MIL.

12-Aug Searched blind 12, 11, 10, and Blind 9.

13-Aug Volunteer Day at RUL

16-Aug Paperwork and final outreach day.

17-Aug Volunteer Day at RUL

18-Aug Searched CAN, Blinds 5, 17, and 13.

19-Aug Searched Blinds 14 and 16.

20-Aug Volunteer Day at MID

23-Aug Collected and GPS canine found plants in #11 and TEM. Searched SPP-N and SPP-S.

24-Aug Volunteer Day at FIN

25-Aug Walked SOR with Henry and walked in north portion of SBL where disking had taken place. Found plants in one patch of NW corner.

26-Aug Pulled and GPS canine found plants in TEM, walked west side of FIN.

27-Aug Volunteer Day at FIN

30-Aug Collected and GPS plants canine team had found in TEM. Found many plants in leg portion of CAN.

31-Aug Last Volunteer Day in leg portion of CAN.

1-Sep ATV searched S-TRE and SQL, used binoculars to search areas that could not be reached. One last ATV search in FIN.

2-Sep Searched southernmost and eastern CAN, walked northeast portion of REL, ATV searched ditch on eastern side of SBL. Water had already filled most of the northern portion and ditch.

3-Sep No Volunteers. Worked on final report.

6-Sep Holiday

7-Sep Searched northern Bachelor Island wetlands in Ranger.

8-Sep Searched Bachelor Island wetlands in south portion by ATV.

9-Sep Last Day

References:

S. C. H. Barrett, D. E. Seaman. (1980). The weed flora of California rice fields. *Aquatic Botany* 9: 351-376.

Brochet, A. L., Guillemain, M., Gauthier-Clerc, M., Fritz, H., and Green, A. J. (2010), Endozoochory of Mediterranean aquatic plant seeds by teal after a period of dessication: Determinants of seed survival and influence of retention time on germinability and viability. Aquatic Botany,93: 99–106.

Fischer, A. J., Strong, G. L., Shackel, K., and Mutters, R. (2010), Temporary drought can selectively suppress *Schoenoplectus mucronatus* in rice. Aquatic Botany, 92 : 257-264.

Ridgefield National Wildlife Refuge
U.S. Fish and Wildlife Service

Ricefield Bulrush (*Scirpus mucronatus*) Field Report - 2012

Report Completed: September 19, 2012
Season Coordinator: Tera Hinkley

Supported in part by a grant from the National Fish and Wildlife Foundation

Summary

Total ricefield bulrush hand-pulled: 16,070
Wetlands affected: 10
Wetlands disked: 3
Wetlands sprayed with herbicide: 1

Number of volunteers: 210
Average number of volunteers per event: 10
Adult volunteer hours: 641.5
Youth volunteer hours: 150.5
Total volunteer hours: 792

T. Hinkley

This report summarizes the survey and eradication of ricefield bulrush (*Scirpus mucronatus*) from Ridgefield National Wildlife Refuge (NWR) in Ridgefield, Washington from June to September in 2012. Ricefield bulrush (RB) occurrence was limited to three units at Ridgefield NWR including the River 'S', Bachelor Island, and Ridgeport Dairy. Eight wetlands were originally planted with RB contaminated seed in 1999; in 2012 seven of these eight wetlands were found to contain RB, including Wetland #6, Ruddy Lake, Canvasback, Pintail Marsh, Teal Marsh, Wetland #11, and Fingers Marsh. Additional wetlands that were not planted with contaminated seed but did contain RB in 2012 include Middle Lake, South Big Lake, and one new location, Hillocks Marsh. Survey and eradication was completed by the Seasonal Ricefield Bulrush Coordinator, a STEP employee, the Habitat Restoration Coordinator, and refuge volunteers. The following report includes the background of the project, a description of RB, and the complete summary of 2012 RB monitoring and eradication. Monitoring data includes circular test plot and transect data, a description of areas surveyed for RB in 2012, maps and description of areas where RB was found in 2012, wetland maintenance completed in 2012 that may influence the future distribution of RB at Ridgefield NWR, and suggestions for the 2013 season.

TABLE OF CONTENTS

Background

As part of the wetland creation, restoration, and rehabilitation projects undertaken on Ridgefield NWR, rice screenings from the San Joaquin Valley of California were planted within the borrow of eight wetlands that had been scrapped to mineral soil in September 1999. Wetlands that received the screenings include six on the River "S" Unit, Teal Marsh, Pintail Marsh, Ruddy Lake, Swartz Lake, Wetland #6 (South Quigley Field), and Canvasback Lake, one wetland on Bachelor Island, Wetland #11, and one wetland on the Ridgeport Dairy Unit, Fingers Marsh. The screenings were spread and harrowed into the wetlands in order to establish a seed source for moist-soil vegetation where the seed bank had been removed by scraping. Rice screenings are composed of seed and other non-rice vegetation remaining after cleaning and processing harvested rice. The screenings consisted primarily of wild millet and smart weeds that are considered high quality aquatic migratory bird food.

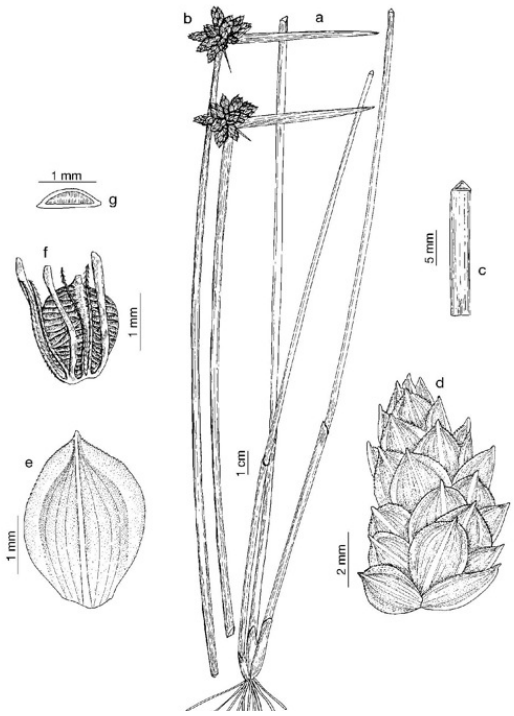
During the spring and summer of 2000, an unknown bulrush germinated in refuge wetlands. It was originally thought to be an Alkali bulrush, however this plant was later identified as the invasive Eurasian species ricefield or rough-seed bulrush (*Scirpus mucronatus*). The identification was verified in September 2002 by Lawrence Janeway Curator of the Biological Sciences Herbarium at California State University in Chico, California. This species had become ubiquitous in wetlands and rice fields of the Sacramento valley of California and is considered a problem weed (Barret, 1980). By the end of August in 2002, ricefield bulrush (RB) was found in all of the original eight wetlands that had been planted with the rice screenings and an additional six wetlands that had not received the rice screenings. Since this species of bulrush has not been previously recorded in the Pacific Northwest, the infestation at Ridgefield NWR represents an introduction of a new invasive species. An aggressive eradication and control plan has been followed since 2002 because there is little known about the ecological impacts this plant may have in the Pacific Northwest.

Although we do not currently know the actual mechanism by which this bulrush has infested additional wetlands on the refuge, the pattern of infestation suggests multiple modes of dispersal with water flow between units as the most significant dispersal method. All River "S" wetland units drain through Bower Slough and may be re-circulated through the northern one third of the unit before being pumped into the Columbia River by an expulsion pump. Although the north portion of River "S" Unit was not seeded, RB was located in wetlands in this area in 2002 indicating that the infestation likely resulted from seed carried by drainage from the rest of River "S" Unit. As of yet, RB has not yet been found growing along the Columbia River shoreline between the refuge and the mouth of the Lewis River, though a seed source may be present. Other mechanisms that may be contributing to the dispersal of seeds to new areas include use of heavy equipment to disturb areas in or near wetlands, seed attached to ORVs that have driven in or near infested wetlands, seed attached to or expelled after consumption by waterfowl (Brochet et al., 2010), and seed attached to refuge visitors, hunters, or staff.

The purpose of the position of Ricefield Bulrush Project Coordinator is to ensure that a complete and organized search schedule is applied to the eradication of this invasive species from the Ridgefield NWR each summer. This position includes recruiting volunteers, organizing open volunteer work parties, and following the RB survey and record keeping system. All wetlands on the River "S", Roth, Ridgeport Dairy, and Bachelor Island Units are searched each summer. Plants found are recorded by GPS by staff, removed from the site, and disposed of at the RB dump site found on the River 'S' Unit at Ridgefield NWR.

Ricefield bulrush description

Ricefield bulrush (*Scirpus mucronatus* syn. *Schoenoplectus mucronatus*) is a modern agriculture weed native to Eurasia. It was first noted to occur in North America in 1948 on more than 10,000 acres in northern California (Robbins et al., 1970). RB is in the sedge family and has culms with parallel veins, a shiny surface, and sharply three-angled concave sides. Mature plants generally grow to 2 to 3 feet tall (60 - 90 cm), though RB has been found at Ridgefield NWR to be more than4ft tall. The production of reproductive structures (spikelet) occurs at Ridgefield NWR from mid-July to October. The position of the spikelet on the culm is about 1 to 2 inches below the tip of the culm. In the summer of 2011 and 2012, spikelets were found on retarded culms that were less than 6 inches long. Once fertilized, the culm above the spikelet begins to reflex to a 90° angle. RB has fibrous roots and generally found in wet soil to emergent in fresh water. As soils dry, RB becomes stressed and the culms change in color from vibrant green to yellow. In California rice fields RB is described as a perennial that behaves as an annual (Fischer et al., 2010).



Castroviejo & al. (Eds.), Flora Iberica (RBG) http://www.rjb.csic.es/floraiberica/ http://www.anthos.es

Monitoring

Test Plots

Forty six circular test plots were established in 2002 at seven of the planted wetlands. Test plots were originally placed at a density of one per acre but over time additional test plots have been added in some areas and removed from others. The current locations of the test plots include 9 test plots at Ruddy, 5 test plots at Swartz, 11 test plots at Canvasback, 8 test plots at Teal, 10 test plots at Pintail, and 2 test plots at Wetland #11. The location of current test plots are illustrated in Figures 1, 2, and 3 (below). All test plots are marked by a pin flag attached to a white PVC pipe over a rebar stake. The PVC pipe serves as the center of the test plot with the number of RB

found within a 1.5m radius of each plot marker recorded. In 2012 the three test plots at Wetland #6 were removed.

Many of the remaining test plots are surrounded by reed canary grass (*Phalaris arundinacea*) and a thick mulch layer, however as more wetlands are disked for RB management and the amount of reed canary grass is reduced, these areas will provide a historical comparison of how specific areas are responding to RB management. In the 2012 RB was not found in any of the circular test plots. A comparison of the total amount of RB found at each wetland since 2002 is illustrated below in Table 1.

Table 1. Total ricefield bulrush found in all of the circular test plots for each wetland by season.

WETLAND	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
#6	1295	2763	500	61	2282	171	150	21	1	288	Removed
RUL	356	703	204	1	0	1	0	0	0	0	0
CAN	382	421		11	4	5	11	1	0	18	0
SWL	114	46	1	3	0	0	0	0	0	0	0
#11	38	6	0	0	0	0	0	0	0	0	0
TEM	298	283	112	71	184	5	3	17	1	0	0
PIM	231	126	209	12	37	1	3	0	0	0	0
Total	**2714**	**4348**	**1026**	**159**	**2507**	**183**	**167**	**39**	**2**	**306**	**0**

Transects

There are a total of three transects located at Wetland #6, Ruddy, and Canvasback. These transects serve as a secondary method to monitor RB management. A $1m^2$ quadrat is placed contiguously along the west side of the transect tape. Sample plots begin at 0m with the corners of the quadrat placed between 0m and1m, the 1m plot placed between 1m and 2m, etc for all plots along the transect. The number of RB found in each quadrat in 2012 was recorded and reported below in Tables 2 thru 4. Photo points were taken at both the 0m and 50m (or 44m Wetland #6) with a meter stick placed 10m down the transect tape and centered in the photograph. See Appendix I for transect photo point images. Note: Additional photo point images can also be found in *Bulrush Coordinator Files>2012 Bulrush Data>Transect Data*.

Wetland #6 Transect Data

The 50m transect begins at the northernmost white PVC pipe over rebar (0m) and ends at the southern white PVC pipe over rebar (44m). Plots were counted on July 13, 2012 with a total of 178 plants found in the 44 quadrats.

Ruddy Transect Data

Transect was installed in July 2012 to capture effects of 2012 disking. Transect begins at the southernmost circular test plot (test plot #10) and ends 50m south at a rebar stake. Plots were counted on July 13, 2012 with no plants found in the 50 quadrats.

Canvasback Transect Data

The transect was moved in July 2012 from the leg portion of the wetland to the top of the foot portion of the wetland. The move occurred to facilitate earlier season counting since the new

location at the foot dries out earlier in the season than the previous transect location in the leg. The transect begins at the southernmost circular test plot (test plot #13) and ends 50m south at a rebar stake. Plots were counted on August 10, 2012. The new transect location had been lightly searched by volunteers before the transect could be counted though there was a lack of disturbed ground along the transect suggesting RB had not been removed by volunteers before counting. RB was not found in any of the 50 quadrats.

Survey and Eradication

Surveyors

Clark County Search Dogs (CCSD)
In 2009, a group consisting of 3 volunteers and 2 experienced search and rescue dogs began training to search for purple loosestrife at Ridgefield NWR. During the 2010 season the group began training to also find RB. By 2011 CCSD was limited to two teams of dog and handler. Each year a Special Use Permit (SUP) is issued to CCSD specifying areas the dogs and handlers can search for invasive plant species. As outlined in the 2012 SUP, areas CCSD could search for invasive plants included Wetland #11, Pintail, Teal, Fingers, Hillocks, and Bachelor Island wetlands 13E, 13W, 13S, Shop, 006, and 002. All sites specified in the 2012 SUP are areas that are closed to the general public and are previous RB locations.

CCSD generally visited the refuge on weekends in the early morning before the weather got too hot and scent detection conditions became unfavorable. RB that CCSD found was removed and recorded by GPS or was flagged for removal by Staff. Some of the results reported here include RB that CCSD found. Additional information about CCSD protocols and complete 2012 results can be found in *CCSD Detection of Ricefield Bulrush at Ridgefield NWR Using Dogs 2012, Annual Report*.

Volunteers
Habitat restoration volunteer events were scheduled twice a week on Wednesday and Saturdays, running from 9am until 12:30pm. Each of the biweekly events during the summer 2012 exclusively searched for and removed RB. At the events volunteers were given a brief history about how RB was brought to the refuge, how to identify RB, and how to remove RB in the field. A total of 210 volunteers attended the 21 scheduled volunteer events, putting in 150.5 youth hours and 641.5 adult hours for a total of 792 volunteer hours. The most effective method of volunteer recruitment was from ads posted on the HandsonPortland.org and VolunteerMatch.com websites. The average number of volunteer attendees per event was 10 people, with as many as 17 people attending one event to as few as 3 people at another. A portion of the reported volunteer hours also includes the work of a handful of volunteers who put in additional RB-related hours outside of the normally scheduled events.

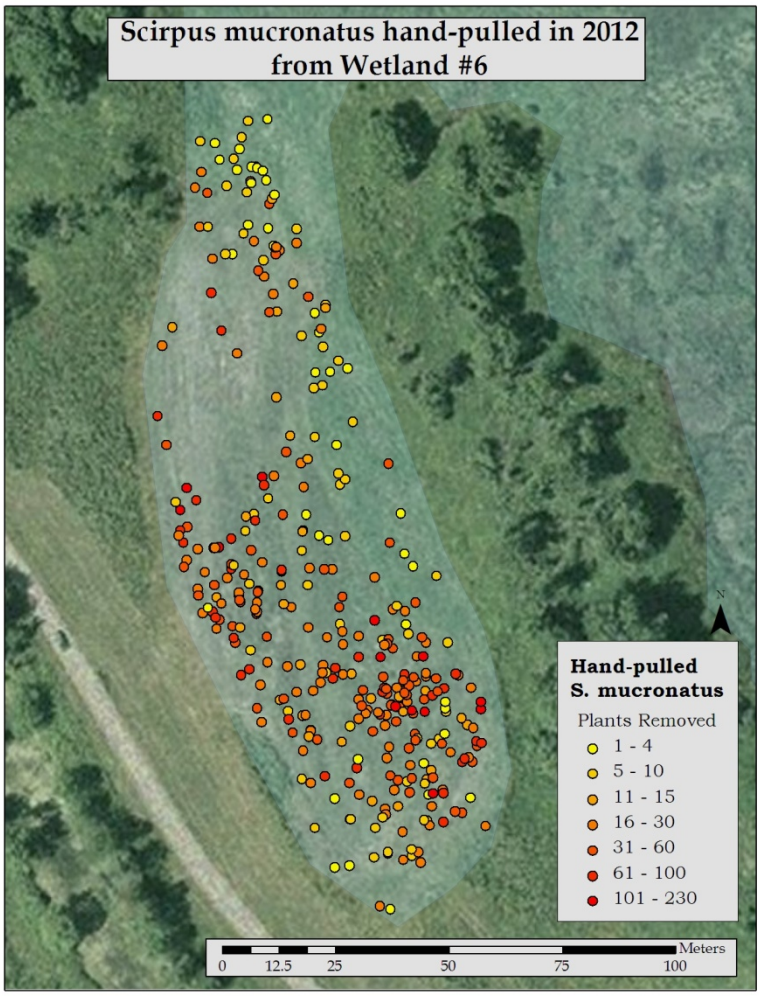
Seasonal STEP Employee
During the summer of 2012 additional staff help was hired to assist on invasive plant work. Many of the wetland searches for RB outside of the volunteer events were completed by the

STEP. The STEP also helped supervise volunteers during the Wednesday volunteer events and collected some of the RB GPS data reported here.

Planted Wetlands Survey

The following wetlands were originally planted with the contaminated seed in 1999 and also prove to have the highest number of RB each season. These areas are the current or most likely candidates for herbicide application and disking. The only wetland that did not contain RB out of the originally planted wetlands is Swartz which has not had a known occurrence of RB since 2009.

