Rare Plant Monitoring Report for Calendar Year 2011

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

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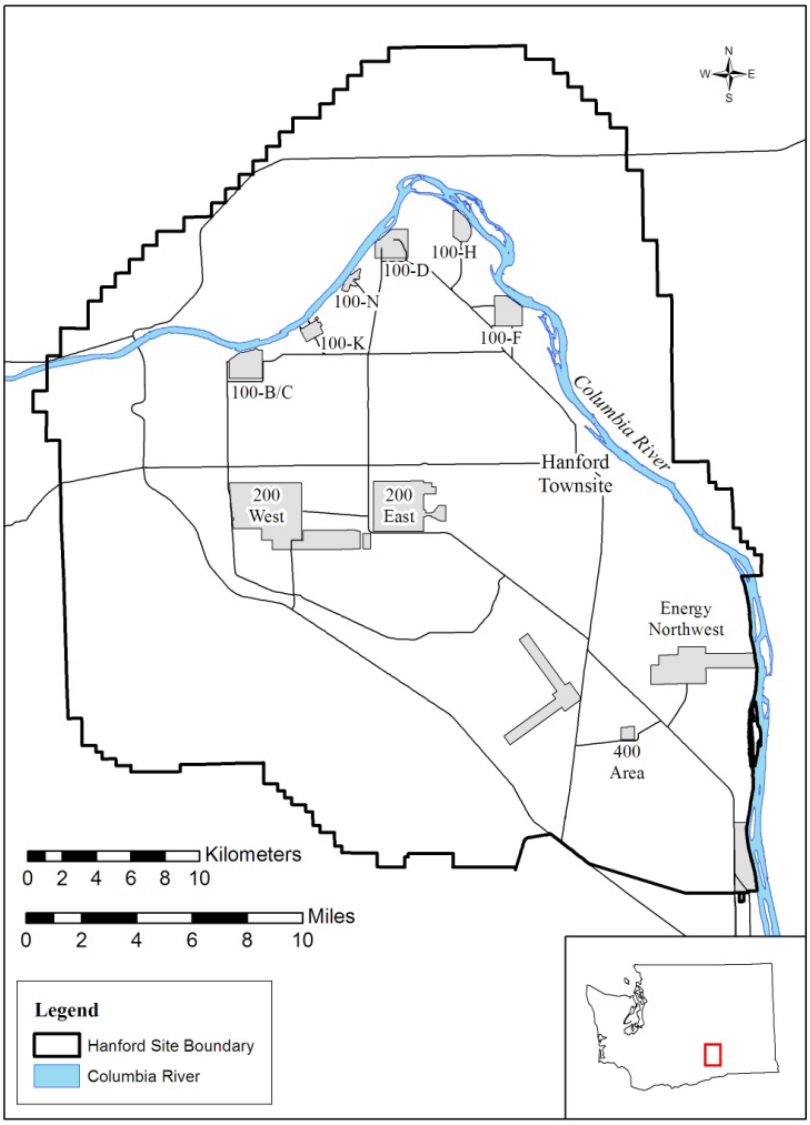
1.0 Columbian Yellowcress

A. Introduction

Columbian yellowcress (*Rorippa columbiae*) is a rhizomatous perennial species that occurs along the lower shorelines of the Columbia River on the Hanford Site in south-central Washington State (Figure 1). It is endemic to Washington, Oregon, and California, is a Species of Concern for the USFWS and is considered to be endangered in Washington (WNHP 2011). Extensive damming of the Columbia River in Washington has eliminated its habitat along much of the shoreline. The species is currently known from two disjunct locations along the Columbia River: a relatively small occurrence below the Bonneville Dam and an extensive occurrence on the Hanford Reach, the latter of which is the most extensive of any of the species' populations.

Figure 1. The Hanford Site in south-central Washington State



Along the Hanford Reach, the species occurs in the open cobble of the lower-most vegetated zone. The sites generally occur where shoreline and channel topography combine to create a surging or accelerating river current (for example, gravel bars that jut into the river flow).

The number of stems can fluctuate widely from year to year, likely due to patterns of inundation and temperature during the growing season. Management of the river flow from upstream dams now regularly inundates the species' habitat on a daily cycle for extended periods during the summer. This has shifted the growing season into the late summer and fall when the habitat is more reliably and continuously exposed. More recently, the growing season has been abruptly curtailed in mid-October due to Reverse Load Factoring. Reverse Load Factoring is defined by the Hanford Reach Fall Chinook Protection Program (HRFCPP) as "the intentional reduction of power generation during daylight hours and the corresponding increase in power generation during hours of darkness for the purpose of influencing the location of redds on Vernita Bar, during which the habitat is flooded on a daily cycle to influence placement of redds by fall Chinook salmon" (HRFCPP 2004). Due to the shifted and truncated growing season, fruits seldom have a long enough/warm enough season to develop, and mature fruits have rarely been observed under this management strategy.