Planted areas with ricefield bulrush in 2012:

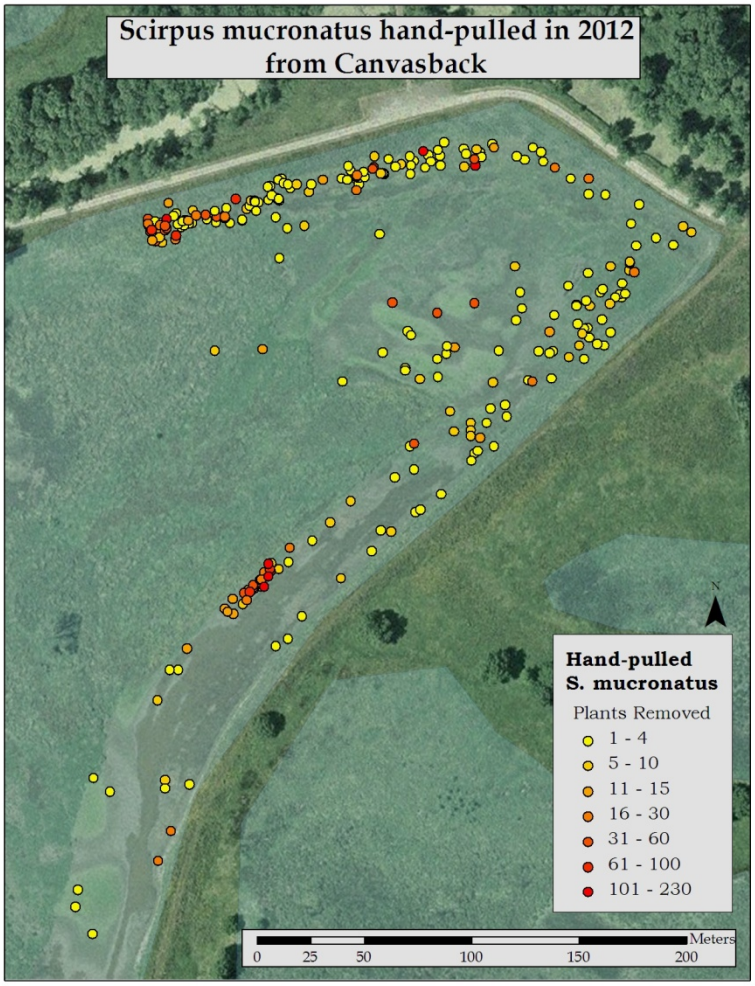


Wetland #6
aka South Quigley Field
Total Plants: 10,962

Wetland #6 is has proven season after season to have the largest quantity of RB out of all wetlands at the refuge. A comparison of the number of plants removed from this area by each season can be masked in some years by the application of herbicide. Depending on the season, it is not always time efficient to hand-pull all of the RB when a few applications of herbicide will have the same results in a fraction of the time. In 2012 only one area around the transect stakes on the northwest side of the wetland received one application of herbicide.

The 2012 season included the removal of the largest quantity of RB removed from a single wetland since 2009, contributed to more than eight visits during volunteer work party events. The large quantity of plants at this site provided a great opportunity for new volunteers to become familiar with how to find and remove RB in the field. Generally one to two hours of the 3.5 hour long volunteer event took place at this location before moving on to another site that needed a thorough search with RB familiar eyes. There are low spots along the west side of the wetland that were difficult to walk through because water is held in this area later than anywhere else.

The southwest side of the wetland had a large patch of fireweed (*Epilobium* spp.) and large patches of teasel (*Dipsacus fullonum*) are found at both the southern and northern ends of the wetland. Other dominant plant species in the wetland include water plantain (*Alisma plantago-aquatica*) and water forget-me-not (*Myosotis* spp.).
The wetland was disked for the first time in 2010 and again in 2012. The purpose of the disking is to increase the number of RB that germinates the following season as an attempt to exhaust the RB seed bank. Additional information about disking can be found in the management section of this report and after disking photo of Wetland #6 can be found in Appendix II.



Canvasback Lake (CAN)
Total Plants: 3,594
Not to be confused with Canvasback Lake on Bachelor Island, Canvasback on the River "S" Unit had the second largest quantity of RB in 2012. This wetland is broken up into two main search areas the leg which runs south towards the water inflow structure and the foot which covers the open northern portion of the wetland. Water in the leg drains very slowly so water can be found here much later in the season compared to other ideal RB locations at this wetland.

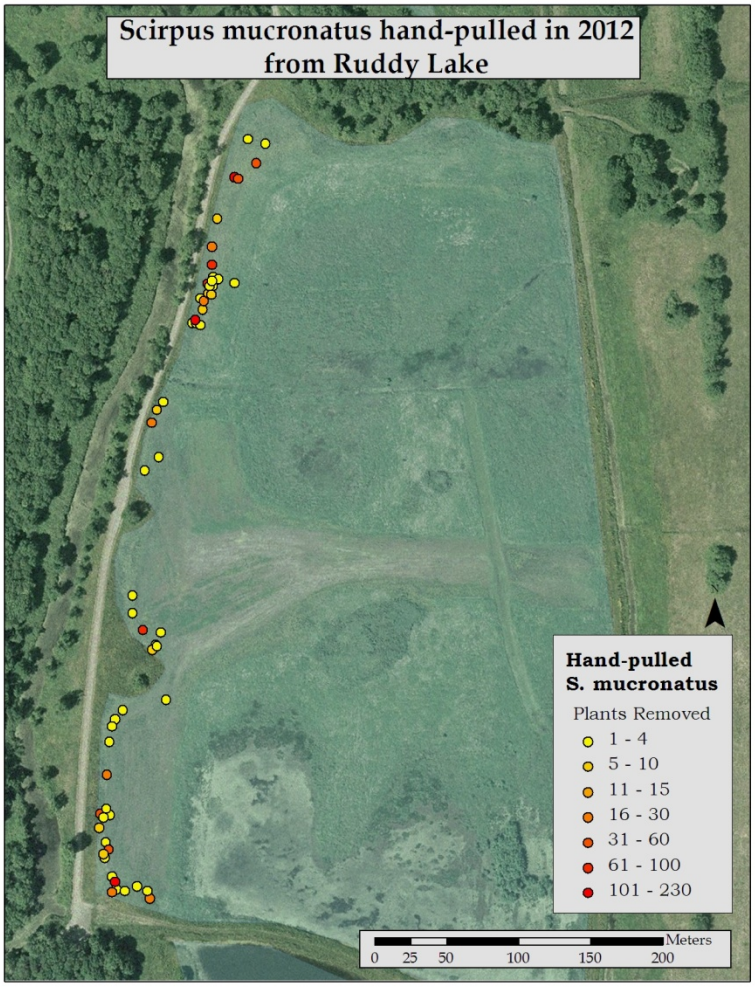
Herbicide was not applied at Canvasback in 2012 instead the entire wetland was searched on foot and all RB found was hand-pulled by staff and volunteers. The majority of RB occurs along the western shoreline of the leg with a lesser amount along the east shoreline and center of the leg. The 2011 season was a wet year and water was held in the leg much later than normal. It was assumed 2011 that high water levels in the leg portion of Canvasback had shut down the production of bulrush in this area for the season, however in 2012 the majority of plants in the leg were also found along the western shoreline and to a lesser amount the eastern shoreline. In 2011 RB was also found high up along the west shoreline of the leg along the edge of the reed canary grass, this was not the case in 2012.

There was not much vegetation growing in the foot of the wetland until late in the season when a large stand of nodding bur-marigold (*Biden cernua*) appeared. Bur-marigold dominated the foot

portion until disking decimated the plant before it could go to seed. RB found across the foot are mostly scattered in small patches with the highest density of plants found along the shoreline. Reed canary grass along the auto tour route shoreline concealed RB well. The shoreline was searched at least three times over the course of the season with large RB with mature spikelets found each search. There is one area just south of the foot and outside of the disk area that contains a thick patch of water plantain and wapato (*Sagittaria latifolia*); RB has been found in this location in both 2011 and 2012.

Areas outside of the foot and leg are mostly reed canary grass with a thick mulch layer. This area was searched by the STEP employee and one volunteer in 2012. No RB was found in the thick reed canary grass and special care should be taken during searching as the mulch layers are inconsistently thick and can give way to water and mud without notice. Near the water outflow and around the southernmost test plots the wetland is dominated by creeping spike rush (*Elocharis palustris*), a rhizomatous plant that appears to outcompete RB for habitat.

The leg and foot portions of the wetland were disked in 2010 and 2012. Additional information about disking at this wetland in 2012 can be found in the Management section of this report and before and after disking photos can be found in Appendix II.



Ruddy Lake (RUL)
Total Plants: 1,205
Ruddy has fluctuated in the quantity of RB found each season. In comparison to 2010 and 2011, 2012 saw a reduction RB likely due to management that was implemented during the 2011 season. Much of the RB found in Ruddy is also areas that were originally planted with RB-contaminated seed, generally along the western shore and in a section that runs almost across the center of the wetland.

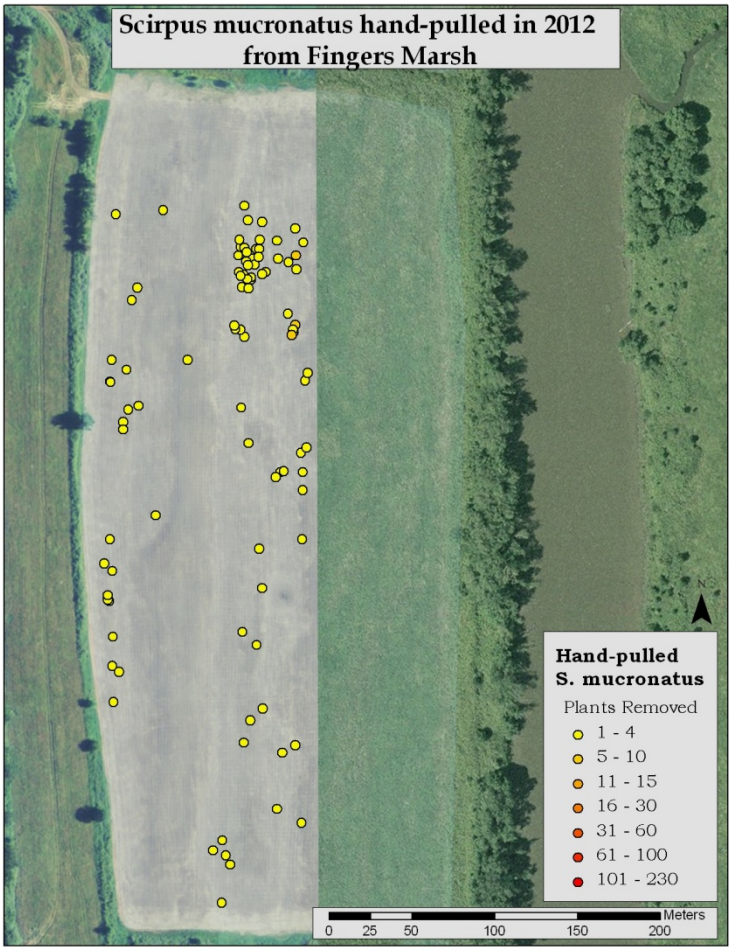
In 2011 a large amount of RB was found hidden amongst reed canary grass that did not have a mulch layer. This area was subsequently sprayed with herbicide at the end of the season with the intent of killing any RB that may have been overlooked during volunteer search events and to reduce the amount of the highly competitive reed canary grass for 2012 disking

preparation. By reducing the amount of reed canary grass it was predicted that more RB would germinate in these areas in the following season; however for much of the 2012 season, very little vegetation grew in areas that were sprayed with herbicide in 2011. Much of the RB found in 2012 was along the edge of the sprayed area near the upland shoreline rather than in open areas free of reed canary grass.

Ruddy was searched by volunteers on four occasions in 2012 with the majority of plants found on the first and second search days. By the time the wetland was searched for the last time on August 15th, 2012, the few plants found were short and unhealthy likely due to extremely dry conditions. Results from the 2012 season suggest that early onset of drought conditions along the shoreline may have impacted germination rates of many plant species in this area not just RB since water was drained from this area earlier than in the previous year.

Dry conditions were not favorable to RB however they did provide great conditions for disking which occurred along the western shore at the end of August in 2012. Additional information about disking at this wetland can be found in the Management section of this report and before and after disking photos can be found in Appendix II.

The water inflow stream stayed full of water throughout much of the season and the thick reed canary grass along this stream contributed to some difficulty in searching the shoreline. Volunteers tend to have a difficult time searching the inflow stream as well as the eastern side of Ruddy. The eastern shore seems to rarely dry out so was searched partly on foot and by viewing binoculars from the dike roads. RB were found in the swathe just south of the inflow stream in both the 2010 and 2011 seasons, however no RB was found in 2012.



Fingers Marsh (FIN)
Total plants: 154
Though an originally seeded location, Fingers had a large break in RB occurrence from 2004 until 2010. Corn was planted in the upland and lowland areas of Fingers in 2008 and 2009 and only in the upland areas in 2010. Fingers was not searched for RB in 2009 but was searched in 2010 finding RB in the northern portion of the west finger near the water outflow structure, also the same area RB was found in 2003. At the end of 2010 herbicide was sprayed in both lowland fingers.

Dominant plants of both lowland fingers include tule (*Schoenolectus acutus*), water plantain, smart weed

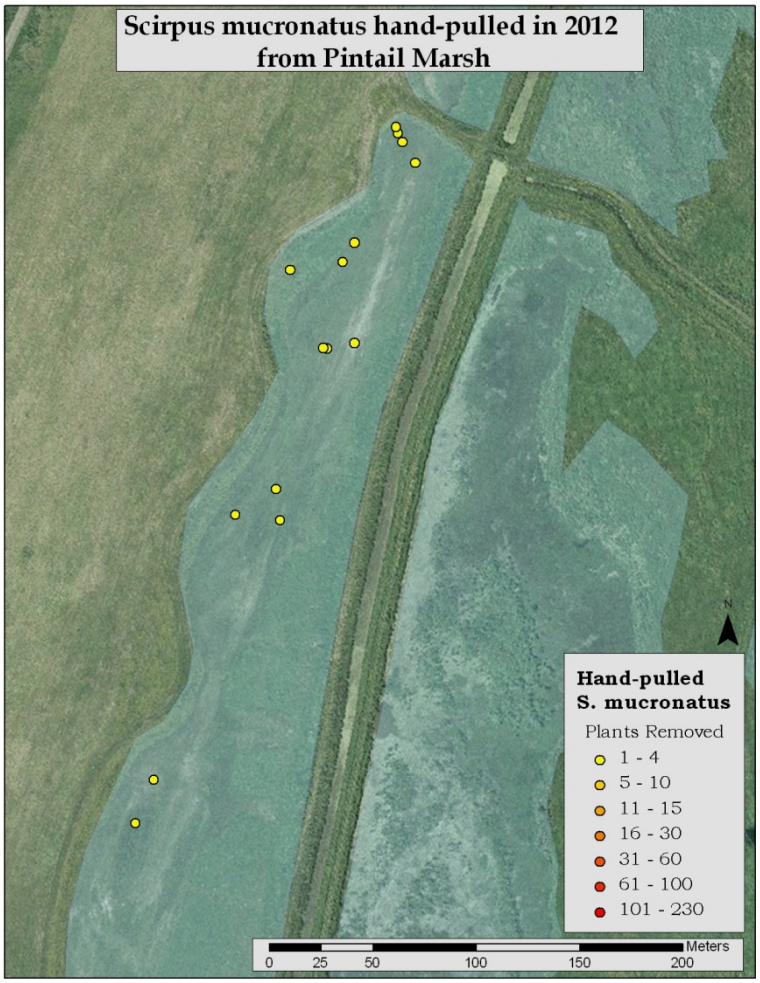
(*Polygonum* spp.), creeping jenny (*Lysimachia* spp.), and water purslane (*Ludwigia* spp.). A lesser amount of RB was found in the western finger in 2011 and 2012 in comparison to 2010. Much of the RB in the western finger in 2011 and 2012 was found scattered rather than in patches. For both 2011 and 2012, the majority of RB was found in the eastern lowland finger, with the majority of RB in 2012 found in the northern one third of the area. Much like the other soil disturbed wetlands, RB often occurred next to or very near water plantain.

With the exception of one area, RB typically occurred this season as a single plant and less often in small clusters of twos or threes. In 2011 plants were found with only one or two culms sticking up through mats of water purslane making it difficult to effectively pull out the entire plant. The culms broke easily while trying to remove RB from the water purslane. The incidence of RB in the water purslane was less common in 2012 likely due to seasonal drought conditions occurring earlier in the season.

Both upland areas are dominated by Canada thistle (*Cirsium arvense*) and blackberry. Search of these areas was done by examining the perimeter since these sites often dry out too quickly for RB. The eastern upland is larger in size with dense blackberry stands. In 2012 the eastern upland area was not searched outside of the west side though in 2011 this entire upland area was searched by ATV.

Teal Marsh (TEM)
Total plants: 27
(CCSD found 15 of the RB reported here).
Teal began with thousands of RB in 2003 however since 2009 the amount of plants found has been much more moderate. The wetland was primarily searched by CCSD as they proved in 2011 to be more effective at searching the area than most human volunteers. Many of the plant CCSD found in 2011 and 2012 were newly germinated RB found primarily in the mudflats that fall between test plots #29, 30, and 31. These mudflat areas are generally free of reed canary grass and when only covered by an inch or two of water, provide perfect RB conditions. The entire wetland was searched three times during human volunteer events, with the primary search focus on the western side of the wetland.

Much of the east and northern portion of the wetland is dominated by reed canary grass and a thick mulch layer, creating unfavorable RB habitat. Water was held around the water outflow control structure in the wetland well into the middle of the season to help control some of the excess reed canary grass in 2011 and to a lesser amount in 2012. The higher than normal water levels in 2011 seem to push the RB growing zone into upland areas that contained the yellow flowered *Lotus* spp. however this was not the case in 2012. *Note the bulrush dump is just to the north and west of this wetland.



Pintail Marsh (PIM)
Total plants: 27
This wetland once contained hunt blind 15 however after finding RB at this site in 2003 the blind was moved west into the upland pasture. Over the past few years the majority of RB found is along the western side of the wetland. The eastern side is dominated by reed canary grass, large bunch rush and red osier dogwood (*Cornus sericea*) all contributing to unfavorable RB habitat. Red Osier dogwood has been slowly taking over this wetland, with many seedlings located next to some of Pintail's test plots. In the future the test plots should be moved to a new location or red osier dogwood should be removed.

The majority of the plants found in 2012 were in the northwest corner of the marsh, becoming more scattered in the southern portion of the wetland. The south portion of the wetland is dominated by large bunch rush and creeping spike rush and is generally not ideal RB habitat.

Wetland #11
Total Plants: 15
Wetland #11 is the only Bachelor Island location that was originally planted with contaminated seed. Plants were found in an unknown quantity in 2002 and 2003 and a small amount in 2004. The break in RB occurrence from 2005 to 2010 is contributed to water management practices. The southern seeded portion of the wetland does not hold water well and early management strategies used this characteristic to temporarily shut down RB germination by not pumping water into the wetland and instead only allowing groundwater and rainwater to fill the shallow wetland basin. Since this wetland tends to dry out quickly once seasonal rainfall stops, the time period for RB to germinate at this wetland is narrow. In 2012 the southern portion dried by mid-June and despite a few attempts to simulate RB germination by pumping water into the already dry wetland, comparable 2011 RB instances were not seen in 2012.

The northern portion of the wetland is dominated by reed canary grass. Water can remain near the outflow pump despite the rest of the wetland being completely dry. The northern portion was searched by foot and ORV by the STEP. The dense cover of the reed canary grass in the northern portion makes this an unlikely area to host RB.