Prior to this inventory, mapped locations of the species' occurrences along the Hanford Reach were available in the 2010 Public Safety and Resource Protection (PSRP) Database, which was transferred from Pacific Northwest National Laboratory (PNNL) to Mission Support Alliance (MSA) in 2011, and Washington Natural Heritage Program (WNHP). Some of the larger concentrations of mapped GPS points in the PSRP Database, however, likely represent multiple points within the same patches recorded during multiple years. Points located in inappropriate habitats (i.e., upland) are likely accounted for by the lower accuracy of GPS prior to May of 2000, when GPS Selective Availability was still active (NCOSPNT 2011). Polygons from the WNHP Information System were often created from maps provided by each surveyor before widespread use of GPS, and polygons were often created to capture multiple discrete subpopulations within each polygon.

The species has been monitored over several years in plots at several locations on the Hanford Reach, including mid-reach at Locke Island (Island 6) and 100-F Beach by PNNL and in the lower reach at Homestead (Island 13) and Plow (Island 12) Islands by BLM and WNHP. Since the beginning of monitoring at Locke and 100-F Beach, stem numbers declined radically, were low for a number of years then gradually increased, but have not reached densities recorded in 1994 (PNNL 2010). The plots at Homestead and Plow islands have shown a sharp decline in the number of stems between 1994 and 2002 (Caplow 2003). The most recently reported shoreline survey, apart from at established monitoring plots, was in 2001 (Caplow 2003), when a "precipitous decline" of the species along the Reach downriver from White Bluffs Boat Launch was reported.

In mid-September, 2011, preliminary surveys along the Hanford Shoreline between 100-D and 100-F indicated that Columbian yellowcress stems were relatively abundant within its microhabitat along the river. As a result, Ecological Monitoring Staff undertook a survey of the species' occurrence along the Hanford Shoreline in order to gain information on the current distribution and vigor of Columbian yellowcress there; islands and the other side of the river were not inventoried. The resulting data and maps can update and integrate with existing information. It can also be used to help minimize potential impacts to this species from Hanford project activities along the shoreline, monitor population trends over time, and increase the understanding of the status and dynamics of this high priority species along the Hanford Reach.

B. Methods

Columbia yellowcress habitat along the Hanford shoreline of the Columbia River from just upstream of Vernita Bridge (HWY-24) to the 300-Area was walked between September 18 and November 17, 2011. "Hanford shoreline" refers to the Benton County shoreline of the Hanford Reach, on the right hand side of the river as one travels downstream.

The survey area was shoreline with open cobble in and around the lower-most vegetated zone, an area between five and more than 100 feet wide depending on the slope. This zone is inundated by flows between 50-120 kcfs (thousand cubic feet per second), as measured at the upstream Priest Rapids Dam. Areas along the shoreline with no previously reported Columbian yellowcress, and areas with a steep shoreline with no obstruction to the current, were considered marginal habitat for the species and were a low priority for this survey.

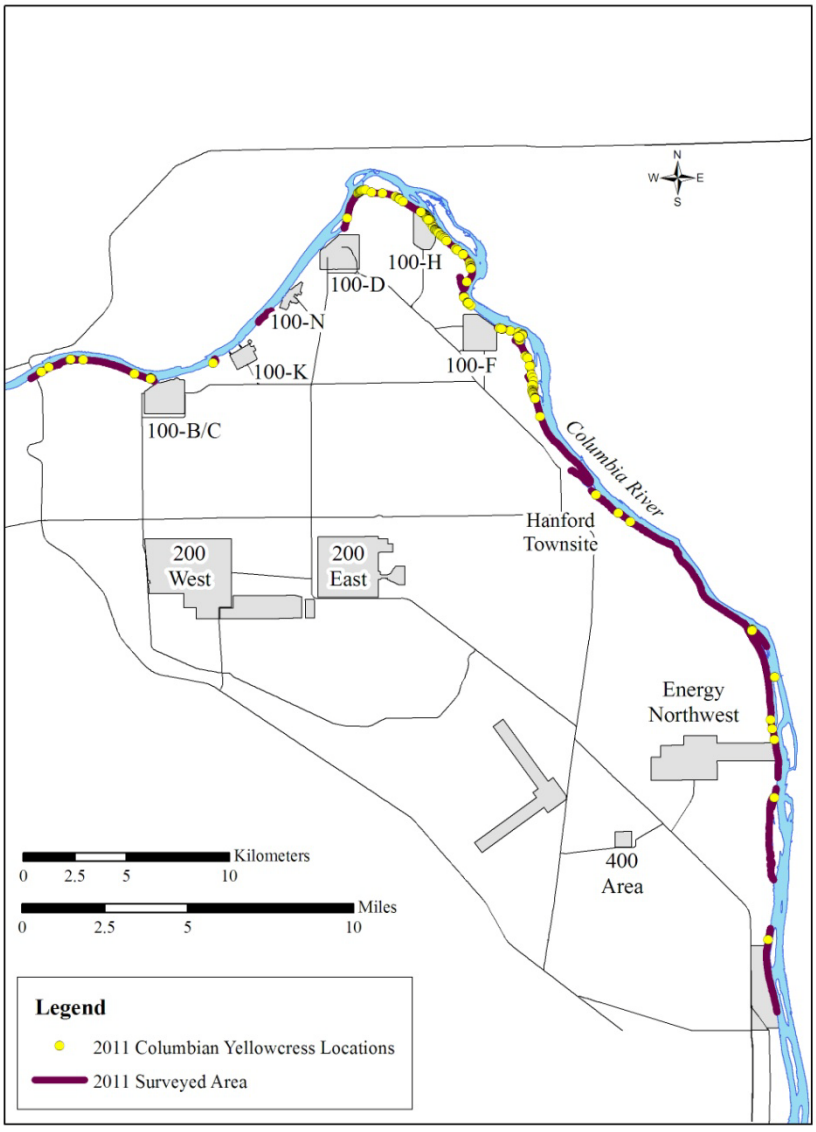
When Columbian yellowcress patches were found, a GPS point was taken at the upstream/inland extent of the patch or group of patches, and the area covered was recorded (length measured parallel to the direction of flow, width measured perpendicular to the direction of flow). Also recorded were the number of stems (estimates were made at sites with large numbers of stems), the range of stem lengths, the number of stems with flowers/fruits, and a range of the number of flowers/fruits per stem. Photographs were taken to depict habitat characteristics (e.g., density of associated vegetation, cobble size, population locations and shoreline configuration). Some larger patches were mapped as polygons, in addition to capturing the upstream/inland point.

Two sites with long-term monitoring plots in the lower portion of the Hanford Reach (Homestead and Plow islands, which are managed by the BLM) were revisited on November 12 to calibrate those sites with observations made along the Hanford shoreline during 2011. Details of PNNL's monitoring methodology at 100-F Beach were not yet available, so direct comparisons with 2011 survey data was not possible. However, a polygon encompassing that occurrence was created with a Trimble GeoXT global positioning system, and the total number of stems at that site was counted. The PNNL monitoring sites at Locke Island were not revisited.

C. Results

A total of 43.7 miles (70.3 km) of the Hanford shoreline were surveyed, with two hundred and thirty-five patches identified and approximately 90,000 stems counted (Figure 2). It is not known how many individual plants that represents of this rhizomatous species. One hundred twenty-six stems had flowers and/or flower buds, although more may have developed at sites that were surveyed early in the season when the stems were just emerging.

Figure 2. Surveyed area and locations for Columbian Yellowcress in 2011.



The typical habitat type where Columbian yellowcress occurs on the Hanford Reach is depicted in Figures 3 and 4. Budding Columbian yellowcress and the variable stem lengths observed within patches are shown in Figures 5 and 6.

Figure 3. Field team members Debra Salstrom and Cole Lindsey document a population of Columbian Yellowcress on the Hanford Shoreline of the Columbia River

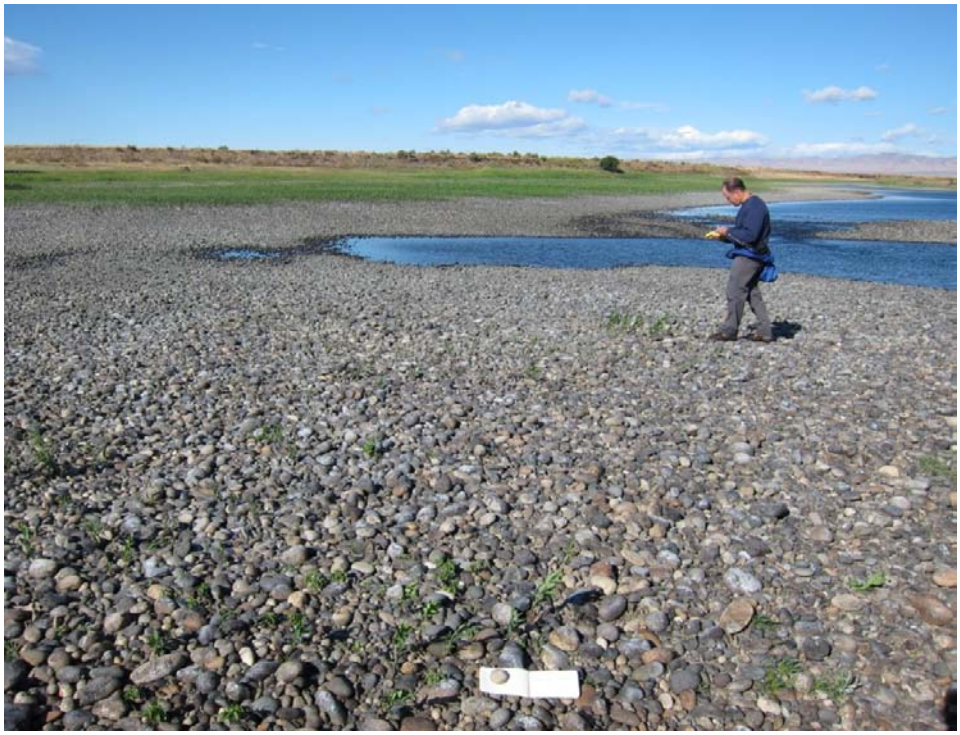


Figure 4. Field team member John Nugent documenting a population of Columbian Yellowcress in the typical habitat type where it exists along the Hanford Reach