Planted areas without ricefield bulrush in 2012:

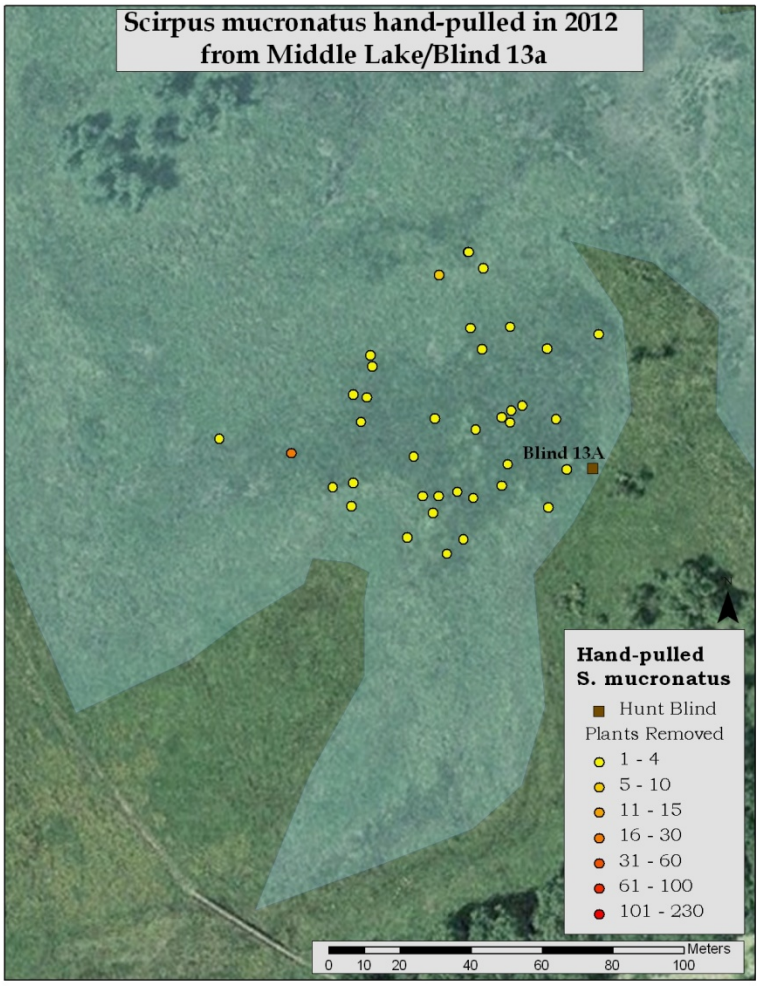
Swartz Lake (SWL)
This is the only originally seeded location that has not had a RB occurrence since 2009. Areas that were originally planted include the northwestern and southeastern edges of the wetland. These areas also contained a plant composition that is more favorable to RB than the rest of the wetland. Much of the wetland contains thick reed canary grass however in the two main planted areas, cattail (*Typha* spp.) surround open areas that contain both bunch and spike rushes (*Eleocharis* spp.), European pennyroyal (*Mentha pulegium*), and an unidentified short grass. The plant composition in these areas is similar to the southern portion in wetland #11. The larger, southeastern portion of the wetland is where RB was last found in 2009. The northernmost portion of the wetland is filled with thick reed canary grass and thatch layer likely keeping RB at

bay in this area. For the past two seasons this area contained water for much of the summer season.

Hunt Blind Survey

The hunt blinds pose a great risk for introducing RB to new areas. During the seasonal duck and goose hunting season in fall and winter, hunters and their hunting dogs may be disturbing areas that contain RB seed while walking to blinds and retrieving waterfowl. Each hunt blind during the 2012 season was searched by the seasonal STEP employee and often times a volunteer and/or Bulrush Coordinator. Areas were searched before seasonal mowing had taken place in potential RB habitat. A minimum 150ft radius was searched thoroughly around each blind in addition to the shoreline of the associated wetland.

Hunted areas with ricefield bulrush in 2012:

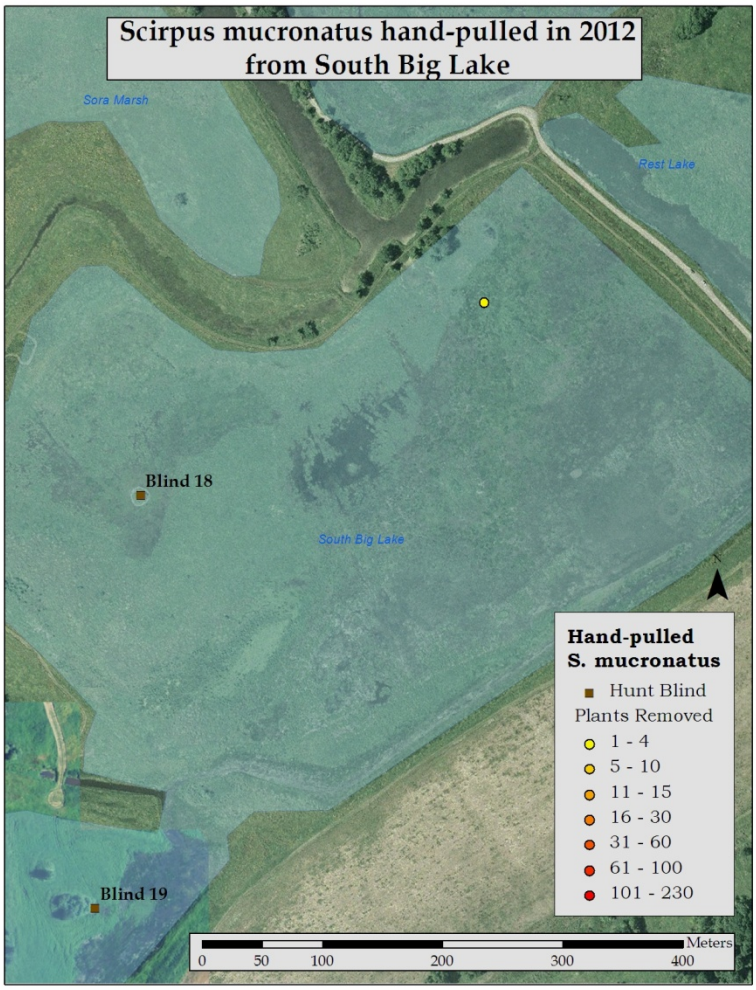


Middle Lake (MID)
Blinds 13 and 13a
Total Plants: 84

Not to be confused with Middle Lake of the Carty Unit, this site previously had not had an occurrence of RB since 2004. Plants were found in 2011 during a routine search in front of Blind 13a. Reasons behind this reoccurrence include the leveling and scrapping of about 6inches of soil in front of Blind 13a in 2010. The soil scrapped from this region was piled just to the north of Blind 13A, so was not removed from the area. The bowl created in front of the blind 13a now contains thick water plantain and wapato that is scattered across the bowl and thick along the edges of this area. RB found in 2011 and 2012 was scattered across the bowl amongst the water plantain and wapato. The water plantain is difficult to walk through and the footing is terrible while the soil is still wet. The emerging leaves of the wapato tend to look a bit like bulrush. This can be a difficult site to take volunteers and is only recommend for experienced searchers before the ground becomes dry. The area in front of blind 13a was searched six times on foot and once on ATV in 2012.

Blind 13 is visible from the Kiwa trail but is not easy to get to. The direct route to the blind is through mud that was up to 12inches deep. Blind 13 is best accessed from the Kiwa trail

boardwalk and should only be searched by experienced volunteers. There is an area west of the blind that once contained RB and should be searched carefully. RB has not been found in this area since 2004. Note: A large portion of Middle Lake is dominated by tule and is the harvest location for the Plankhouse basket weaving workshop. The amount of soil disturbance during harvesting is negligible but is still being noted as a potential source for a future reoccurrence in the area.



South Big Lake (SBL)
Box Blind 19 and Pit Blind 18
Total Plants: 1
Much of the areas around both blinds 18 and 19 contain reed canary grass with a heavy thatch layer. There are open pockets within the grass mostly containing smart weed that are difficult to see until walking on top of them. South Big was disked along the north edge of the wetland in the summer of 2010 to control for reed canary grass. Water plantain and bur-reed (*Sparganium* spp.) dominated the disked area, with only the northwest corner having a small reoccurrence of RB in both 2011 and 2012. Historically the largest stretch of RB at this wetland was along the east edge of the wetland and around blind 19. There is a ditch that runs most of the length of this area and for the past two seasons does not appear to be good RB habitat. This area is mostly dominated by reed canary grass, smart weed, and spike rush. The ditch will often hold water throughout the season, typically draining slower than the west and the northern portions of the wetland.

Hunted areas without ricefield bulrush in 2012:

Bull Lake (BUL) - Pit Blind 1
The perimeter of Bull Lake including the area around the blind was searched on foot. The southern portion around the outflow water control structure holds water late in the season, making the ground around it soft and difficult to walk through. The northern portion dries out much earlier and is easy to walk. The vegetation in the north portion is dominated by creeping

spike rush with some patches of common water plantain. The last time RB was found in at this location was along the western shore in 2002.

North Quigley Lake (NQL) – Hunt Blinds 1a, 2, and 3

Vegetation is dominated by wapato, smart weed, spike rush, large bunch rush, and reed canary grass. This wetland holds water throughout the year so only the shoreline was searched. Blinds 1a and 2 are easy to locate, with blind 2 located on its own island. Just north of blind 2 is an area that contains a substantial amount of bur-reed and looks as if it could potentially host RB. Reaching blind 3 is more difficult because of thick mud and wapto. Reed canary grass in front of blind 3 has a thick layer of thatch. Along the southwest corner of the wetland there are breaks in the reed canary grass which contain water pursalane and wapato. RB was last found in the southwest and southeast corner of this wetland in 2006.

Plantain Marsh aka Hall Lake (HAL) - Pit Blind 4

Much of Plantain includes a thick stand of reed canary grass with a heavy thatch layer. Before the perimeter of the wetland is mowed it can be difficult to effectively search this wetland. There are low spots in the middle of the wetland that have a large amount of creeping spike rush and smart weed. These low spots are the most likely place to find RB. The perimeter was searched by on foot and by ORV while the low spots were searched by foot. Most of the wetland will dry out early in the season except for the outflow water channel which often holds water much longer. RB has not been found at this location since 2005 but maintenance around the blind at the end of the season in 2012 is likely to cause a resurgence of RB. Maps and photos of maintenance areas are found below in the hunt blind and dike maintenance section of this report.

Note: The previously unnamed drainage pond just to the north and east of Plantain was named Tera Pond in the summer of 2011. This pond has steep slopes and is surrounded by reed canary grass. It contains water throughout the summer and is an unlikely place to find RB.

South Mantrap (MAL) – Pit Blind 5

The pit blind is easy to locate since it is out on its own island however reaching this island can be difficult depending on the water level. The shoreline was searched on foot and binoculars were used to scan areas for RB that were not easily reached by foot. There are not any previous RB locations in this wetland likely due to the high and persistent water level. South Mantrap is dominated by wapato, bur-reed, reed canary grass, bunch rush, and tule.

North Mantrap (NMA) - Pit Blind 6

The pit blind at North Mantrap is difficult to find because there are few landmarks that assist in locating it. The blind is on a hill looking west at the wetland and is surrounded by reed canary grass. The shoreline was searched by foot. The dominate plant species include wapato, water plantain, tule, and creeping spike rush. There are two former RB sites, one is in the wetland in front of the blind and the other is in the northern-most portion of the wetland.

North Tree Lake (TRE-N) - Blind 7 and Pit Blind 7

Most of the water in North Tree Lake is dominated by cattail, rush, and to a lesser amount tule. The box blind was easy to locate while the pit blind is much more difficult to find. The pit blind is concealed by reed canary grass and sits further away from the wetland then the hunt maps imply. The area around the pit blind tends to dry out earlier in the season then the rest of the

wetland while the pool surrounded by cattail often holds water later in the season. The entire shoreline was searched on foot.

North East Lake (NEL) - Blinds 8 and 9
The shoreline was searched on foot by a group of volunteers. Areas not dominated by reed canary grass contain bur-reed and smart weed. The reed canary grass that separates Blinds 8 and 9 contain a thick thatch layer. Open areas in the reed canary grass contain creeping spike rush and/or smart weed. There are two locations that once contained a small amount of RB, one near blind 9 and the other just south of blind 8. RB has not been found in North East Lake since 2003.

South East Lake (SEL) - Blinds 10 and 11
This area was searched by foot and is easily accessible from the Kiwa trail. The area around blind 10 has open vegetation and was easy to search. Reed canary grass, bunch rush, bur-reed, wapato, and spike rush are the dominate plants in the area. Blind 11 is much more difficult to search because of deep mud around the shoreline. The mud made it too difficult to search the shore across from the blind so binoculars were used to visually inspect all potential and previous RB locations. There are three former RB locations one across the shore from blind 11, the other two are locations are south and to the east and west of blind 10. RB was last found here in 2004.

West Lake (WEL) - Blind 12
The blind is found amongst reed canary grass and some upland meadow herbs and is not inherently obvious. Most of the southern portion is covered in thick reed canary grass and thatch with some scattered patches of wapato and within the open patches of reed canary grass there is smart weed and various rushes. Searching by ATV is difficult because the reed canary grass is so thick and it conceals most of the pothole openings of grass until you are right on top of them. Search carefully. The northern pool still contained water in the middle of August so the shoreline was walked.

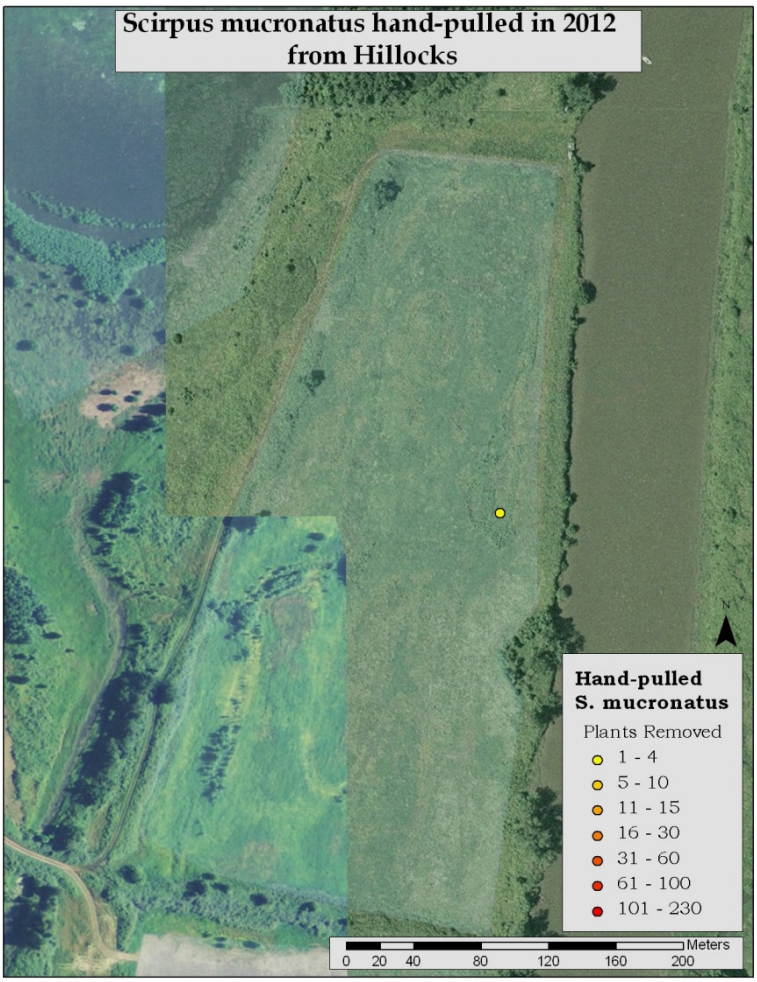
Deep Lake (DPL) – Blind 14
Most of the wetland contains reed canary grass with a thick thatch layer. There is a small patch of willows and red osier dogwood along the southwest side of the wetland and the only noticed location of water lily (pad radius of about 7inches). Other dominate plant species include bur-reed, large spike rush, smart weed, reed canary grass, and mare's tail (*Hippuris vulgaris*). The blind can be difficult to find, located behind some red osier dogwood that is surrounded by large bunch rush and just south and west of the patch of water lily and willow. RB was last found in the southeast corner of this wetland in 2005.

South Lake (SOL) - Blind 16
Much of the wetland is dominated by reed canary grass and a thick thatch layer with openings that give way to patches of smart weed. The blind can be found by going to the fence post and heading south to the patch of willows. Directly south of the blind is large bunch rush, wapato, and water plantain. The 2006 season is the last time bulrush was found here probably due to the reed canary grass growing in so thick along the west side of the wetland. The former patches of RB include in the northeast corner of the wetland, midway down the eastern shoreline, and one location just south of blind 16. RB was last found here in 2006.

Sora Marsh (SOR) - Blind 17
The northern leg primarily contains reed canary grass, cattail, spike rush, and smart weed while the southern boot portion has opening in the reed canary grass filled with creeping spike rush and bunch rush. The entire shoreline was searched by foot. RB was last found in at Sora in 2010 near the inflow structure, no plants were found in 2011 and 2012. Former RB locations include the northwest channel, just south of the blind, west of the blind, and across the blind along the eastern shoreline.

Non-hunted and not planted wetlands

Areas with ricefield bulrush in 2012:



Hillocks (HIL)
Total plants: 1
Much of Hillocks is dominated by reed canary grass however aerial images will show a well-developed stream pathway that leads from the Finger inflow water control structure, the Hillocks outflow water control structure, and the Hillocks inflow control structure. This pathway may potentially host RB and was searched thoroughly by ORV and on foot by the STEP employee and one volunteer. The entire wetland was searched again after one plant was found in the east side of the wetland where a tree had been removed in 2011. The dirt was disturbed in this area and the plant found had two culms and was yellowing from drought stress.

Areas without ricefield bulrush in 2012:

Dusky Lake & Campbell Lake
High water events generally occur on the refuge from April to June, during this time it can be difficult to access the Ridgeport Dairy Unit as the road can become flooded. During the 2010 high water period Fingers became so full of water that water backed up into the tidal-controlled

Campbell Lake. This likely also occurred during the much wetter 2011 high water period. During the 2012 season the STEP employee and one volunteer searched the Hillocks outflow drain into Campbell Lake as well as the inflow path to Fingers and Dusky Lake. RB was not found in these areas.

North and South Sand Pit Ponds
Both wetlands live up to their name and unlike any other wetland on the refuge contain sand. The southern portion of the North Pond contains lots of reed canary grass but after venturing into the trees there is an open area that hosted RB in 2003 and 2004. The former RB location is in the middle of this wetland where the current dominate plant species include creeping spike rush, tule, and cattail. As the trees have grown taller over the years, this area has become an area that is less likely to see RB again due to reduced sun exposure.