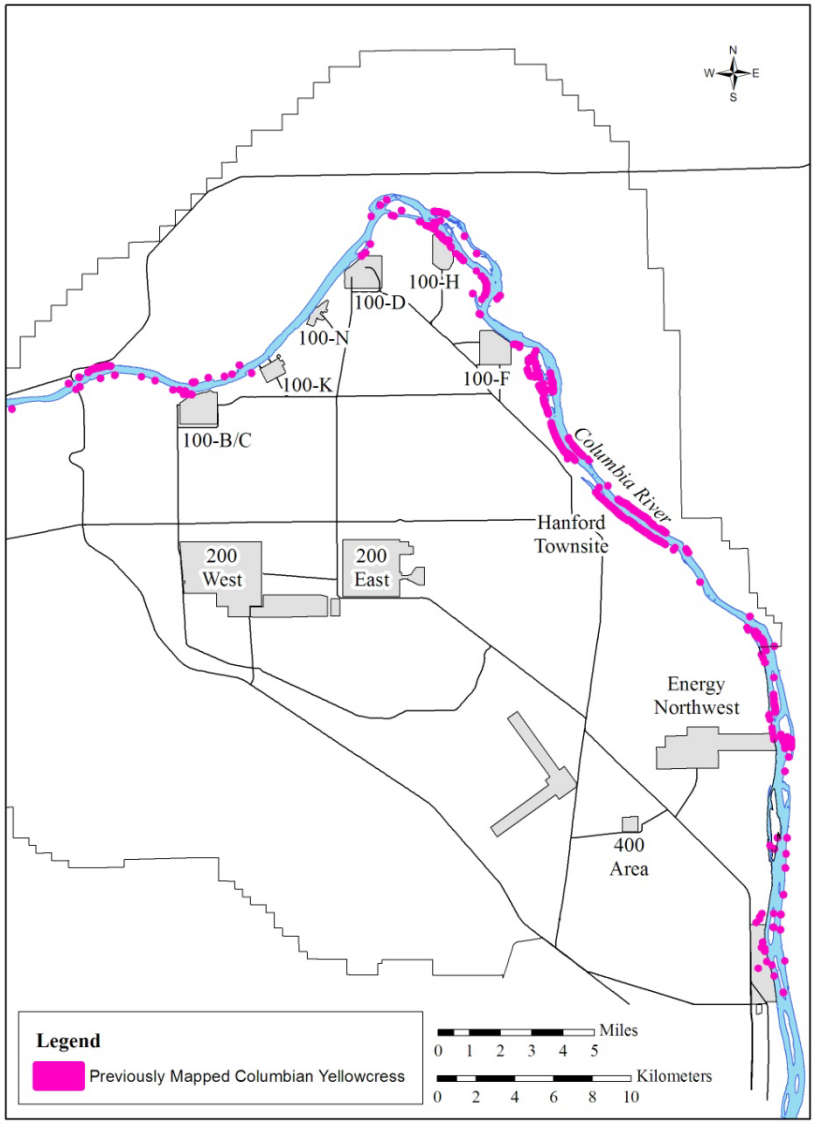
Figure 5. Budding Columbian yellowcress observed on October 19, 2011

Figure 6. Population of Columbian yellowcress shows size range of stems within a single patch

During the survey, all sites in the database provided by PNNL and nearly all sites in the WNHP Information System along the Hanford shoreline were revisited (Figure 7). Points provided to MSA by

PNNL in the PSRP Database had location information only. Similarly, the electronic data report obtained from the WNHP generally did not have site specific information for each point or polygon, except for surveyor name and date of report/revisit. However, some site specific information is available from the WNHP paper files, which were recently accessed at their office. Using that data, some comparisons with 2011 data may be prepared at a later date.

Figure 7. Locations for Columbian Yellowcress from the 2010 PSRP Database and WNHP



Occurrences of the species along shorelines near the Hanford Townsite and 100-F Beach, where flower buds were relatively numerous and robust during the initial survey, were revisited November 7 to assess whether seeds had matured. During the subsequent survey, the stems were chlorotic, no fruits were present and the remaining buds were waterlogged from frequent inundation due to Reverse Load Factoring; successful fruit production was deemed highly unlikely.

Data from the monitoring plots on Homestead and Plow islands were consistent with earlier plot data that documented a steep decline in numbers of stems on plots from the time monitoring records are available for those sites (1994).

D. Discussion

Long-term trends are often difficult to discern for a rhizomatous species that produces large fluctuations in the number of stems from year to year, as with Columbian yellowcress. Annual differences in the river flow regime and air temperatures during the time the plants are exposed likely influence the number of stems and amount of flowering that occurs along the Hanford Reach. Variations in the numbers of stems have been noted as early as 1984 (WNHP 2011). While the pre-dam river flow regime during summer was characterized by sustained low river levels, current management of the river typically inundates and exposes the species' habitat repeatedly during that time period, often daily. This management has shifted the primary growing period into the fall, when some years there are not enough heat/days to develop mature fruits. In addition, Reverse Load Factoring abruptly curtails the growing season in mid-October, compounding the above problems for viable seed production.

In contrast to conditions experienced most years, during 2011 the plants were inundated all spring and summer until early September, when they began to be mostly exposed (USGS 2011). Throughout September, air temperatures were warmer than normal (DOE 2011). During the 2011 surveys, the species was generally present, and stems were sometimes abundant, within a high proportion of sites that met its apparent microhabitat parameters. This was especially true within the middle and upper portions of the Hanford Reach (upriver from approximately River Mile 366, near the south end of the 100-F Slough).

During the early portion of the survey (before Reverse Load Factoring), stems were vigorous and appeared to have only recently begun growing. However, the apparent absence of mature seeds at the end of the season suggests that even though it was warmer than normal, the growing season between early September and the beginning of daily inundation from Reverse Load Factoring in mid-October was not sufficient for reproduction. In 1992, D. Wilderman noted a stem fragment along the beach at one site and speculated that it might be able to become rooted (BLM 2012). During the 2011 survey one stem fragment was again observed on the downstream end of the Hanford Townsite Slough further documenting this ongoing process. Vegetative propagules have not been otherwise reported, and the species is probably mostly limited to habitat within the reach of established rhizomes. There is some indication that the rhizomes are producing stems slightly higher in the shoreline profile in at least some locations (PNNL 2010). In addition, known sites that were mapped lower in the shoreline profile are not currently being relocated.

Many of the earlier mapped points were generated before accurate GPS navigation was available, and precision of some of those points is likely relatively low (especially given the changes in river shoreline relative to those depicted on the USGS topographic maps) compared to accuracies that are now easily obtainable. With few exceptions, data for Columbian yellowcress along the Hanford Shoreline in the transferred PSRP database and WNHP information systems[1] consist of location data and lack information on numbers of stems observed, so that direct comparisons at particular locations are not generally possible at this time.

1. [1] Details of PNNL data collection at the 100 F Beach monitoring plots have not yet been obtained, so direct comparison at that site has not been done. WNHP occurrence data has been combined; more detailed records likely exist in their paper files.

As discussed above, monitoring data indicate that the species has declined precipitously since 1994 in the lower portion of the Reach (Caplow, 2003). Another observation indicating decline of the species in the lower Reach is that the species has not been seen for many years at Ringold, where it had been abundant in the past (Rickard, personal communication).

In contrast, PNNL's monitoring data in the middle portion of the Hanford Reach at Locke Island and F-Beach showed variability from year to year, but relative stability during recent years (PNNL 2010). That data, together with results of this survey, suggest a possible differential status of the species along the Reach, with large declines in the lower portions of the Reach, and apparent current relative stability in the middle and upper portions of the Reach.

The reason(s) for the apparent decline in the lower portions of the Reach relative to upriver are not understood. Possible contributors could include slumping along the White Bluffs, which has reduced the width (and possibly depth) of some channels downriver. This may have altered the dynamics of river slope, flow, and subtle downriver trajectories of the river current and subsequent patterns of scour along the shoreline. The microhabitat of Columbian yellowcress along the shoreline appears to be determined by position relative to the current. While it is in the nature of a river to change course over time, the lack of seed production and the apparent lack of vegetative propagules in Columbian yellowcress suggest that it currently does not have the means to dynamically reestablish itself to take advantage of newly developed habitat, except for slight repositioning of established rhizomes into suitable microhabitat within the river profile.

Another factor in changing habitat may be the entrapment of sediment behind upriver dams, which essentially eliminates all but local deposits feeding into the Reach. This may have led to a net-erosion of sediment over time. A further cause may be a 'ripple' effect of inundation that causes an approximately eight-hour lag in inundation/exposure in response to management at Priest Rapids Dam. A result of this delay from one end of the Reach to another, for example, is that during the fall Reverse Load Factoring, Columbian yellowcress habitat nearer to the dam is exposed near daybreak, while habitat downriver, such as at Homestead and Plow Islands, is typically not exposed until midday, further reducing its growing season.