The northern portion of South Sand Pit is also dominated by reed canary grass and like North Sand Pit also contains trees that have grown tall enough to also reduce potential places to find RB. This wetland contains pools of stagnant water surrounded by cattails in many of the tree-shaded areas. Data from 2004 has made it difficult to tell if RB had ever been found at this location. There is only one shared record of RB for both North and South Sand Pit Ponds; this is the only year that provides a record for South Sand Pit.

Rest Lake (REL)
The first and only appearance of bulrush in Rest Lake was in the 2010 season. It was found along the shore of the southeast side across from Swartz Lake. The plant was large with many culms and mature seed heads. RB has not been found since 2010.

The water remains high for much of the season and is difficult to search on foot in most areas of Rest Lake. The shoreline outside the reed canary grass may look dry enough to walk on but the mud layer may actually be more than 1.5ft deep. The edges are fairly steep and uneven in some locations. The most significant plant type along the edge of the reed canary grass was bur-reed. The north portion near the outflow water control structure had better footing and it was possible to walk out onto the mud flat that is filled with tule, creeping spike rush, and smart weed. Along the western shore cattails and willows dominate.

In 2012 the Ricefield Bulrush Coordinator and AmeriCorp member searched the interior of Rest Lake by canoe and while the exterior shoreline was searched on foot by a volunteer. By mid-July the mud flats along the perimeter became exposed but not too dry for RB and the water was still deep enough in most areas to pass a canoe. Searching by canoe provided the best method to examine potential RB locations that are not easily reached on foot.

Millet (MIL)
The south portion of Millet contained a thick reed canary grass with some scattered patches of cattail and large bunch rush. The area surrounding the water outflow control structure contains open areas mostly home to creeping spike rush. Much of the wetland contains a thick layer of thatch from the prevalent reed canary grass. At the end of August 2012 this thatch layer was greatly reduced after the excavation of the swale that runs down the center of the wetland occurred to improve drainage of the wetland. The last occurrence of RB was in 2003, it was found in the northern portion of the wetland where the excavation occurred. Additional

information about the swale excavation can be found in the "Hunt blind, dike, and wetland drainage maintenance" portion of the "Management" section of this report. Photos illustrating the maintenance can be found in Appendix III.

Horse (HOR)
RB was once found along the western edge of Horse but has not been seen in this area since 2005. The vegetation at this wetland includes reed canary grass, with the low areas of the wetland containing spike rush and smartweed.

South Tree (S-TRE)
Water has remained in the southern portion of the wetland during the past two summer seasons. This area does not contain ideal RB habitat and is dominated by reed canary grass, smartweed, rush, and bur-reed. RB has not been found in South Tree since 2005 with much of it located along the western side of the wetland and at least one location in the southeast corner. The west side of the wetland includes a moss layer, creeping spike rush, and bur-reed.

South Quigley (SQL)
Cattail dominates much of South Quigley with open areas dominated by smart weed. At the end of August in 2012, nodding bur-marigold took over the open area. The only RB occurrence was in 2005 at the northwest portion of the wetland. The entire wetland was searched in 2012 on foot by the STEP employee and one volunteer.

Long Lake
There are not any recorded occurrences of RB at Long Lake likely due to prevalent deep water throughout the year, complimented by a steep shoreline. The shoreline was searched on foot and ORV in 2012. When walking along the center portion of the shoreline the slope becomes steep and visibility of the shoreline below can be compromised by large stands of blackberry.

Bachelor Island Wetlands

Previous ricefield bulrush locations:

Wetland 013-East & Shop Wetland (013-E)
Wetland 013-East is long and narrow and was searched by ORV in 2012. Much of the wetland is dominated by reed canary grass with scattered patches of cattail, bur-reed, smartweed, and various rush species. The only 013-East location of RB was found in the northern portion of the wetland which hosted water plantain, large bunch rush, and pennyroyal (*M. pulegium*) in 2012. Willows border the western shore of the wetland. The eastern side of Wetland 013-East can be accessed by heading north of the Bachelor Island house and east along the south portion of the cow pasture fence, once reaching the corner of the fence head north to search the eastern shoreline of Wetland 013-East or south to search the Shop wetland.

There is some assumption that the source of RB at the shop wetland is from washing equipment at the shop. There are only two RB recorded for both 013-East and the Shop Wetland in 2003. One location is recorded to in the northern portion of 013-East and one location in the northern

portion of the Shop Wetland; this suggests that only one plant was found at each location unless additional data is missing from records.

Wetland 013-West (013-W)

RB was only found at this location in 2003 along the western shore. The north portion of the wetland contains lots of water, reed canary grass, cattail, bur-reed, and smartweed. In areas that once contained RB there was rush and horsetail. In 2011 and 2012 the cow pasture fence did not allow travel south along the eastern shoreline. Search of the southern 1/3 of the wetland was accomplished from the west shore because the shoreline is less steep than the east side.

Wetland 013-South & Smith Lake (013-S)

Wetland 013-South is broken into two sections with the dike road and two water control structures separating the smaller northern from the much larger southern portions of the wetland. The south portion of Wetland 013-South is also known as Smith Lake and is the only known location of RB for Wetland 013-South. RB was only found in 2003. The wetland was searched by ORV. The western shoreline has steep slopes that sit much higher than the eastern shoreline. In many areas large patches of blackberry along the upper western slope obstruct the view of the exposed shoreline below. The shoreline in the northern portion of the wetland is very steep and dominated by reed canary grass and bur-reed.

Wetland 006 (006)

The only known occurrence of RB at Wetland 006 was in 2003. RB was found in the southern portion of the wetland and at two separate locations in the center portion of the wetland. In 2012 much of the wetland was filled with thick reed canary grass and a thick thatch layer.

Wetland 002 (002)

Areas where RB was found in 2003 are directly south of Wetland 013-South/Smith Lake. Much of the wetland is dominated by reed canary grass. The center swale contains cattail and smart weed. Most of Wetland 002 was searched from the dike road with binocular except for the southern shoreline which was searched by ORV.

Bachelor Island wetlands without a known occurrence of ricefield bulrush:

Wetland 012

RB has not been recorded at this site likely because it is dominated by reed canary grass. The most likely location to host RB is near the outflow water control structure where the reed canary grass opens up enough for water plantain and some rush to grow.

Wetland 016

This wetland is dominated by reed canary grass, a thick thatch layer, and some rush species along the shoreline. The bowl that contains this wetland is relatively shallow and often dries out early in the season.

Wetland 018

The Bachelor Island expulsion pump sits just north of Wetland 018. The area is dominated by reed canary grass, wapato, water plantain, bur-reed, creeping spike rush, smartweed, and cattail.

Wetlands 017a and 017b
These wetlands are often still filled with water at the end of the season. Both wetlands are dominated by reed canary grass and large bunch rush along the shoreline. Cattail is found in the southern portion of both wetlands. Both can be difficult to search because of the thick vegetation and the inability to see potholes that are along the jagged shorelines.

Wetland 015
The north end of this wetland is filled with tightly packed willows which open up to short reed canary grass that contain a thick thatch layer. There are some rushes along the west shore and some willows scattered all along the length of the wetland.

Wetland 014
Wetland 014 is dominated by reed canary grass and willows. The area looks fairly similar to its neighbor wetland 015.

Wetland 004
Much of the wetland is dominated by reed canary grass, willow, and ash trees. The southern shore was difficult to search so much of the wetland was searched from the dike road with binoculars.

05a Wetland, Wetland 005, and 001 Wetland
These wetlands are enclosed in three separate cow pastures and are not inherently obvious to locate. There are merely slight indentations in the topography. These three wetlands were completely absent of water when they were searched at the end of the season. All three had been mowed and/or grazed and did not appear to contain any other vegetation besides pasture grass.

Off Refuge Canoe Survey

A canoe search was conducted of Bachelor Island Slough and Lake River on August 23rd, 2012 by the Ricefield Bulrush Coordinator and the seasonal STEP employee in a canoe and one volunteer in a kayak. Water craft was launched from Bachelor Island at the ferry landing at 9am and returned at 2pm. Bachelor Island slough was searched from the Bachelor Island Bridge to the junction of the slough and Lake River. The water level in both Bachelor Island Slough and Lake River was low enough to expose mud flats on the shoreline but not so low that the entire Bachelor Island Slough was unnavigable by boat. The shoreline of both Bachelor Island and the River “S” Unit was searched. The search of Lake River included as far south as the 3030 gate on the Carty Unit to the Columbia River. Much of the shoreline searched was not ideal RB habitat due to steep and shaded shorelines. A thick stand of Indigo bush (*Amorpha fruticosa* L.) covers much of the shore along Bachelor Island and the River “S” Units but is also shaded by other tree species including Oregon ash (*Fraxinus latifola*) and willow. Other plant species that occurred along the shoreline include wapato, bur-reed, and spike rush. During the search one small patch of yellow-flag iris (*Iris pseudacorus*) was found along the Carty Unit shoreline where Lake River and Bachelor Island Slough meet, the plants were subsequently removed and their location was

recorded by GPS. No other significant invasive plant species, including RB, was found during the canoe search.

Season summary and wetland occurrence comparison

Table 5. Amount of ricefield bulrush hand-pulled each season by wetland from 2002-2012.

Legend
? = Plants found, unknown quantity
Blank = No Data
* = Applied Herbicide

WETLAND	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
#6	1,295	2,763*	810*	2,956*	22,318*	13,280	26,304	1,113*	207*	3,047*	10,962*
TEM	298	5,579	19,195	553*	13,680*	16,581	8,842	120*	20	390	27
PIM	231	618*	7,383*	656*	37*	389	909	56*	61	173	27
RUL	706	11,651*	16,001*	3,994	490	6,934	963	247	5,268	3,400*	1,205
SWL	1,130	2,291*	366	2,173	2,983	62	88	22	0	0	0
CAN	2,082	3,285	370	1,165*	26,914	4,806	4,005	12,891*	427*	4,549*	3,594
FIN	0	106	0	0	0	0	0	0	1,974*	1,650	154
#11	38	6	5	0	0	0	0	0	187	284	15
REL	0	0			0		0	0	1	0	0
HIL	0	0	0	0	0	0	0	0	0	0	1
SOR	300	268	18	19	8	8	17	8	1	0	0
SBL	205	109	71	45	0	2	0	0	0	6	1
NQL	580	647	294	34	18	0	0	0	0	0	0
TRE-S	139	69		41	6	0	0	0	0	0	0
SOL	137	357	58	37	1	0	0	0	0	0	0
SQL	?	0		17	0	0	0	0	0	0	0
NMA	0	0		14	0	0	0	0	0	0	0
HOR	4	9		1	0	0	0	0	0	0	0
HAL	7	24	3	1	0	0	0	0	0	0	0
DPL	12	129		1	0	0	0	0	0	0	0
SEL	13	1	3	0	0	0	0	0	0	0	0
WEL	14	6		0	0	0	0	0	0	0	0
NEL	5	2		0	0	0	0	0	0	0	0
TRE-N	0	0	18	0	0	0	0	0	0	0	0
BUL	?	0		0	0	0	0	0	0	0	0
MIL	0	1		0	0	0	0	0	0	0	0
MID	248	22	10	0	0	0	0	0	0	83	84
002	0	11		0	0	0	0	0	0	0	0
013-S	0	10		0	0	0	0	0	0	0	0
013-E	0	2		0	0	0	0	0	0	0	0
013-W	0	4		0	0	0	0	0	0	0	0
006	0	24		0	0	0	0	0	0	0	0
SPP-S	0	0	373		0		0	0	0	0	0
SPP-N	0	5		0	0	0	0	0	0	0	0
Total Plants (including test plots)	**7,444**	**10,676**	**44,978**	**11,866**	**68,962**	**42,245**	**41,295**	**14,496**	**8,152**	**13,582**	**16,070**
Infested Wetlands	18	27	16	16	10	8	7	7	9	9	10
Wetlands Sprayed		4	3	4	3	0	0	3	3	3	1


http://environment.com/index.php/2009/04/corkscrew-regional-mitigation-bank/disking-nov-07/

Management

Disking

Disking involves a tractor pulling large discs through soil. The discs break up the soil and can bury surface soil while bringing subsurface soil up to the surface. At the end of the 2010 season a disking/herbicide application strategy was implemented as an attempt to exhaust the RB seed bank from areas known to have occurrences of RB. The idea is to create ideal conditions for RB seed to germinate so plants can be sprayed with herbicide or hand-pulled from the ground. Wetland #6 and Canvasback were disked in 2010 with both experiencing an increased quantity of RB the following season. Both wetlands were subsequently sprayed with herbicide in 2011 to compensate for the large number of plants. In 2011 a large quantity of ricefield bulrush was found in Ruddy and it was decided that Ruddy would be prepared for disking in 2012. Herbicide was applied along the western shoreline of Ruddy to not only kill RB hiding in reed canary grass but to also to open up the shoreline for disking by killing the reed canary grass. In 2012 the disking of Wetland #6 and Canvasback occurred for the second time and for the first time at Ruddy. These areas will likely receive heavy herbicide application in 2013 and possibly disked again at the end of the season. Before and after photos of the 2012 disking can be found in Appendix II.

Hunt blind, dike, and wetland drainage maintenance

Hunt blind maintenance and deepening of some water channels occurred in 2012. Due to this maintenance, the 2013 season will likely have a resurgent in RB in areas that have not had RB since at least 2006. A reoccurrence of RB in front of Blind 13a after hunt blind realted maintenance has shown that any sort of earth movement in or along the shoreline of wetlands will increase the likelihood of RB resurgence. Improvements to the wetlands in areas hunted include scraping the area around blind 4 at Plantain in order to deepen the wetland for improved hunting opportunities, scrapping the center of Millet to improve drainage, and rebuilding the path to blind 14 at Deep Lake. The path to blind 8 at Northeast Lake was planned to occur but was not complete before this report was written. Other maintenance causing major earth movement includes scraping of the outflow water channel from Middle Lake and the scraping of the water inflow channel into Swartz. Both channel-related maintenance are unlikely areas to have an occurrence of RB because the slopes of the channels are relatively steep, however both were noted here as areas to watch in the future. See Appendix III for a map of the hunt blind and dike maintenance and photos of maintenance completed before September 6, 2012.

Recommendations for 2013

Large populations of RB are expected in 2013 at Wetland #6, Ruddy, and Canvasback after disking in 2012. It is likely that these areas will be managed with herbicide if the density and

distribution of RB prove to be more than can be efficiently hand-pulled by staff and volunteers. Depending on disking results at Wetland #6, Ruddy, and Canvasback, other wetlands that may benefit from disking/herbicide regiment include Wetland #11, Pintail, and Teal.

Areas that are likely to have a resurgence of RB in 2013 include Millet, Plantain, Northeast Lake, and Deep Lake due to wetland excavation and blind maintenance. Millet, Plantain, and Deep Lake once contained RB in the areas that received maintenance. North East Lake does not have RB recorded historically in the proposed maintenance areas though previous occurrences of RB at this wetland indicate that an RB seed bank is likely present thus warranting some extra attention in 2013. The water channel maintenance areas for both Middle and Swartz should be surveyed more than once over the course of the summer 2013 season in case proper RB conditions arise. It is also recommended that the Ricefield Bulrush Coordinator in 2013 confirm with the refuge Equipment Operator and Tractor Operator all wetland areas that may have been affected by earth movement-related maintenance over the past year to make sure these areas are also properly surveyed.

More obvious areas that will need attention in 2013 are wetlands that contained RB in 2012 including Wetland #11, Fingers, Middle Lake/blind 13a, Teal, Pintail, Hillocks, and South Big Lake. With the occurrence of RB in Hillocks for the first time this year, the inflow/outflow channels into Fingers, Hillocks, Campbell Lake, and Dusky Lake as well as the shore to Dusky Lake should continue to be searched in the future to avoid any potential RB seed from flushing out into the Columbia River system. Post Office Lake was not actively searched this season for RB however if and when additional flooding events occur at the refuge, it may also beneficial to expand the regular RB search area to include the shoreline of Post Office Lake, the Columbia River shoreline along Dusky Lake, and Lake River as far south as the southern tip of Post Office Lake. Less urgent areas that will need attention in 2013 include wetlands that contain hunt blinds and areas that have a historical record of RB.

References

The background section above was borrowed from *Control and Eradication Plan for Ricefield Bulrush (Scirpus mucronatus) at Ridgefield National Wildlife Refuge* (2002).

S. C. H. Barrett, D. E. Seaman. (1980). The weed flora of California rice fields. Aquatic Botany, 9: 351-376.

Brochet, A. L., Guillemain, M., Gauthier-Clerc, M., Fritz, H., and Green, A. J. (2010). Endozoochory of Mediterranean aquatic plant seeds by teal after a period of desiccation: Determinants of seed survival and influence of retention time on germinability and viability. Aquatic Botany, 93: 99–106.

Fischer, A. J., Strong, G. L., Shackel, K., and Mutters, R. (2010). Temporary drought can selectively suppress *Schoenoplectus mucronatus* in rice. Aquatic Botany, 92: 257-264.


09/01/2011


09/22/2011


Volunteers Search Private Duck Hunt Club for Invasive Plants
08/03/2012


09/24/2011


01/21/2012


08/08/2012

Comparison of photopoints taken 2009 and 2012 for fragrant water lily control, Middle Lake, Carty Unit, Ridgefield NWR

Ridgefield National Wildlife Refuge Invasive Species Spotlight

Ricefield bulrush (*Scirpus (Schoenoplectus) mucronatus*)

Ricefield bulrush is an invasive plant that is threatening the health of the refuge. An aggressive spreader, it crowds out other plants that wildlife rely on for food and cover. Due to volunteer efforts, ricefield bulrush on the Ridgefield Wildlife Refuge has been reduced and this plant has not yet been found anywhere else in the Pacific Northwest.

Look along edges of wet areas for...

Early in the summer, clumps of spongy, triangle-shaped stems emerge.

It's most distinguishing character is sharply triangular stems that are leafless.

As the plant matures and the flowers get larger, the stem bends at a 90° angle.

Clusters of young flower buds that develop on straight stems.

Full grown bulrush that can be over three feet tall.

Friends of Ridgefield NWR

This fact sheet is funded in part by a grant from the National Fish and Wildlife Foundation

Ridgefield National Wildlife Refuge Invasive Species Spotlight

Yellow flag Iris (*Iris pseudacorus)*

The dense mats of this non-native iris can crowd out native vegetation, trap sediment, inhibit flow in streams and rivers, and jeopardize habitat for fish and wildlife. The sap produced by this plant is poisonous to livestock and can cause skin irritation in humans.

Look along edges of wet areas for...

Early in the season, long thin leaves arranged in a fan shape

Clumps of Iris. You can still see the fan shape of individual plants.

Three sided seed pods that are 4 inches long.

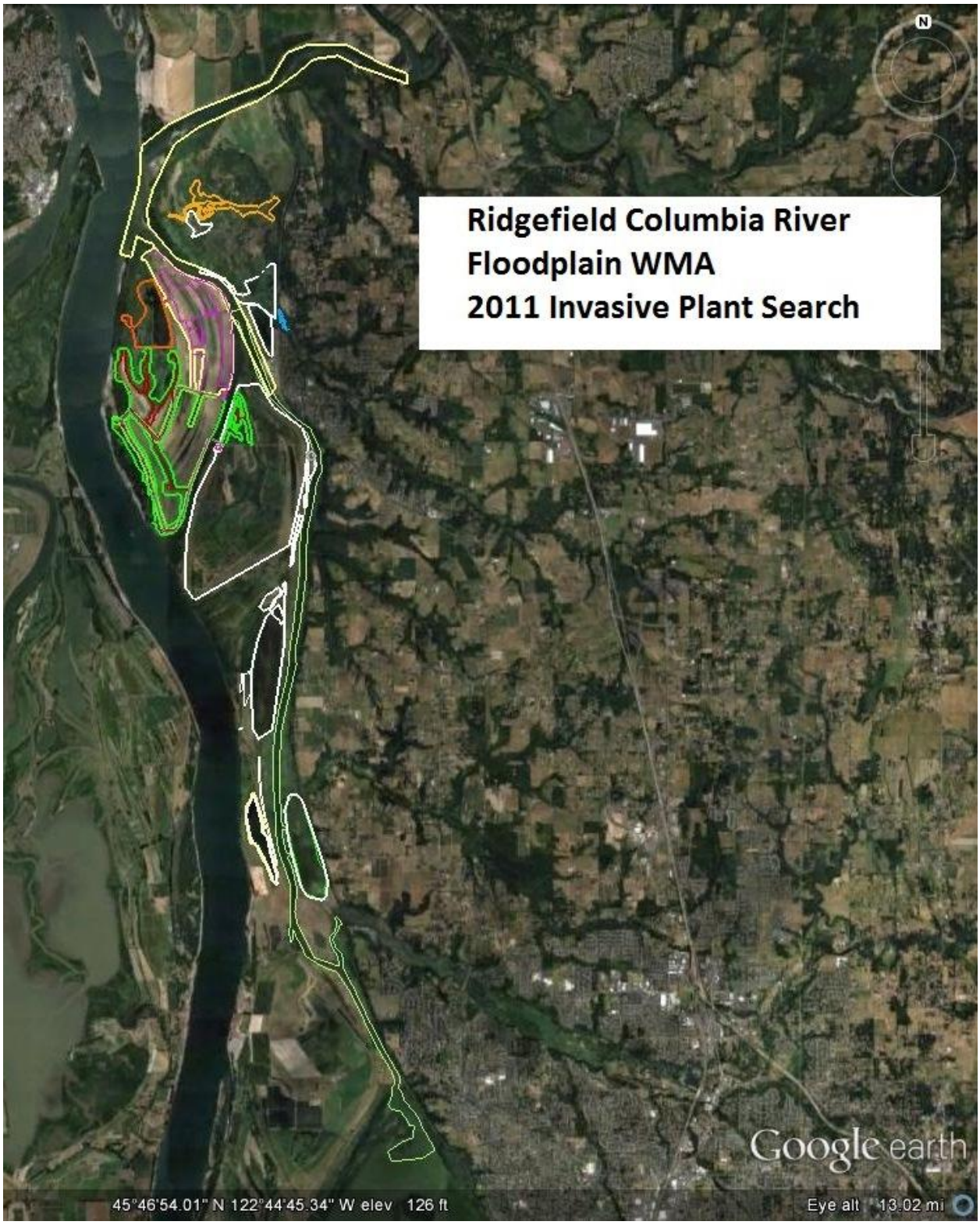
Bright Yellow flowers with three big petals

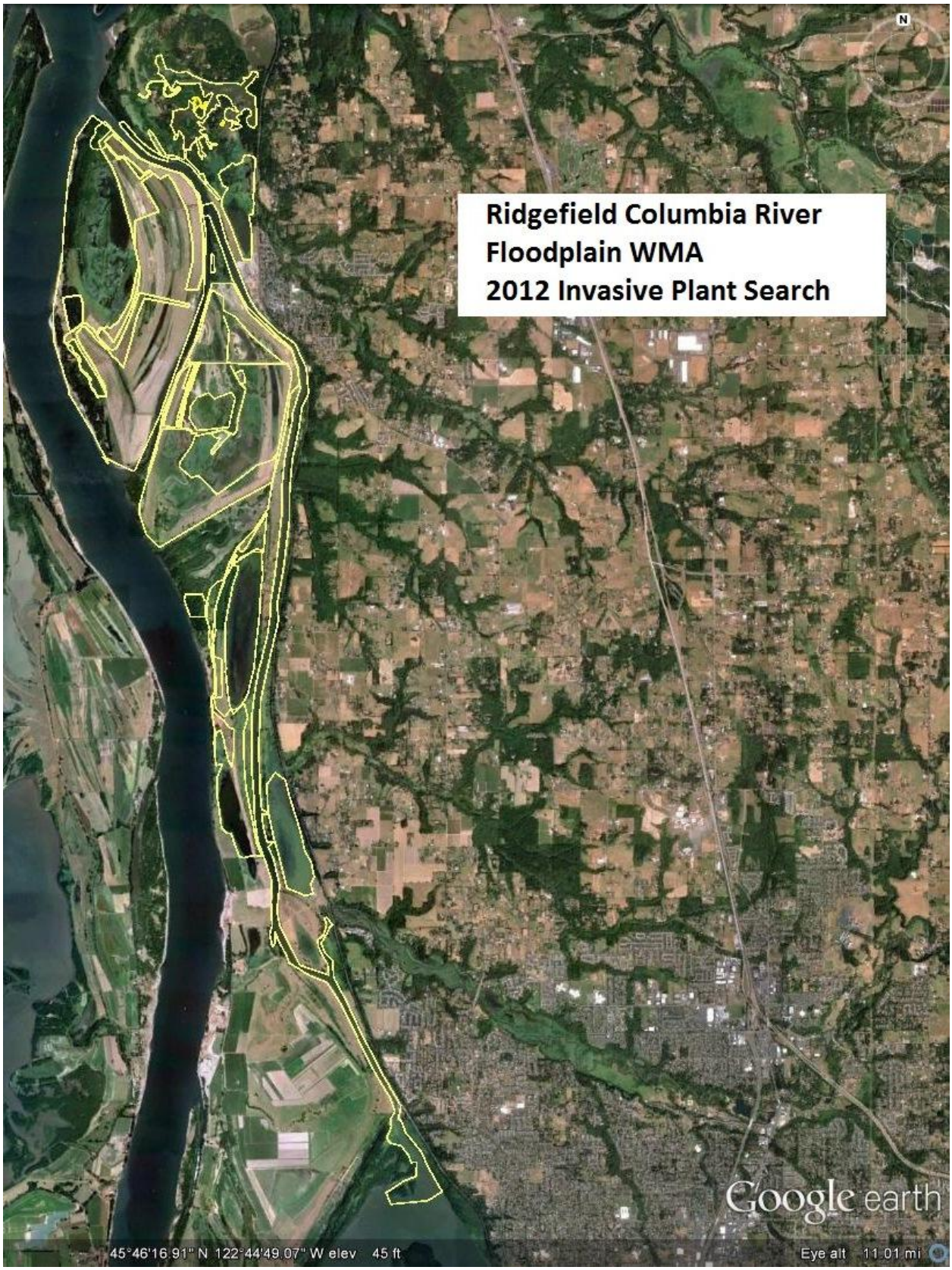
Iris crowding out other species

Friends of Ridgefield NWR

This fact sheet is funded by a grant from the National Fish and Wildlife Foundation


Ridgefield Columbia River Floodplain WMA
Restoration Planting Sites 2011-2012
Duck Lake Oak Planting 2011 & Cages
Riparian Replantings 2012 Roth Unit 2.0 ac
45°48'12.08" N 122°45'19.30" W elev 13 ft
Eye alt 26542 ft


Ridgefield Columbia River
Floodplain WMA
2011 Invasive Plant Search
Google earth
45°46'54.01" N 122°44'45.34" W elev 126 ft
Eye alt 13.02 mi


Ridgefield Columbia River
Floodplain WMA
2012 Invasive Plant Search
N
Google earth
45°46'16.91" N 122°44'49.07" W elev 45 ft
Eye alt 11.01 mi

RIDGEFIELD COLUMBIA RIVER FLOODPLAIN WEED MANAGEMENT AREA INTEGRATED WEED MANAGEMENT PLAN 2012 - 2017

Prepared By:

Lynn Cornelius
Habitat Restoration Coordinator
Friends of Ridgefield National Wildlife Refuge
December, 2012

Funded by a grant from the National Fish and Wildlife Foundation - Pulling Together Initiative
Project 2011-0034-020: Ridgefield Columbia River Floodplain Weed Management Area, WA

INTRODUCTION

Purpose

This plan is intended to summarize basic information on target invasive plant species occurrences, to document search, prevention and control methods used by Ridgefield Columbia River Floodplain Weed Management Area (WMA) partners, to identify resource sharing opportunities, and to communicate information among the partners and other interested parties. The plan will serve as a guide for coordinating efforts between each landowner and agency to prevent and control key invasive vascular plant species on their respective lands within the WMA. This plan is a living document and can be revised as needed. The plan will be reviewed on a yearly basis and the "Target Weeds" list adjusted as necessary.

A coordinated effort through a Weed Management Area approach to address invasive weed issues will result in:

- Better invasive weed control: Landscape level management and sharing of best management practices typically lead to more effective control plans and better implementation.

- Greater efficiency in use of funds and staff: Coordination helps distribute research and educational materials created by one organization to all the others; thus, duplication of effort is reduced and funds and staff can be redirected toward other weed management priorities.

- Early Detection, Rapid Response: Communication between agencies allows organizations to be aware of, identify, and control new invaders. This is the most cost effective way to control invasive weeds.

Authority

Authority for elements of this plan pertaining to the Ridgefield National Wildlife Refuge lies within the U.S. Fish and Wildlife Service 2010 Ridgefield National Wildlife Refuge Comprehensive Conservation Plan (CCP) and Environmental Assessment finding of No Significant Impact. This plan follows suggested management strategies outlined in the CCP's Appendix K, Ridgefield NWR CCP Integrated Pest Management (IPM) Program.

Permits and Licenses:

U.S. Fish and Wildlife Service policy requires that all Refuge herbicide applicators including volunteers hold a current Pesticide Applicator License with the State of Washington Department of Agriculture. Refuge applicators making aquatic herbicide applications in on or over water must also have an Aquatic Pest Control endorsement on their license.

The Refuge in 2012 obtained a required NPDES permit from the U.S. Environmental Protection Agency (EPA) for aquatic herbicide application in and over water on Federal Land. For other ownerships, coverage under the Aquatic Plant and Algae Management General Permit from the WA Department of Ecology may be required to apply herbicide to noxious weeds, native plants, algae, or nutrients that are in or around a waterbody (e.g. river or lake, ditchbank), or to in-water (floating or submersed) noxious weeds. (http://www.ecy.wa.gov/programs/wq/pesticides/)

GOAL

The goal of the Ridgefield Columbia Floodplain WMA is to prevent the introduction and control the spread of harmful invasive plant species in the WMA area by facilitating cooperative management among all willing land owners and managers. Goals of WMA partners are to restore, maintain and preserve native and introduced floodplain and associated upland vegetative communities, pastures and crops for the benefit of migratory birds, indigenous wildlife and the public, and to improve and maintain the condition of private managed pastures, croplands, and forestlands for landowners.

THE WMA APPROACH

A Ridgefield Columbia Floodplain Weed Management Area (WMA) committee was formed in 2010 with grant funding support from the National Fish and Wildlife Foundation to the Friends of Ridgefield National Wildlife Refuge. The committee meets annually and communicates regularly on invasive species issues to share information and resources. Primary partners within the WMA are listed below (* denotes landowning partners).

- *U.S. Fish and Wildlife Service-Ridgefield National Wildlife Refuge
- *Washington State Department of Fish and Wildlife (WDFW) - Shillapoo Wildlife Area (WLA)
- *Clark County Environmental Services - Vegetation Management
- *Plasnewydd Farms, LLC
- *Bachelor Island Farms, Inc.
- *City of Ridgefield
- *Private small acreage landowners along lower Gee Creek
- Friends of Ridgefield National Wildlife Refuge (Friends)
- Gee Creek Enhancement Committee volunteers
- Refuge and Friends of RNWR volunteers
- *Washington State Department of Natural Resources (WADNR Including the Natural Areas Program)

Occasional ad hoc partners:

- *Port of Ridgefield

General Strategies, Objectives, and Activities

(Adapted from Cooperative Weed Management Area Management Plan Outline format through the Western Invasives Network http://www.westerninvasivesnetwork.org/phpBB3/viewtopic.php?f=15&t=25)

1) Manage the WMA through information sharing and relationship building.
   Activities:
   a) Hold a WMA annual meeting, a knotweed coordination meeting, and at least one field outing.
   b) Use regular email and phone communications to share and seek advice among partners.
   c) Involve new partners to represent all major land managers, landowners, and others who work on weed issues in the WMA.
   d) Inform partners of new issues and opportunities.
   e) Develop an IWM Plan and update regularly.
   f) Develop long-term management objectives for weeds of concern, according to area prioritization.

2) Inventory and assess weeds
   Activities:
   a. Collect evidence of invading species by mapping locations with GPS and taking photographs.
   b. Maintain monitoring and evaluation programs.
   c. Develop risk assessment methodology and use it to assess potential invaders.
   d. Review the target weed list on a yearly basis.
   e. Track and assess weed spread.

3) Conduct outreach to raise awareness about weeds among the wider public.
   Activities:
   a) Produce an annual invasive plant fact sheet and post
   b) Hold annual field training for volunteer invasive plant hunters
   c) Promote general outreach and education through Clark County Vegetation Management programs, Refuge volunteer programs and events, Friends of Ridgefield NWR, Shillapoo Wildlife Area activities, and private organizations (such as the local Farm Forestry Association)

4) Sponsor effective and innovative weed control (and native plant restoration) projects.
   Activities:
   a) Prevent Introduction and Spread
   b) Conduct control projects c) Recruit volunteers, and take monitoring photos to show successful demonstration projects.
   d) Determine appropriate restoration strategies for affected sites.

OBJECTIVE: INTEGRATED WEED MANAGEMENT

The objective of this plan is to implement integrated weed management (IWM) practices through a WMA approach to contain, reduce, and remove occurrences of target weed species, including Washington State Class A Noxious Weeds, from lands and waters within the WMA and to prevent increases, additional occurrences, and new species from becoming established. IWM involves the integrated use of cultural, physical, biological and chemical control strategies to contain or eradicate populations of noxious weeds.

IWM programs contain the following principal components:

- gathering background information and conducting weed inventories
- setting management objectives
- establishing monitoring programs to inventory weed growth stages, locations, and acreage infested
- setting treatment action levels and treatment thresholds to determine if treatment is necessary
- using weed prevention measures and revegetation in a management plan
- applying effective, least-toxic management methods
- educating practitioners and the public
- evaluating the program

The IWM process considers factors from the entire system in which the noxious weed problem is occurring in order to find practical, effective solutions. The goal is to keep noxious weed populations low enough to prevent unacceptable spread, damage, or annoyance, and to encourage desirable vegetation to permanently replace the weeds.

General IWM Control Measures

(Adapted from Minnesota Department of Agriculture's IWM web site http://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/whatisiwm.aspx)

The goal of any noxious and invasive IWM program should be to combine the advantages of each control method to successfully suppress populations of undesirable plant species.

1. Prevention

This is the most effective and least expensive long-term management option for weeds. It encompasses methods to prevent new introductions or the spread of the established weeds to uninfested areas. It requires identifying potential routes of invasion to reduce the likelihood of infestation. Prevention may include source reduction, using pathogen-free or weed-free seeds or fill; exclusion methods (e.g., barriers) and/or sanitation methods (e.g., wash stations) to prevent re-introductions by various mechanisms including vehicles, personnel, livestock, and horses. Because invasive species are frequently the first to establish newly disturbed sites, prevention would require a reporting mechanism for early detection of new pest occurrences with quick response to eliminate any new satellite pest populations (**Early Detection/Rapid Response – EDRR**).

2. Mechanical Control

Mechanical control of weeds consists of using machines or other human-made tools to suppress weeds. Mowers, cultivators, saws, rakes, etc., are all examples of tools commonly used in mechanical weed management. The use of hand tools to physically pull or destroy weeds can be a very successful approach to managing small infestations of weeds. However, hand tools alone are impractical on large-scale weed problems. Mechanical controls like cultivating and mowing are generally used on larger populations of weeds to inhibit growth or reduce seeding. When used alone and on a large scale, mowers and cultivators can be disruptive to the greater landscape and may cause more problems than they solve. When used as part of an IWM program, targeted mechanical controls can play an important role in overall weed suppression.

3. Biological Control

Biological control, as it applies to weed management, is the use of plant-feeding insects, pathogens, or diseases that are host-specific to a noxious or invasive weed species, with the intention of suppressing the weed's population to an acceptable level. Biological control does not intend to eradicate the target weed species, but instead is used to bring the plant into balance with the rest of the landscape. It is important to note that successful biological control agents are specific to the plant they are intended to control. In other words, the biological control agent feeds and develops only on the intended weed species. Therefore, the risk to other plants and organisms in the ecosystem is minimal. Biological control is intended to be a cost-effective and long-term solution to weed management. It may take several years for biological control agents to establish, but once their populations begin to build-up to appropriate levels, they provide long-term suppression and reduce management costs significantly. Leafy spurge, purple loosestrife, and spotted knapweed are all examples of noxious and invasive weed species where biological control is successfully being used in Minnesota.

4. Chemical Control

Chemical control in weed management is the use of synthetic or naturally occurring compounds that are applied to noxious and invasive weed species with the intent of killing those plants. Chemicals (herbicides) range in selectivity to certain types of plants and their persistence within the environment. Herbicides are typically applied in dry (granular) or liquid forms. Some types of herbicides are applied before weeds

germinate (pre-emergent) and others are applied after germination (post emergent). Extreme caution must always be followed when handling or attempting to work with any herbicide. By law, all herbicides must be labeled according to their use and users must adhere strictly to label instructions and warnings.
Chemical controls are usually short-term solutions to weed problems. In some cases, herbicides have to be reapplied annually and certain weed species can begin to develop resistance or tolerance to specific chemicals. Furthermore, large-scale applications can be expensive and detrimental to the environment. However, when herbicides are used on a selective basis or as part of an IWM program, they are a very useful tool for managing weed problems.

5. Cultural Control

There are other ways to manage weeds by altering landscapes through human intervention. These methods would involve manipulating habitat to reducing its suitability to the weed. Cultural methods could include water-level manipulation, mulching, winter cover crops, changing planting dates to minimize pest impact, prescribed burning, flaming with propane torches, trap crops, crop rotations that would include non-susceptible crops, moisture management, addition of beneficial insect habitat, reducing clutter, proper trash disposal, planting or seeding desirable species to shade or out-compete invasive plants, applying fertilizer to enhance desirable vegetation, prescriptive grazing, and other habitat alterations.