E. Future Considerations

a. Review files at the WNHP and BLM offices (Olympia and Wenatchee, respectively) to exhume early records and data associated with particular points. This may more clearly indicate the trend and fluctuations over time of this species, and more accurately assess the relative changes of Columbian yellowcress in different segments of the Hanford Reach.
b. A recently located letter report from 1988 and 1989 suggest low stem counts on the islands that include the BLM permanent plots. Further cross-walking and analysis of this data would likely be highly informative.
c. Complete survey inventory of Columbian yellowcress along the Hanford Shoreline, ideally during a year when stems are abundant. Pay particular attention to early WNHP data points and associated information. Partner with USFWS and BLM to update records elsewhere along the Reach.
d. Assess habitat dynamics along the Reach in an attempt to understand the effects of river management on the overall vegetation and habitat (for example, scour and deposition patterns). This would involve analyzing changes in habitat from the vegetation map and informal plots (Easterly and Salstrom 1995), old aerial photos, and other sources.
e. Assess whether the potential reduction of habitat and lack of seed production are indicative of an overall degradation of the habitat along the river and whether the declines seen in the

lower portion of the Hanford Reach will later be observed upriver. If continuing degradation is documented, generate recommendations for river management that will reverse the potential of extirpation of this species along the Hanford Reach, while also managing for fall Chinook salmon and the requirements of upriver dams.

f. Periodically survey plants at key points along the Reach to assist in documenting trends in population size and location.
g. Explore potential to grow seed from garden plantings and out-planting into appropriate habitat, using lessons learned from the 2011 outplanting on the BLM islands done by the USFWS (Heidi Newsome, personal communication).

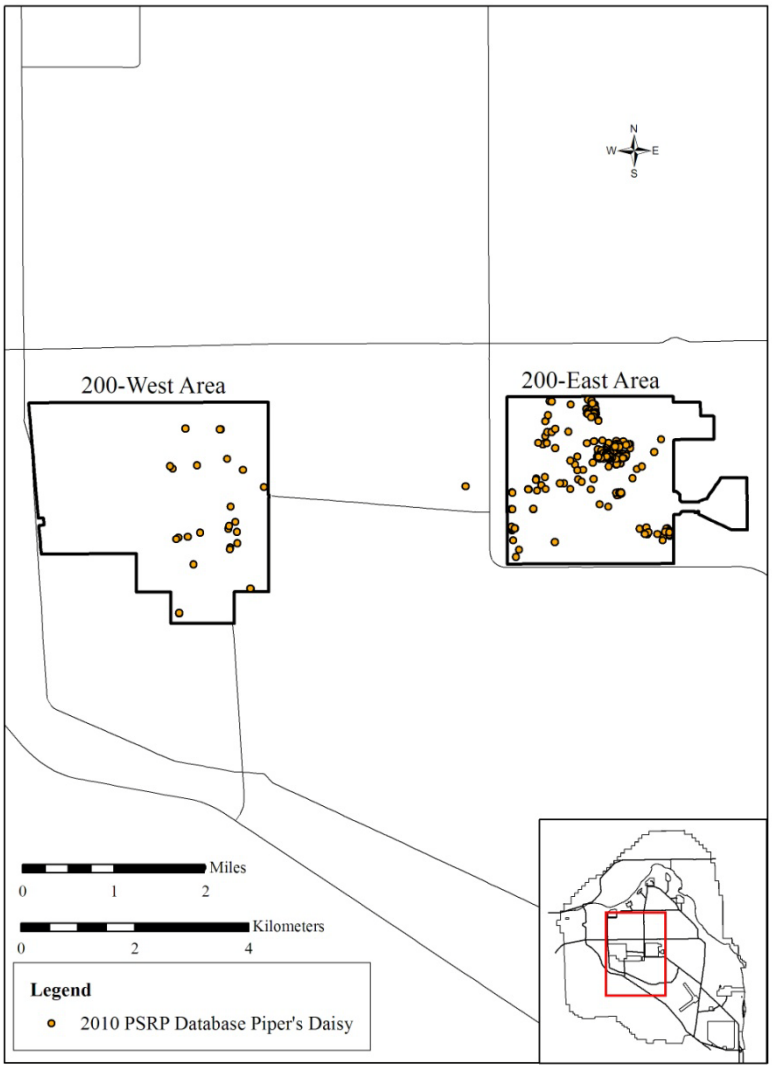
2.0 Piper's Daisy

A. Introduction

Piper's daisy (*Erigeron piperianus*) is a perennial species that is locally endemic to the Columbia Basin in Washington. It is considered "sensitive" in the state due to its limited range, habitat loss, and the relative isolation of remaining populations (WNHP 2011).

Prior to this survey, Piper's daisy was associated with 580 point locations in the 200 Areas, which were established by PNNL (Figure 8). This data was transitioned to MSA as part of the PSRP Database transfer. No data regarding the number of plants at each point location were available, and many observations were undated. Many of the larger concentrations of mapped points represent multiple records of the same groups of plants recorded as separate GPS entries), during different annual surveys.