6. Example

As an example, an IWM program for Canada thistle (*Cirsium arvense)*, may consists of multiple management scenarios throughout the growing season to achieve the most efficient suppression of this invasive weed in contrast to using any one given management practice by itself. Below are listed steps throughout the growing season that may be followed in a one-year Canada thistle IWM management strategy.

1. Fall (Late September, October): Spot spray or broadcast thistle plants/rosettes, overseed area with competitive native grasses and forbs. Leave mowing debris in place (e.g. blackberry canes, grass) to mulch bare soil against weed seed establishment.
2. Early spring (April - early May): Spot spray (or selectively broadcast) thistle rosettes with a selected herbicide.
3. Late spring (May - early June): Spot spray any emerging thistle plants.
4. Summer (Late June, July, early August): Mow thistle patches prior to seed development; release Canada thistle biological control agents.
5. Fall (Late September, October): Spot spray remaining thistle plants and/or rosettes.

SITE DESCRIPTION

The Ridgefield Columbia River Floodplain Weed Management Area (WMA) consists of approximately 9,800 acres of contiguous floodplain lowlands and associated uplands along the lower Columbia River between Ridgefield and Vancouver in Clark County, Washington. The proposed Weed Management Area in 2012 consists of approximately 5,200 acres on the Ridgefield National Wildlife Refuge (RNWR) and approximately 4,600 acres of other private, state, county and city lands (Figure 1). Floodplain habitats include deciduous riparian forest, managed (diked) and tidal freshwater wetlands, wet pasture, oak woodland shoreline, managed private forestlands, and more than 30 miles of lake, slough, creek, and river shoreline. The waters of the Columbia River connect these floodplain lands together through regular water flow and periodic flood events. Uplands areas within the WMA are in watersheds which drain into the floodplain.

Floodplain habitats are regionally important for wildlife and support large numbers of migratory and resident waterfowl (including dusky Canada geese, for which the Refuge was established in 1966) along with sandhill cranes, tundra swans, migratory songbirds, shorebirds, wading birds, juvenile salmonids, endangered and threatened species, and other native wildlife and plants. Floodplains are also productive sites for grain and hay crops and season-long livestock grazing. Upland habitats adjoining the floodplain are important for forest production and livestock grazing and include managed pasture, oak woodland with prairie remnants (grass "balds"), oak-conifer woodland, and managed deciduous-coniferous forestlands. These upland watershed slopes drain into the floodplain and also provide buffer to floodplain wetland habitats. Elevation within the WMA ranges from approximately 3 feet at fall low water along the Columbia River shoreline to 700 feet on the first zone of adjoining upland shoreline.

Primary habitat types within the WMA include diked and undiked (freshwater tidal) riparian floodplain and adjoining upland oak woodland/coniferous forest habitat. Riparian habitat includes channel, slough, river, lake and creek shorelines and associated current and former floodplain. Riparian plant communities include black cottonwood (*Populus trichocarpa*) forest on highest floodplain elevations, Oregon ash (*Fraxinus latifolia*) wetland forest on mid elevations, Pacific willow (*Salix lasiandra*) wetland forest (seasonal swamp), and herbaceous-dominated seasonally flooded wetlands characterized by reed canarygrass (*Phalaris arundinacea*), wapato (*Sagittaria latifolia*), and other wetland emergent forbs. Floodplain pasture habitat includes both diked and undiked converted floodplain indicated by introduced pasture grasses such as tall fescue (*Festuca arundinacea*), perennial ryegrass (*Lolium perenne*), orchard grass, and many other non-native species, with water foxtail (*Alopecurus spp.*) on wetter sites. Remnants of native Columbia sedge (*Carex aperta*) occur with pasture grasses on the wettest open tidal floodplain pasture sites. Wetland habitats include seasonal and permanent herbaceous wetlands on diked floodplain with managed water levels and freshwater undiked tidal floodplain, dominated by a variety of native and non-native submergent, floating-leaved, and emergent aquatic plants. Oak woodland consists of Oregon white oak woodland with shrub understory on shallow soil basalt outcroppings and naturally regenerated and planted second or third growth Douglas-fir (*Pseudotsuga menziesii*) dominated conifer forest on deeper upland soils. On some very shallow soil outcrops adjoining oak woodland at the north end of the WMA floodplain, grass-dominated "balds" contain remnants of native prairie plant species. Riparian areas along lower Gee Creek and lower Salmon Creek include stream banks dominated by red alder (*Alnus rubra*), big leaf maple (*Acer macrophyllum*), western redcedar (*Thuja plicata)*, Oregon Ash, and black cottonwood.

Land uses within the WMA include: Wildlife management, livestock (mainly cattle) grazing, waterfowl hunting, and public wildlife appreciation on the Refuge and on the Shillapoo Wildlife Area. Rural, rural-residential, and residential (primarily in the City of Ridgefield and Salmon Creek drainage) land uses occur in the watershed slopes above the floodplain. Further details on RNWR history and management can be found in the 2010 Ridgefield National Wildlife Refuge Comprehensive Conservation Plan (See References).

Ridgefield Columbia River Floodplain WMA 2010,
Primary land ownership boundaries

Green	Ridgefield NWR	**Brown**	Clark County
Purple	WDFW Shillapoo WLA	**Blue**	City of Ridgefield
Yellow	Private Large Acreage	**Red**	Port of Ridgefield
Pink	WA DNR		

IWM CONTROL PLAN

(This section includes general control measure format and text adapted from U. S. Fish and Wildlife Service 2002. Dinkler, D.R. USFWS Integrated Pest Management Plan, Maxwell National Wildlife Refuge, Colfax County, New Mexico. 42pp. http://nctc.fws.gov/CSP/Resources/MaxwellModelIPM_files/MaxwellModelIPM.pdf)

Target Species

Table 1 lists target weed species initially identified by WMA partners as of the greatest interest for prevention and control. Specific priorities among these species will vary between sites and land managers. New species will be added based on new information and partner interest.

Prevention

The ultimate control action against invasive plant species on the WMA will be to maintain healthy wetland communities, pastures, forests, and croplands and prevent new invasions by emphasizing an Early Detection/Rapid Response (EDRR) approach. Annual searches for invasive plants and rapid response to newly detected occurrences will be emphasized as the most efficient approach, especially along road, trail, and waterway corridors. Annual boat searches will be continued for major rivers, sloughs and lake waters.

In addition to current species and occurrences, WMA partners intend to prevent the invasion and proliferation of plant species likely to pose future problems to the area if not detected and controlled immediately. Refuge and Partner staff, owners, volunteers, and visitors will be trained to recognize these species and will remove any of these species found or will contact an agency partner such as the Refuge for help. Removal actions will occur as soon as possible following documentation, including mapping, preferably with GPS units.

Another aspect of prevention will be recommended emphasis on weed control along roadsides, ditch and dike banks, slough, creek and river shorelines in addition pastures, croplands, and hay fields, since these are key production areas of seeds of invasive weeds, and seeds from these sites are especially likely to be transported by vehicles or water to other locations. Prevention of spread by cleaning landowner equipment, vehicles, and boots before leaving contaminated areas is already practiced by agency partners. All equipment used off-road or in the field, including tractors, 4-wheelers, trucks and other equipment should be thoroughly cleaned with high pressure water or air spray equipment before being taken to another location away from the station. Equipment coming from another source should be cleaned before arrival or at a wash station and monitored afterwards. Cleaning vehicles and equipment travelling within public access routes within the WMA is not feasible (e.g. county roads, car visitors to the Refuge tour route, hunting access) but close monitoring and education will provide early detection/rapid response to these public uses.

Use of weed-free seed is recommended to land managers and lessees. (Ricefield bulrush was accidentally introduced (seeded) on the Refuge in 1999 through contaminated rice screenings from California, a by-product of rice harvest which was sought for its desirable waterfowl food plant seed content.)

Clark County has recommended sowing annual rye grass (*Lolium multiflorum*) on non-crop sites where vegetative cover and/or invasive plants have been removed, as a cover crop to reduce invasions or re-invasion and to reduce soil erosion. The Refuge volunteer applicator program has effectively seeded ryegrass onto bare soil as soon as moisture and temperatures are available for germination in early spring (Feb-Mar), and late fall (October) after rains commence, following treatment and mowing of dead blackberry canes. Where this was not done or delayed, many broadleaf weed species seedlings became established (mullein, thistles, tansy ragwort, prickly lettuce, and others).

Outreach & Coordination

Since weed plant invasions do not start or stop at the WMA boundary, working with neighboring landowners and other partners in the wider community will assist in the successful management of invasive plant infestations both on and off the WMA. The WMA coordinator and other WMA partner land managers will communicate with other local weed management area groups in the Region, including the Southwest Washington Cooperative Weed Management Area based in Longview, WA, the Gorge Weed Management Area in neighboring Skamania County, and the 4-County Cooperative Weed Management Area in Portland, Oregon.

In addition, the Refuge and WMA partners will familiarize all volunteers and staff with the WMA invasive species control program, and will produce bulletins and pictures of unwanted invasive species, enabling staff, volunteers, and visitors to assist in control efforts. Community volunteers will be educated by WMA partners during Refuge, County, and WDFW invasive plant and tree planting work events and annual Refuge trainings. On the Refuge more than 600 volunteer visits are made each year for invasive plant pulling, searching, volunteer applicators, and tree planting. Invasive plants and the purpose of restoration work are discussed at each hands-on work event, exposing many members of the community directly to invasive plant issues. Infestations of invasive species and their management will be an important subject for interpretation to Refuge, County, City, and WDFW lands visitors, as well as to refuge neighbors and the community in general. Staff, volunteers, and visitors will also be encouraged to look for and report easily recognized invasives, unusual, or uncommon plant sightings.

Mapping and Monitoring

To assist in strategy and planning control work, all target species locations will be mapped by GPS as feasible. If hand-mapped by volunteers, data points will be created in Google Earth or GIS depending on partner resources. Information will be shared with partners. The Refuge has GPS waypoints and/or pesticide application report boundary maps for nearly all wetland species and minor wetland occurrences on the Refuge, and for some occurrences on major waterways and private lands. WDFW and Clark County both keep records of locations and areas treated and private partners summarize areas treated. Licensed applicators keep a daily Pesticide Application Record as required by the Washington State Department of Agriculture. Refuge application records include a boundary map of the area treated and this is mapped as a polygon on Google Earth and saved as a kmz file. All refuge and adjoining property mapping will be entered into the Refuge GIS system as resources and staff expertise permit.

WDFW keeps detailed monitoring records and has analyzed control efforts for purple loosestrife over the last few years. Clark County vegetation Management closely monitors locations and has done test studies on treatment effectiveness for some target species. Refuge monitoring consists of GPS mapping and permanent photopoints established for test trials and to document large scale, long term control results on species such as Himalayan blackberry (including at restoration planting sites), yellow flag iris and ricefield bulrush. Two permanent sample transects for ricefield bulrush density to monitor the results of spray/disk treatments were established in 2010 and 2012 on the Refuge.

Mechanical, Cultural, Biological, and Chemical Control Measures By Species

Many fact sheets with details for control of target invasive plan species are readily available for western Washington and Oregon. Only key features, local search and control, and first-hand experiences by WMA partners are presented here. Basic details of the species biology and reproduction are included as a refresher

and as background to support search and treatment approaches. Much of the information presented on the following pages was taken from existing fact sheet and control documents, primarily Clark County Vegetation Management, Thurston County Noxious Weed Control, King County Noxious Weed Control, and other agency programs in the Pacific Northwest. Clark County weed species fact sheets summarize chemical control details and timing, recommend application of chemicals only during the growing season, and recommend for many species both a Spring and Fall application. Clark County adds a further reminder for the public that only licensed professional applicators can use herbicides in wetland or aquatic areas and to check chemical labels for proper use, restrictions and relevant information (see References). For small occurrences, many invasive non-woody herbaceous plants in late or post-flower with ripe seed can be pulled and bagged since herbicide application would not kill the seed already formed. Plants collected should be bagged and carefully transported to avoid spreading the plants beyond the infested area. See Clark County and other weed fact sheets for more details on the species listed below. The WMA Coordinator has copies of Clark County fact sheets for most target species in .pdf form obtained from:

Clark County Vegetation Management
11104 NE 149th Street Building C Suite 200
Brush Prairie Washington 98606
Telephone 360-397-6140 Fax 360-759-6557
Email: weed.management@clark.wa.gov

Ricefield bulrush

Ricefield bulrush is perennial sedge growing typically 2-3 feet at maturity, with tiny seeds which can remain viable for many decades in wetland soils. Identification of this plant can be difficult unless plants are found with mature flower stems. The best search time is July to October. The production of reproductive structures (spikelets) occurs at Ridgefield NWR from mid-July to October, with apparently ripe seed developed by August. In California ricefield bulrush is described as a weak perennial that usually behaves as an annual.

This plant is a problematic weed in 43 countries, and is especially a problem in ricefields worldwide. It has documented resistance to herbicides, making it especially difficult to control. In Washington State, it is currently only known from managed seasonal wetlands on the River S unit of the Refuge, where it was accidentally introduced in 1999 during wetland habitat restoration projects which brought in contaminated seed materials from the ricefields of central California – the nearest population in North America.

The Refuge conducts focused search and control over nearly 400 acres of habitat each year, and has consistently sprayed and hand-pulled this plant to contain and reduce the population on the Refuge since 2002. In 2012 the Refuge hand pulled with volunteers more than 16,000 bulrush plants, sprayed additional areas with Aquaneat and Polaris herbicide, and expanded a disking and spraying approach to speed depletion of the seed bank. Hand pulling is an effective treatment. Plants in late or post-flower with ripe seed are pulled and bagged since herbicide application would not kill the seed already formed. No biological control is reported. There is some history of cultural control through manipulation of water levels in rice fields. Equipment and boots of personnel and volunteers are cleaned on site with a portable battery sprayer and vehicles are air or water cleaned at base stations to prevent spread after entering bulrush wetlands when soils are wet enough to adhere.

Purple loosestrife

Purple loosestrife is a long-lived wetland perennial that can reach over 9 feet tall, but flowering stems can range from 2-7’ tall. Plants can produce over 2 million seeds the size of ground pepper. This plant spreads by seed and root fragmentation. Flowering time in the WMA is Mid-July to Early October. Best time to search

is during peak flowering period July 15-Aug 15 when brightly colored flower stalks can be seen from a distance in shorter vegetation. Seasonal floodwaters can bring in new plants and several single plants have been discovered in the WMA in new locations, at higher elevations following the prolonged high water of May/June/July 2011. Insect biocontrols have proven very effective on large populations. A small population of plants was effectively treated on the Refuge in early to late flower, including smaller plants at the base of larger individuals, with aquatic imazapyr (Habitat, Polaris) using backpack and small bottle sprayers. Hand pulling is an effective treatment when in muck soils or soft ground the entire root system can be pulled or dug. Plants in late or post-flower with ripe seed should be pulled and bagged since herbicide application would not kill the seed already formed. WDFW has conducted the most search, control and monitoring of treatment effectiveness for purple loosestrife within the WMA.

Clark County IPM control measures: Mechanical: Pulling, digging – small young plant, bag and dispose in garbage. Mowing and cutting – destroying the stalks and preventing seed production. Remove flower heads and place in a bag to dispose in the garbage. Do not compost. Cultural: Covering with black plastic/cloth can help prevent plant photosynthesis and can kill young plants. Using mulch prevents sun from penetrating through to loosestrife plants and can help control plants. Biological: *Hylobius transversovittatus* (root beetle), *Galerucella pusillia* (leaf beetle), *Galerucella calmariensis* (leaf beetle). Clark County Vegetation Management has more information. Chemical: several compounds are effective, generally applied from spring to fall, varying with the product used: triclopyr, imazapyr, glyphosate, and metasulfuron.

Fragrant water lily

A perennial floating aquatic plant typically found in 3 to 6 feet of water. Usually flowers June to October – flowers are large, usually white to pink with many pointed petals. After fertilization, the flower stalk curls like a corkscrew, drawing the flower underwater. This plant reproduces by floating seeds and thick, fleshy rhizomes. Seeds move by wind and wave action and rhizome pieces can break off, establishing in new locations. Plants spread quickly and widely - one rhizome can cover up to a 15-foot diameter circle within five years. Best search time is when plant is in flower June – October. It is difficult to positively distinguish the leaves from our native pond lily which has ball-shaped yellow flowers. Treatment requires an aquatic permit to apply on or over water. The only know population within the WMA is Middle Lake on the Refuge Carty Unit, subject to annual tidal floodwaters. The plant has been effectively reduced by 80% over 3 years using foliar applications by boat of 1% -1.5% aquatic glyphosate with .5% Agridex or LI700 surfactant. The nearest occurrences for this plant in Washington are reported from Cowlitz County.

King County IPM Control Measures: Mechanical: Dig up small isolated patches, making sure to get the entire rhizome. Make sure to remove all pulled/cut plant pieces from the water. An opaque bottom barrier can be used to suppress growth in small areas such as a boat launch or around a swimming area. Underwater rototilling of the rhizomes using a backhoe mounted to a barge and cutting and harvesting using boat-mounted cutters are options for large scale removal and control. All manual control methods that disturb lake bottoms, wetlands or streambeds require at a minimum an HPA pamphlet permit from the WA Dept. of Fish and Wildlife. [Mechanical methods, however, risk stirring up seed and releasing rhizome pieces which can float off to spread the plant.] Hand pulling by an AmeriCorps crew in 2009 on the Refuge location discovered rhizome buds which floated loose during hand digging and were found on the lee shore of the lake. Biocontrol: No effective biocontrol has been reported.

Slenderflower thistle, Italian thistle

Slenderflower thistle is a winter annual broadleaf weed and it is very similar in appearance to Italian thistle. Typically slenderflower thistle germinates in the fall, over winters as a rosette, and flowers in late spring. Slenderflower thistle reproduces by seeds only. Best search time on the Refuge has been when plants are in

flower, May-June, beginning earlier than Canada thistle, from which it can be difficult to distinguish when not in flower. Refuge staff and Clark County Vegetation Management have effectively treated this plant in early flower on Refuge roadsides and road tracks with a selective broad leaf herbicide such as triclopyr, leaving grass cover as competition to reduce the chances of plants reestablishing.

TABLE 1. INITIAL TARGET WEED SPECIES, RIDGEFIELD COLUMBIA RIVER FLOODPLAIN WMA

Identified by WMA partners as the greatest interest for prevention and control. Priorities among these species vary between sites and land managers.

Common name	Scientific Name	Primary Habitat	WA Noxious Weed Class*	Location/Comments
ricefield bulrush[+]	*Shoenoplectus mucronatus*	wetland	A	Only known from managed wetlands on the RNWR, River S Unit - introduced with contaminated seed 1999
purple loosestrife[+]	*Lythrum salicaria*	wetland	B	Local populations on RNWR River S, Bachelor Island, lower Lewis River, Shillapoo Wildlife area, and Vancouver Lake wetlands.
fragrant water lily	*Nymphaea odorata*	wetland	C	Only population in middle Lake, RNWR, Carty Unit
slenderflower/Italian thistle[+]	*Carduus tenuiflorus/pycnocephalus*	upland	A	Several sites on dry uplands, road tracks, gravel roadsides - including a new site in 2012 in oak savannah on the RNWR Carty Unit
yellow flag iris	*Iris pseudacorus*	wetland	C	Widespread - scattered in RNWR tidal wetlands, along tidal slough and river shorelines, floodplain pasture.
poison hemlock	*Conium maculatum*	upland	B	Frequent in pastures and woodland edges.
milk thistle[+]	*Silybum marianum*	upland	A	Infrequent in one location on RNWR Ridgeport dairy, ,
Japanese knotweed[+]	*Polygonum cuspidatum*	wetland/upland	B	occurrs in substantial amounts along lower Gee Creek within the City of Ridgefield much reduced by city and volunteer control efforts 2009-2012; scattered pls on RNWR.
shiny geranium[+]	*Geranium lucidum*	upland	A	Discovered 2012 on one oak woodland outcrop island on RNWR, Carty Unit
indigobush[+]	*Amorpha fruticosa*	wetland	B	Prevalent along open (non-forested) slough and river shorelines, occasionally at upper flood line in floodplain pastures.
diffuse, spotted knapweed[+]	*Centaurea diffusa, C. stoebe (maculosa)*	upland	B	3 small populations On sandy dredge spoil and higher elevation Columbia River beach on the RNWR;
Canada thistle	*Cirsium arvense*	upland	C	Prevalent in pastures and fields, upland openings, highest floodplain.
tansy ragwort[+]	*Senecio jacobea*	upland	B	Prevalent in pastures, fields, upland openings
bull thistle	*Cirsium vulgare*	upland	C	Occasional in pastures, field, upland openings
reed canarygrass	*Phalaris arundinacea*	wetland	C	Widespread - dominant monoculture in managed wetlands and open seasonal floodplain
Himalayan blackberry	*Rubus discolor/armeniacus/bifrons*	upland/wetland edge	C	Widespread on uplands and wetland edges
English ivy	*Hedera helix, H. hibernica cultivars*	upland	C	Several small sites in floodplain and upland forest on RNWR, Shillapoo WLA.
water speedwell	*Veronica angallis-aquatica*	wetland	Not Listed	Identified at Shillapoo WLA
Scotch broom[+]	*Cytisus scoparius*	upland	B	Two occurrences on sandy dredge spoils RNWR, cleared upland forestlands.
prickly lettuce	*Lactuca serriola*	upland	Not Listed	Of interest in Refuge upland (oak woodland) restoration plantings, Carty Unit
meadow knapweed[+]	*Centaurea jacea x nigra*	upland	B	One plant removed from RNWR public access roadside in 2009.
bittersweet nightshade	*Solanum dulcamara*	upland/wetland edge	Not Listed	Common along lower Gee Creek climbing on trees and logs and in moist uplands.
WATCH LIST (Not yet found within the WMA)				
garlic mustard[+]	*Alliaria petiolata*	upland/riparian	A	Nearest population is in lower Salmon Creek watershed.
giant hogweed[+]	*Heracleum mantegazzianum*	upland	A	Nearest occurrence reported in past was Vancouver Lake area

Table 1 Legend

**Class A Weeds*: Non-native species whose distribution in Washington is still limited. Preventing new infestations and eradicating existing infestations are the highest priority. Eradication of all Class A plants is required by law.

Class B Weeds: Non-native species presently limited to portions of the State. Species are designated for control in regions where they are not yet widespread. Preventing new infestations in these areas is a high priority. In regions where a Class B species is already abundant, control is decided at the local level, with containment as the primary goal. Please contact your County Noxious Weed Control Coordinator to learn which species are designated in your area.

Class C Weeds: Noxious weeds which are already widespread in WA or are of special interest to the state's agricultural industry. The Class C status allows counties to enforce control if locally desired. Other counties may choose to provide education or technical consultation.

[+]This species is on the Washington quarantine list (known as the prohibited plants list) and it is prohibited to transport, buy, sell, offer for sale, or to distribute plants or plant parts of this species, into or within the state of Washington. It is further prohibited to intentionally transplant wild plants and/or plant parts of this species within the state of Washington.

Clark County IPM control measures: Mechanical: Cultivation (disc, hoe, till, slashing) – Good results if done repeatedly before seed formation. Slashing is more effective than mowing as it destroys the above ground part of the plant completely. If pulling or digging, remove as much of the taproot as possible to prevent future growth. Mowing – Fair short-term control when done on a regular basis prior to seed formation. Repeated mowing is required as plants emerge due to seed production possible in plants as small as 8 cm in length. Cultural: Grazing – Sheep will graze on plants and have been proven effective in reducing infestation. Re-seeding – Grasses/native vegetation can help reduce re-growth and other weed establishment. Biological: Clark County Weed Management has information re *Psylliodes chalcomera* (Flea Beetle), and *Rhinocyllus conicus* (Weevil).

Yellow flag iris

Yellow flag iris is an emergent aquatic perennial and typically grows up to 5-6 feet tall with showy yellow flowers which open from late May to July. It spreads both by rhizomes and by seed which grow in large seed pods. The seeds are about 1/4 inch in diameter and have the ability to float. Best search time in our area is usually May 1-June 15 when plants can be easily spotted from a distance. Iris can remain green much of the winter in mild years. Small infestations of yellow flag iris may be pulled or dug out, since the sap is poisonous and may cause a skin reaction, hand protection has been recommended. Care should be taken to remove all rhizomes as regrowth will occur from missed rhizomes. The Refuge has used recommendations to treat iris with aquatic glyphosate with more (1%) surfactant to help the product stick to the smooth vertical leaves. However, these herbicides kill all plants leaving little competition and create an opening for other weed species, so careful application to only the iris will preserve other competing vegetation cover. During prolonged high floodwater in 2011, iris in undiked areas on and adjoining the Refuge were resubmerged in May and when floodwaters subsided in July, were observed to be stunted in growth and did not produce seed. Iris on the Roth unit of the Refuge was observed not only along the edges of slough channels, but well up into forest/pasture edge where only the highest floodwaters reach each year. Flower stalks with mature (brown) seed can be cut and bagged for removal to prevent spread. No effective biocontrol has been developed.

Clark County IPM control measures: Efficacy tests showed good results when injecting hollow flowering stems with aquatic glyphosate.

Poison hemlock

This species is a biennial, producing large rosette leaves during the first year of growth. During the second year the plant may grow to a height of up to 12 feet. It is a biennial, reproducing by seeds only. Each plant is capable of producing up to 38,000 seeds, which can remain viable in the soil for up to 6 years. Caution: The entire plant is toxic to humans and animals. Poison hemlock remains toxic for several years after being pulled, and it is wise not to leave the dead plants where they might be eaten by wildlife or children. Follow-up planting of any bare or disturbed area is recommended to provide competition with hemlock seedlings that will emerge from the seed bank in the soil at infestation sites. Manual removal can be effective but contact with this plant is not recommended. WDFW at Shillapoo WLA has cut hemlock with a shovel just below the ground - cutting the tap root - and plants do not seem to ever re-sprout. This is done when plants are found that have bolted and flowered or just before they bolt, usually when staff do not have a sprayer or there is risk of drift to nearby plants. Plants will reportedly re-sprout if cut above ground and if mown while it is

still green, it will still continue to grow and flower in the same season. Although manual control efforts are reported successful, it has been found that the disturbance of soil resulting from manual removal methods encourages germination of seeds at infested sites. Solid carpets of hemlock seedlings are not uncommon. Biocontrol: The Defoliating Hemlock Moth is available and has been released in Thurston and other counties in Washington but results have been reported highly variable and almost completely ineffective in Thurston County. Best search time: this plant can be seen easily when flower stalks elongate.

On the Refuge, poison hemlock plants persist within the edges of dense shrub thickets of snowberry and rose. The flower stalks emerge above the tops of the shrubs and are very difficult to access for effective treatment to lower leaves or rosettes. Under cattle grazing on the Refuge, in areas where cattle lie down under shade trees, little grass or other competing ground vegetation survives and the only herbaceous plants in some spots are poison hemlock. Establishing competition is difficult.

Clark County IPM control measures: Mechanical: Digging or repeated cutting after plant has developed stalks can prevent seed production. **Use extreme caution and use gloves when handling Poison hemlock. **Do not put Poison hemlock in compost or incinerate. Cultural: Good vegetative cover lessens likelihood of initial infestations. Biological: *Agonopterix alstroemeriana,* (defoliating moth) –Clark County Vegetation Management has more information. Chemical: Several products are effective, most applied from the rosette to bolting stage. Plants can also be treated with glyphosate in a cut-stem injection treatment.

Milk thistle

Milk thistle is a biennial or winter annual thistle, growing up to 6 feet tall, with very large, white-marbled leaves. Ingestion by grazing animals may cause nitrate poisoning, which can be lethal to cattle and sheep. No biocontrol agents are reported effective for use in western Washington and are not an appropriate control for this Class A weed which must be eradicated. Refuge plants have been both dug and sprayed with a selective broadleaf herbicide to favor grass competition and reduce the chances of seedling reestablishment. No consistent observations are yet available to assess treatment effectiveness on the single location on the Refuge. Plants in late or post-flower with ripe seed have been pulled and bagged since herbicide application would not kill the seed already formed.

Clark County IPM control measures: Mechanical: *Mowing – 2 to 3 times throughout the summer and fall months while the plants are growing, but before development of flower heads will help in short term control. *Mowing prolongs plant survival for years and is not recommended as the only means of control. Cultural: Sod competition can help decrease infestation numbers. Grazing – use of goats has been effective in controlling large infestation numbers. Biological: *Rhinocyllus conicus* (seed head weevil) – contact Clark County Vegetation Management for more information. Chemical – plants can be effectively treated with several herbicides available to the public, in both spring and fall from rosette to after bolting stage.

Japanese knotweed

This is one of 4 species of invasive knotweed in the Pacific Northwest. A perennial which blooms July to October, the plant can reach four to eight feet in height with long creeping rhizomes and is often shrubby. Male and female flowers are produced on separate plants. This perennial plant is difficult to control because it has extremely vigorous rhizomes that

form a deep, dense mat. In addition, the plant can resprout from fragments. Along streams, plant parts may fall into the water to create new infestations downstream. In Clark County, Clark County Vegetation Management has led the way in directing large scale control programs along major rivers and streams. Best search time is June-October when plants are tall, but plants can be spotted in spring before grasses grow tall. Control is challenging due to the deep seated roots and developing resistance to herbicides. Gee Creek volunteers and the City of Ridgefield have been aggressively injecting and spraying the core population of this plant in the Gee Creek Watershed from Pioneer Street to Main Ave and have significantly reduced (75-90%) the number and size of plants since 2004. Herbicides effectively used on knotweed include glyphosate (also licensed for injection application), triclopyr, and imazapyr. Rotating products each year is reported to help reduce herbicide resistance. The Refuge has been spot-treating small knotweed along lowermost Gee Creek and although general observations reveal no increase and definite eradication of some well-marked individual stems, small plants <24 inches tall appear to persist at some locations. Refuge early detection search efforts found new locations of single plants in 2011 along Campbell slough and on lower Gee creek in 2012.

Clark County IPM control measures: Mechanical: Do NOT mow. This will cause it to spread further through fragmentations. Do NOT spread Japanese knotweed stem and crowns. If you cut down Japanese knotweed, it is best disposed of on site. Use plastic sheeting and or thick cardboard to prevent soil contact. Do NOT spread soil contaminated with Japanese knotweed roots and rhizomes. Any soil that is obtained from area within seven (7) meters of a Japanese knotweed plant could contain live rhizome buds. The rhizome is highly regenerative and will readily grow into new plants. Do NOT chip Japanese knotweed material. Mechanical chippers do not kill Japanese knotweed. If you spread the chipped material on soil, Japanese knotweed will re-grow from rhizome buds or stem nodes. Do NOT add Japanese knotweed to compost. Compost Japanese knotweed separately, so that you can ensure it is dead before you use it for mulching. Cultural: Not effective. Biological: No biological controls are currently available in the United States. Chemical: Foliar treatment with imazapyr and glyphosate from late spring to first fall frost. Glyphosate can also be applied by stem injection from June to first fall frost. Knotweed has shown herbicide resistance.

Shiny geranium

Shiny geranium is predominantly an annual weed though it may become biennial depending on moisture conditions. Flowering is from April-May to July. By late June and July, seed formation is completed and the plant material melts back into the forest floor. Seed germination is in late summer to early fall. The seeds are small and rapidly transported to uninfested areas on boots, vehicles, and by wildlife. Boots should be cleaned off before leaving a site to prevent seed spread. A similar annual, herb Robert (*Geranium robertianum*), produces seed that can be viable for 3-5 years. In Europe, shiny geranium is described as growing up to 0.5 meters high and being very shade intolerant. Here in the Pacific Northwest, it is predominantly an oak and ash forest understory species, shade tolerant and only seen up to 10 -12" high but is also found along roadways and open forest edges. Best search time is spring (April/May on the Carty Unit of the Refuge) when in flower and the bright red stem color is most easily visible beneath deciduous shrubs. No approved biological control agent is currently available. This plant was just discovered on the Refuge Carty Unit in spring of 2012 as a ground cover beneath snowberry, rose, poison oak, and shrubs along the edges of oak woodland. No control information has been developed for the Refuge population yet but DNR has been working on this species at the Washougal Oaks

Natural Area Preserve in Clark County and other practitioners have been working in Skamania County and in Oregon. In the Portland area, control methods for G. lucidum include: (1) hand-weeding for isolated plants or small populations, (2) burning with a propane-based flaming unit (effective if done several times each growing season, and (3) chemical control with a 1.5 to 2% solution of either a broadleaf selective herbicide such as triclopyr, or a non-selective herbicide such as glyphosate.

Clark County IPM control measures: Mechanical: Hand-pulling is effective. During flowering, plants pull easily. Bag the pulled plants and dispose. Do not compost; seeds may mature even after plant is pulled. Do not mow - mowing is not effective, as the plant will re-grow with multiple flowering stems. Cultural: After spraying or pulling plants, sow annual rye grass seed to provide ground cover, where appropriate. For infestations away from seasonal flooding, if spraying or pulling is not desired, cover with cardboard. Overlap the cardboard and top with bark mulch. Biological: No biological controls currently available in the United States. Chemical controls include selective and non-selective herbicides applied late fall through early spring until seed pods (or flowers depending on the product) begin to appear

Indigobush

Indigo bush is a perennial shrub species reaching 20' tall that reproduces by seeds. This is a Class B Noxious weed In Washington but control is not required in our region (Clark, Cowlitz and Skamania Counties) within 200 feet of the Columbia River, acknowledging that the plant is already well established along river shorelines. Although an invasive non-native shrub which can dominate shorelines, Phil Burgess of Clark County Vegetation Management cautioned that the plant does provide erosion control for shorelines and removal or control should consider replacing plants treated with native shrubs and trees for erosion control. This plant is already well-established in monotypic stands along the main shorelines of the WMA along the Columbia River, Lake River, and the lower Lewis River. During a boat survey for invasive plants along Lake River in 2011, observers noted that where native tree and shrub cover was intact and overhanging the shoreline bank, indigobush was not present. On the Refuge, current thinking is to control indigobush within diked areas, along internal tidal slough and stream corridors such as Gee Creek and Campbell Slough where the plant has not yet become established and higher floodplain pastures where the plant occurs in a zone which corresponds to extreme annual high floodwaters. The Refuge has successfully treated this plant with both glyphosate and triclopyr foliar applications made during late summer and early fall. Cut-stump treatment with 50% glyphosate or triclopyr was tried at Pierce NWR with mixed results. IPM measures: Replanting treated riparian shorelines with native species such as willow, ash and cottonwood to shade out indigobush.

Canada thistle

Most WMA partners are familiar with this plant and its control. Canada thistle is a colony-forming perennial growing from deep and extensive horizontal roots. Canada thistle differs from other species of the true thistle in that there are male and female flower heads and these are on separate plants. By asexual reproduction it is possible that a colony of male plants would produce no fruits, but still maintain itself. Flowering occurs during July and August. The plant spreads primarily by vegetative means and secondarily by seed. Seed dissemination occurs 2-3 weeks after pollination. Plants grow rapidly from seed and flower the second year. The root system can be extensive with individual roots living up to two years. New root buds

develop in autumn after the death of aerial shoots. The plant can reproduce through seeds, roots or stems with most reproduction occurring through seed dispersal onto bare shorelines. Best time to search: late June/July when plants are in full flower.

The Refuge treats pasture fields in spring for broadleaved weeds including using Dicamba/2,4-D and recently tried experimental applications of aminopyralid (Milestone). Refuge volunteer applicators spot treat thistle before flowering in late spring/early summer. Clark County has worked with the Refuge to release three different biological control insects on several plots of Canada thistle since 1988. Canada thistle is also mowed by the Refuge when pastures are mowed for goose grazing July 15 to October.

Clark County IPM control measures: Mechanical: Mowing is critical to prevent seed production, will require mowing 2-3 times during each season. Disking/plowing/grazing is not effective; Cultural: Sod forming grasses (lawns) – healthy thick sod competes with weeds and reduces infestation. Weed barriers (horticultural) – eliminate sun and decreases weed growth Plant competition (pastures) – Alfalfa and perennial grasses can help reduce weed infestation. Biological control involves four species of insects. Several types of broadleaved and general herbicides can be effective for control, and both spring and fall application may be required during the growing season generally from rosette to early bud stage. Chemical: Several selective and non-selective herbicides are effective, applied in spring and fall from rosette to early bud stages depending on the product.

Tansy ragwort

Another very familiar species to partners in the WMA, tansy ragwort is classified as a biennial herb and is toxic and Poisonous to cattle, horses, sheep, pets and people; a. Toxicity of the plant remains even when it is dried and baled in hay. Flowering occurs June to October, forming seeds in August. but can reoccur with rain in early fall following summer drought in our area. It can complete its life cycle as a winter annual and occasionally as a perennial, depending on environmental conditions. Some plants may become perennial if mowed, grazed, or otherwise disturbed. As a biennial, tansy ragwort spends the first year in the rosette stage. The size of the rosette may indicate the potential for flowering, with larger rosettes producing more flowers. During the second year, one or several flowering stems bolt, with the overall plant typically being two to five feet high. Tansy ragwort has a taproot, and often a large woody rootstock. Initial infestation is by seed. Best time to search is when in flower when plants are easily visible.