Figure 8. Locations for Piper's Daisy from the 2010 PSRP Database



The monitoring goals for 2011 were to establish a current baseline for Piper's daisy in the 200 Areas reflecting the status of the species at previously known sites, and to document the size and population structure of the occurrences currently at those points. This updated baseline data will be useful during Hanford project planning to help avoid impacts to this sensitive species. In addition, the data will inform future planning and protection efforts by better understanding dynamics of the species' habitat and population ecology over a known time period.

B. Methods

Locations from the PSRP Database associated with Piper's daisy were revisited June 14-23, 2011. A systematic survey of the entire 200 Areas was not undertaken, thus a "surveyed area" is not provided. A Trimble GeoXT global positioning system, which is capable of sub-meter accuracy, was used to navigate to each known point, where the number of Piper's daisy plants and the approximate area in which they occurred were recorded (Figure 9). Also recorded at many of the sites were the numbers of plants in each of three size classes (small, < 5cm; medium, 5-15 cm; and large >15 cm). If a known point appeared to be inaccurately located, an additional GPS position was taken at the location. A new GPS

point was established where individual plants (or patch of plants) were found and no existing point was nearby. Previously known points where Piper's daisy plants were not found during 2011 were retained in the database, along with the notation that no Piper's daisy plants were present there in 2011. Individual sites with multiple years of data points were managed in the database so that only one point was used to actively represent the site, while all additional GPS points at each site were hidden but still retained in the database.

Figure 9. Confirmed, inaccessible, and new locations for Piper's Daisy from the 2011 survey

Figure 10. Field team members John Nugent and Richard Easterly record a Piper's daisy in the 200 East Area of the Hanford Site.

C. Results

Field personnel revisited 557 of the 580 previously recorded points in the 200 Areas; the remaining points were not accessible. Some points were deemed inaccessible due to fences and postings. Piper's daisy plants were present at 217 of the sites and seven new point locations were found, totaling 224 sites and 2,222 plants. The population structure of the occurrence was not evaluated for this report, but the data were gathered at many of the points so that an assessment can be done in the future. Field team members are shown above recording a location for Piper's Daisy, while the size range of individuals found in the 200 Areas is shown in Figures 11 and 12.

Figure 11. Relatively small Piper's daisy individual observed during the CY2011 survey

Figure 12. Relatively large Piper's daisy individual observed during the CY2011 survey

D. Discussion

While Piper's daisy is not uncommon in some areas elsewhere on the Hanford Site, the current status of many of those occurrences is uncertain. A significant portion of the area in which the species occurs burned in wildfires and some of those areas were subsequently treated with herbicides, attempting to control invasive weeds. In addition, the species has a restricted range off the Hanford Site, and its status at other sites is largely unprotected.

The occurrence of Piper's daisy in the 200 Areas of the Hanford Site likely represents an important portion of the overall distribution of the species. Although Piper's daisy was located throughout the 200 Areas, the majority of plants were found in the north-central portion of 200 East (Figure 13). Since this area is undergoing active management that involves habitat disturbances, monitoring the dynamics of the Piper's daisy occurrence there is important, particularly since it is not currently understood what level and types of disturbances are tolerated by the species. Care should be taken to avoid escalating the status of this species and the resulting amount of protection required.

Figure 13. Relative number of Piper's daisy individuals per location in the 200 East and 200 West Areas

E. Future Considerations

a. Evaluate the occurrence and distribution of this species in the 200 Areas to determine the effects of management activities on the viability and population dynamics of the occurrence there.
b. Assess the ecological condition and dynamics of the habitat of this species in the 200 Areas to determine the population dynamics and responses to different types of disturbances.
c. Add context to the importance of the Piper's daisy occurrence in the 200 Areas by evaluating the status of the species elsewhere, particularly on the ALE, McGee-Riverland, Saddle Mountain and Wahluke Slope units of the Hanford Site and Hanford Reach National Monument.
d. Investigate variability of characteristics within the species and the extent to which hybridization with other species may have occurred.

3.0 Other Rare Plants

A. Lowland toothcup (Rotala ramosior)

Numerous occurrences of lowland toothcup (*Rotala ramosior*) were located during the course of surveys for Columbian yellowcress. From this and other surveys (Easterly and Salstrom 2006), that species has been observed to be abundant and dominant in several areas within its emergent mud habitat. It is one of the first species to appear when the sites become exposed and it quickly produces seeds. This species is considered to be threatened in Washington (WNHP 2011).

1. Future Considerations

a. Examine and define the habitat characteristics of the emergent mud habitat status of lowland toothcup along the Hanford Reach to establish the dynamics of the habitat and species.
b. Determine whether a status change should be recommended to the WNHP or whether its habitat is in jeopardy (which would justify its current status).