Clark County IPM control measures: Mechanical: Pulling - good results when entire root is pulled with stem prior to seed formation – soil should be moist, surrounding soil left undisturbed. Follow up by filing hole or mulching area after pulling. Failure to remove the entire root may result in re-growth from fragments. Cultivation (disc, plow, hoe, till) – Fair results if done before flowers mature, mulch recommended. Disturbing soil may provoke new seedling growth. Mowing – Fair short-term control; must be mowed prior to seed formation. Repeated mowing required as new flowers emerge from cut plants. Poor long-term control; natural biennial life cycle is curtailed resulting in perennial stage of plant growth. NOTE: Any mature flower heads should be collected and removed to a landfill to prevent seed development and re-seeding. Cultural: Grazing – goats/sheep both will graze on plants and are effective in reducing plant infestation. Mulching – used to cover cleared areas, it can slow down re-establishment of plants. Re-seeding – grasses/native vegetation can help reduce re-growth and other weed establishment. Biological: Biological control efforts in Thurston

County have consisted of the distribution of three effective biological agents: the Cinnabar Moth (*Tyria jacobaeae*), which defoliates the plant, a flea beetle (*Longitarsus jacobaeae*), that mines the root system, and a seed fly (*Pegohylemyia seneciella*), that consumes the seeds. Flea beetle and cinnabar moth are measures listed in Clark County. Chemical controls include broadleaved and general herbicides applied Chemical controls include broadleaved and general herbicides applied spring to fall, in rosette to pre-flower stage (or actively growing, depending on the product).

Bull thistle

Bull thistle is a biennial with a short, fleshy taproot, with wind-scattered seeds produced in mid-summer. Flowering occurs from July through September, which is the best search time when plants are tall and visible, although first-year rosettes are easily identifiable. Clark County IMP control measures: Mechanical: Digging plants (at rosette stage) prior to bolting/stem elongation is most effective when entire root is removed. It is critical to prevent plants from producing seed. Mowing will only be effective if performed once plant bolts, and prior to flowering (several mowings may be needed as new stems bolt). Cultivation will effectively control bull thistle infestations. Cultural: Grazing – animals may be effective. Results are best when animals are introduced when stems bolt. Fertilization – make applications in spring and early summer to promote desirable plant cover to compete with thistle infestation (minimizes thistle germination and development). Biological: *Urophora stylata* (seed head gal fly) Clark County Weed Management has more information. Chemical: several products will effectively control this plant with timing dependent on the product for both spring and fall treatments at both the rosette and flowering stages. See Clark County weed fact sheet for more details (see References).

More than one partner reports that cutting flowering plants with a shovel just below the ground has worked to kill flowering bull thistle plants which did not resprout.

Himalayan blackberry

Himalayan blackberry and the less common similar but divided-leaf evergreen blackberry (*Rubus laciniatu*s) is a perennial semi-evergreen woody plant that can reproduce from seed, root crowns, root pieces, and stem cuttings. Canes of Himalayan blackberry can grow ten feet tall and over twenty feet long in a single year. The cane dies at the end of the second year although the plant will continue to live by producing new canes each year from root crowns. Best search time: Blackberry is easily identifiable throughout the year and the red/green leaves and stems can stand out in winter among dead weed and grass cover and deciduous shrubs and trees.

Clark County IPM control measures: Mechanical: Mowing – shows little long term effect (can help reduce plant size to prepare for other control methods; Pulling – shows little effect (only reduces size of above ground plant) Digging – may be effective for small, young infestations; Cultural: Grazing – goats/sheep both will graze on plants and are effective in reducing plant infestation; Mulching – used to cover cleared areas, it can slow down re-establishment of plants; Re-seeding – grasses/native vegetation can help reduce establishment of berries and other weeds. Biological: No biological controls are currently available in the United States. Chemical: Triclopyr and glyphosate have been used effectively used as foliar and stump cut treatments. Triclopyr leaves grass to recolonize where blackberries were removed and the County recommends best treatment is from green fruit to first frost (Late July to early November most years). Plasnewydd Farm saw noticeable improvement in

control when using this timing window. The Refuge has used this timing with good success on blackberry, then mowed after one month in late fall and seeded with Gulf annual ryegrass which significantly reduced broadleaved weed establishment. Follow up with spot treatment of re-sprouts or new seedlings was necessary for at least the first 2 years and thereafter only occasionally within new oak woodland shrub plantings. Spring applications are also listed under County control measures.

English ivy

English ivy (and similar Atlantic/Iris ivy cultivated varieties) is an evergreen climbing vine that attaches to the bark of trees, brickwork, and other surfaces by way of small rootlike structures which exude a sticky substance that helps the vines adhere to various surfaces. Vines may grow for up to ten years before producing flowers. With enough light, terminal clusters of small, pale yellow-green flowers are produced in the fall. The flowers are attractive to flies and bees in search of late season nectar sources. Black-purple berry-like fruits are produced and spread by birds and other wildlife.

Clark County IPM control measures: Mechanical: If climbing trees – pry small vines off the bark with a large screwdriver. Cut large vines with loppers or a saw, then pull the vine away from the base of the tree. If on the ground – can be hand-pulled with some difficulty. For large infestations, chop through ivy roots in a line, then peel back the mat of ivy into a large roll. Repeated pulling will likely be required. Cultural: For ground infestations (when practical) place cardboard over entire area, then cover with several inches of bark mulch. This covering should remain in place for at least two growing seasons. Biological: No biological controls currently available in the U.S.A. Chemical: Due to ivy's thick waxy leaf, herbicides should be coupled with a surfactant/penetrant. Late spring may be the best time for foliar sprays, after light-green new leaves form. English ivy is best controlled by combining mechanical and chemical methods – two examples: 1) Mowing ground infestations will stimulate the growth of new leaves, which absorb foliar herbicide much better due to less wax build-up on the cuticle. 2) After cutting large tree-climbing vines near the ground, apply concentrated herbicide. Triclopyr and glyphosate are recommended by Clark County, along with a 2% Scythe (fatty acid based) /glyphosate mixture.

Shillapoo Wildlife Area, the Refuge, and Clark County have been successful in cutting main stems to kill aboveground vines on trees and hand pulling ground material in small infestations. Other practitioners report success with late fall/winter foliar applications from Nov through Feb which minimize damage to native trees and shrubs which are leafless. The Refuge has had 90% success using two years of foliar treatment on ground ivy with 3-5% Glyphosate in November and January on a dry day with mild temperatures. Effects were not visible however, for several weeks. Shillapoo Wildlife Area reports success with stump application of Triclopyr/2,4-D concentrate.

Scotch broom

Scotch broom is a perennial evergreen shrub that reproduces by seed, roots and plant fragments and is a relatively limited occurrence within the WMA. Mature shrubs are about three to six feet tall and grow best in drier areas with full sunlight and well-drained soil. It does not grow well in forested areas but will quickly establish itself after land clearing activities. Seeds from pods can be thrown 20 feet. Found on the Refuge on sandy substrate dredge spoils and along river shorelines on sand, gravel and on dike roads on the north end of

the WMA. Best search time – the plant is evergreen and can be identified at all times of year. Showy yellow flower clusters occur from March- June on mature plants.

Cowlitz County IPM Control Measures: Mechanical: Pulling small plants is easily done after a rain when the soil is loose. Remove all root system, which may re-sprout if left in the ground. Repeated pulling may be required for several years. Mowing small plants can be effective, especially when broom is under drought stress. Cutting plants at ground level at end of the season can help reduce sprouting. Follow up with stump chemical treatment for best results. Cultural: Competition by planting native vegetation like trees and shrubs can be effective in a long-term management plan. Canopy shade has reduced broom infestations. Biological: There are two biological controls currently in use in Washington State showing success - Seed-feeding beetle *Exapion fuscirostre* and seed-feeding beetle *Bruchidius villosus.* Chemical: Spring foliar spray -best when applied to growing plants in early spring to early summer: Garlon 3A, Garlon 4 & 4 Ultra, Crossbow, and Milestone VM Plus. Brush-on application of herbicide - applied to cut plants at end of summer: Roundup PRO, Crossbow.

Reed canarygrass

Widespread as a dominant monoculture on seasonally wet sites and pastures in the Pacific Northwest, reed canarygrass is not a target of focused control efforts at scale on the WMA but is managed in the short term on specific wetlands on the Refuge and the Shillapoo Wildlife Area through draining and disking, and by herbicide pre-treatment prior to restoration plantings of trees and shrubs on unmanaged floodplain sites. Refuge volunteer applicators treated canarygrass with glyphosate in 2010, 2011, and 2012 in both spring and late summer/early fall as a site preparation prior to tree and shrub plantings. These treatments appeared to reduce the plant for one season, with best results from the late summer/fall applications. Stands were, however, well-established at the end of the following season. Much research has been done in the last decade on canarygrass biology and control, but no significant large-scale solution for land managers who prefer other species has been developed.

Other Species of interest:

Water speedwell

A biennial or perennial wetland herb widespread in temperate North America, this plant is uncommon in the Pacific Northwest in or along slow-moving streams in the lowlands. WDFW reports this plant of concern on the Shillapoo Wildlife Area. Other sites in the WMA should be monitored for this species, which needs to be identified from other native species of speedwell.

Prickly lettuce

Prickly lettuce is a very tall winter annual which can reach 8 feet. The plant forms a rosette of leaves after emergence, usually in autumn (also in spring), and develops a long taproot. It overwinters as a rosette, and then produces one or more flowering stems in early summer with flowering in July and August. More than 40,000 dandelion-like seeds can be produced by larger plants and are readily spread by wind from the tall stalks which can rise above other vegetation. All plants die after flowering. Best Search time is any time during the growing season when rosettes or the tall stalks can be identified. The

milky juice and row of spines down the underside of the leaves are key features. This plant has been noticed in the last few years on the Refuge along roadsides, invading open upland fields, and appearing on upland sites after clearing blackberry. Prickly lettuce appears to seed readily. Preventing seed production is important to controlling this plant. The Refuge has seeded newly cleared areas with annual ryegrass to reduce establishment of this and other broadleaved herbaceous weeds, and spot-treated weeds with triclopyr to encourage grass cover prior to replanting with native trees and shrubs. Prickly lettuce has acquired resistance to Group II herbicides (includes imazapyr) in the northwestern United States and Australia. The sticky white sap found in this plant discourages hand pulling. For small infestations, stems with viable seeds can be cut and bagged for removal.

Diffuse, spotted, and meadow knapweeds

Diffuse knapweed is an annual to short-lived biennial or perennial plant that grows up to 40 inches tall from a long, stout tap root. First year plants form rosettes but even very small plants can produce flowers on 12" stems. Spotted knapweed is a close relative and similar in appearance. Plants bloom from July to October with white, pink or lavender flowers. When flowers are mature, the plants dry up and break off at ground level, becoming tumbleweeds. Plant readily establish from seed so preventing seed production is key to controlling these species. Knapweed plants compete on hard, dry roadsides, sandy or gravelly soils. On the Refuge, knapweed occurs at dredge spoil sites on sand and along gravel roadbeds. Also found in old gravel pits, dry riverbeds, shallow rock outcrop soils, and other similar sites.

Meadow knapweed, a fibrous rooted perennial knapweed with larger flowers, is established in several locations and along roadsides in north Clark County, one plant appeared on the Refuge along a gravel roadside at the River S. Unit entrance bridge in 2009 and was treated before flowering – an example of Early Detection/Rapid Response at work.

Thurston County IPM control measures: Large, stout tap roots make diffuse and spotted knapweeds difficult to remove manually. Mechanical: Small, isolated infestations can be dug out if the soil is damp or sandy or using a weed digger tool. Be careful to collect and dispose of all the pieces of roots and crown to prevent them from re-establishing, and double bag flowering parts to prevent seed spread especially during transport. Mowing is largely ineffective because knapweeds are persistent and the remaining tops of the plant produce flowers below the mowed height. The Refuge has reduced three small populations on dredge spoil sands by early detection and hand pulling - making 2-3 visits in late spring and early summer before plants produce seed and leaving vegetative plants dropped on-site to prevent travelling seed in dirt on the roots. Cultural: The most effective control of these knapweeds is prevention. In some situations, cultivation combined with re-seeding, fertilization and irrigation have been part of an effective control regimen. Above all, prevent plants from going to seed. To prevent plants from spreading from known infestations, carefully clean vehicles, boots, clothing, and pets after visiting infested areas.

Bittersweet nightshade

Although active control of this plant has not been discussed in detail by partners, bittersweet nightshade is included as a significant problem in some areas, especially along lower Gee Creek. This plant is common along lower Gee Creek on and off the Refuge, making dense blankets of climbing vines (like ivy) on standing and fallen trees and shrubs. No focused control has yet been implemented. Individual nightshade plants are also common as small plants within some managed wetlands and ash stands on the River S Unit of the Refuge. Nightshade is a woody perennial shrub or climbing vine. The plant flowers mid-May to September and forms bright red berries. Reproduction is by abundant seed production and vegetatively from stem and root fragments. Plants may grow in dense patches or individually. Branches grow and die back 3 to 6 feet or more each year and are known to climb 30 feet or higher into trees. Caution**:** All parts of the plant are toxic to people, pets and livestock. Nightshade outcompetes native species such as salmonberry, red osier dogwood and willows and can take over small streams causing channel disruption. The plant can grow in a wide range of conditions, from relatively dry to flooded soils and from full sun to medium shade. Best search time: the woody vine clusters can be recognized at all times of year, smaller individual plants are most easily recognized by the distinctive leaves with lobes at the base.

King County IPM Control Measures: Mechanical: [Hand pulling or digging can be effective but all parts of this plant are poisonous and contact is not recommended]. In addition, even a small root or stem fragment left behind can re-sprout. Cutting plants to the ground and then covering with a heavy duty geotextile fabric securely fastened for at least two years. Chemical: Apply to foliage at a time when plants are actively growing often just prior to flowering, or treat plants in the fall before leaves begin losing their green color. Products containing glyphosate are effective when applied after berries have formed or in the early summer after the plants have fully leafed out, but before flowering. Selective broadleaf herbicides with the active ingredient triclopyr work well and they won't harm most grasses Choose a formulation that is appropriate for the site: either aquatic or terrestrial. Follow the label exactly as written and only use at the rate that is prescribed on the label. Caution: bittersweet nightshade is often found growing in or adjacent to water. When using herbicides in a riparian or wetland situation, be certain that no terrestrial herbicide is sprayed into or over water or in such a way that it may move into water. When controlling bittersweet nightshade in these wet sites, it is best to select an herbicide labeled for aquatic use. In addition, the applicator is required to be properly licensed with an Aquatic Pest Control endorsement in Washington.

REFERENCES

Clark County, WA. Department of Environmental Services, Vegetation Management. Weed fact sheets for: Garlic mustard, Purple Loosetrife, Shiny Geranium, Blackberry Species, Japanese Knotweed, Bull Thistle, Canada Thistle, Poison Hemlock, Giant Hogweed, Meadow Knapweed, Milk Thistle, Slenderflower Thistle, and Tansy Ragwort. Hard copy or .pdf available by contacting: 11104 NE 149th St C-200, Brush Prairie, WA. 98606, 360-397-6140, weed.management@clark.wa.gov, http://www.clark.wa.gov/weed/index.html.

Cowlitz County Noxious Weed Control Board. Scotch Broom Cytisus scoparius, control measures document. 2pp.
http://www.co.cowlitz.wa.us/noxiousweeds/download%20documents/County%20documents/Scotch%20broom.pdf

King County, WA. Noxious Weed Control Program. Weed Alerts and Best Management Practices publications for: Purple Loosestrife, Bittersweet Nightshade, Yellow Flag Iris, Tansy Ragwort, Fragrant Water Lily, and Japanese Knotweed.
http://www.kingcounty.gov/environment/animalsAndPlants/noxious-weeds/brochures-reports.aspx.

Oregon State University Extension Service, 2006. Problem Thistles of Oregon. EC1288. Revised 2006. 4pp.
http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/18905/ec1288.pdf

Oregon State University Extension Service, 2006. Bennett, Max. Managing Himalayan Blackberry in Western Oregon Riparian Areas. EM8894, Reprinted Feb, 2007. 16pp.
http://extension.oregonstate.edu/catalog/pdf/em/em8894.pdf

Soll, Jonathan. 2005. Controlling English Ivy in the Pacific Northwest. The Nature Conservancy. Revised 2005. 12pp. www.invasive.org/gist/moredocs/hedhel02.pdf

Thurston County Noxious Weed Control. Noxious Weed Fact Sheets for: Diffuse Knapweed, Herb Robert, Milk Thistle, Poison Hemlock, Scot's Broom, Shiny Geranium, Tansy Ragwort. http://www.co.thurston.wa.us/tcweeds/order.htm

U.S. Fish and Wildlife Service, Ridgefield National Wildlife Refuge, 2012. Ricefield Bulrush (Scirpus mucronatus) Field Report. Tera Hinkley, Sept. 19, 2012, unpublished report on file at Ridgefield National Wildlife Refuge, Ridgefield, WA. 25pp.

U.S. Fish and Wildlife Service. 2010. Ridgefield National Wildlife Refuge Comprehensive Conservation Plan. 701 pp.
http://www.fws.gov/pacific/planning/main/docs/WA/docsridgefield.htm

University of Nevada Cooperative Extension. 2010. Fact Sheet -10-28. A Northern Nevada Homeowner's Guide to Identifying and Managing Prickly Lettuce. 2pp.
http://www.unce.unr.edu/publications/files/nr/2010/fs1028.pdf

Washington State Department of Agriculture, Plant Protection Division, 2010. Plants and Seed Whose Sales Are Prohibited in Washington State, A Summary of Current Regulations on Sales of Noxious Weeds and Other Invasive Exotic Plants. Available on Washington State Noxious Weed control Board website:
http://www.nwcb.wa.gov/siteFiles/ProhibitedPlants.pdf

Washington State Department of Agriculture, 2008. Aquatic Weed Management Fund Final Report, Grant Number G0500123, Yellow Flag Iris Control and Eradication. Bridget Simon, June 30, 2008. 10pp. http://www.ecy.wa.gov/programs/wq/plants/weeds/YFI%20Final%20Report%20to%20DOE%206-30-08.pdf

Washington State Department of Ecology. Non Native Invasive Freshwater Plants Technical Info web pages for: Indigobush. http://www.ecy.wa.gov/programs/wq/plants/weeds/aqua014.html

Washington State Noxious Weed Control Board, 2007. Written Findings of the State Noxious Weed Control Board, for Schoenoplectus mucronatus, Amorpha fruticosa, and Geranium lucidum. http://www.nwcb.wa.gov/siteFiles/

Washington State Noxious Weed Control Board. 2012. Washington State Noxious Weed List (by scientific name). http://www.nwcb.wa.gov/siteFiles/2012%20State%20Weed%20List_Scientific_Name.pdf

Washington State University Extension. 2006. Nightshade Biology and Control in the Pacific Northwest, PNW0588. T.W. Miller and R. Parker. 8pp. http://cru.cahe.wsu.edu/cepublications/pnw0588/pnw0588.pdf

Western Invasives Network website. Cooperative Weed Management Area (CWMA) Management Plan Format for 4-County CWMA and Columbia Gorge CWMA. http://www.westerninvasivesnetwork.org/phpBB3/viewtopic.php?f=15&t=25

.