B. Awned halfchaff sedge (Lipocarpha aristata)

One occurrence of awned halfchaff sedge (*Lipocarpha aristata*) was found during the course of surveying for Columbian yellowcress (walking back to the vehicle, not near habitat for the latter species). The species is considered to be threatened in Washington (2011).

C. Canadian St. John's-wort (Hypericum majus)

One previously unknown occurrence of the species was found in an eroding silt bank near the river during the course of surveying for Columbian yellowcress. Canadian St. John's-wort is considered to be sensitive in Washington (WNHP 2011).

D. Suksdorf's monkey-flower (*Mimulus suksdorfii*), Loeflingia (*Loeflingia squarrosa* var. *squarrosa*), Great Basin gilia (*Alliciella leptomeria*), and Rosy pussypaws (*Cistanthe rosea*)

Several rare annuals are known from the sandy habitats north and south of Gable Mountain. The occurrences were initially found during surveys in 1995 and 1996, after winter and spring weather combined to provided the right conditions for them to germinate and develop. During those survey years, numerous occurrences of rare annuals were found on both the Hanford Site and on the nearby Yakima Training Center. The occurrences of loeflingia, rosy pussypaws, and Great Basin gilia near Gable Mountain have not been relocated since their original sightings, despite several visits over the years

(Sackschewsky, personal communication), including during visits in 2006 and 2011 (D. Salstrom & R. Easterly, personal observation).

Two sites north of Gable Mountain that are known variously for Suksdorf's monkey-flower, rosy pussytoes, loeflingia, and Great Basin gilia were revisited on June 2 for personnel training and to gauge whether 2011 was a productive year for the rare annuals. The spring had been dry until mid-May, when rainfall increased and the total was above normal for the month (HMS 2011). None of the species were relocated except, after much searching, two desiccated Suksdorf monkey-flower plants were located at a site that had thousands of individuals when it was reported in 1996 (WNHP 2011). In 2011, the plants were small (<2 cm), with two dried flowers each. The flowers had dried without developing fruits, indicating either that the rain came too late for those plants to mature at that site or that they were not fertilized.

Rosy pussytoes, loeflingia and Great basin gilia are considered to be threatened in Washington (WNHP 2011). The Gable Mountain sites for the first two species were the only known occurrences in Washington until 2006, when they, along with Suksdorf's monkey-flower, were found in the Saddle Mountain Unit (Hanford Reach National Monument) on Priest Rapids Bar, located north of Vernita Bridge (personal observation). The known location on Gable Mountain was revisited that year, and the plants were not found there. This suggests that the rare plants occur variably between sites, as well as between years. Except for a few Suksdorf's monkey-flower and loeflingia plants seen in 2007, the plants on Priest Rapids Bar have not reemerged, although three subsequent visits were made.

It was determined that 2011 was not a good year to spend significant effort searching for rare upland annuals in most sites, and further efforts were curtailed. Germination and plant development stimulated by the spring rainfall was not observed during the June 2 visit.

1. Future Considerations

a. Revisit several known sites annually to determine whether it would be a good year to do intensive surveys to identify additional sites and habitat. Be prepared to spend time and resources during a year when these rare species are more likely to be detected.
b. Assess habitat and suite of associated species so that likely habitat can be more easily detected during suboptimal years and those habitats can be adequately identified and protected.
c. Although these sites didn't appear to have been sprayed, research effects of vegetation management activities on herbaceous species, especially rare annuals.

E. Caespitose evening-primrose (*Oenothera cespitosa* ssp. *cespitosa*)

One known caespitose evening-primrose (*Oenothera cespitosa* ssp. *cespitosa*) near the intersection of Route 1 and Federal Way was revisited as part of staff training and reconnaissance. The occurrence was not relocated and may have been extirpated by road maintenance (i.e., chemical sprays). Since the location write-up information appeared to be different from the mapped point, an expanded footprint capturing an additional 100-meter area was searched, and the plant was not found. The species is a perennial that is considered to be sensitive in Washington (WNHP 2011).

1. Future Considerations

a. Revisit occurrence and conduct thorough search of the area.

E. Gray cryptantha (*Cryptantha leudophaea*)

Gray cryptantha (*Cryptantha leucophaea*) is a locally endemic perennial species that is a federal Species of Concern and considered to be sensitive in Washington (WNHP 2011). A known gray cryptantha site west of Ginger, southeast of 100-D, was revisited for staff training purposes. At that site, one plant was originally reported in 1991, and 'hundreds' of plants were reported in a subsequent visit in 1992 by different personnel (PNNL 2011). During 2011, two gray cryptantha plants were located in the general area at reported occurrence. The site is fenced to protect the rare plant occurrence; currently one of the two plants was located outside the fenced area.

1. Future Considerations

a. Reevaluate the site and adjust fence.
b. Attempt to determine why the species has declined at the site.
c. Revisit known occurrences of this species on Central Hanford (and the Hanford Reach National Monument, if possible) to determine the species status and describe the habitat dynamics so that the sites can be managed and protected effectively.

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