Latah Soil and Water Conservation District
Meadow Restoration Vegetation Monitoring Summary
November 2021

BACKGROUND

Since 2007, the Latah Soil and Water Conservation District (Latah SWCD) has been implementing habitat restoration projects in the Potlatch River watershed (Figure 1) for the benefit of steelhead trout (*Oncorhynchus mykiss*). Many of these projects are process-based meadow restoration projects. Process-based restoration strategies emphasize addressing "root causes of degradation" by reestablishing "normative rates and magnitudes of physical, chemical, and biological process that create and sustain river and floodplain ecosystems" (Beechie et al. 2010). The goals of our meadow restoration projects are to restore meadow hydrology, floodplain connection, and native riparian vegetation. Objectives for achieving these goals typically include addressing channel incision, removing floodplain features (e.g., railroad berms) that interfere with floodplain access, installing grade control structures (e.g., beaver dam analogs) to further address flow conditions and to increase cool summer base flows through groundwater discharge, and restoring riparian vegetation to promote shade and future wood recruitment, and to reduce streambank erosion.

Figure 1. *Potlatch River watershed and associated subwatersheds within.*

The lower mainstem Clearwater River steelhead population is a priority of the Clearwater Major Population Group of the Snake River Distinct Population Segment, as identified in the National Marine Fisheries Service (NMFS) recovery plans for salmon and steelhead (NMFS 2017). The Potlatch River has been identified as one of the watersheds with the highest priority for protection and restoration within the Lower Mainstem Clearwater River steelhead population (NMFS 2017, Ch. 6, pg. 58). Limiting factors identified for steelhead (listed as threatened under the Endangered Species Act (ESA) in 1997 (Federal Register notice

62FR43937)) include water temperature, instream flow, flow timing, sediment supply, floodplain connectivity, riparian vegetation, habitat complexity, and migration barriers.

Priority actions to address these limiting factors for steelhead recovery as provided by the NMFS 2017 recovery plan include the following:

1. Restore hydrologic processes to retain surface flow by reducing surface runoff from altered land surfaces, disconnecting artificial drainage systems from natural drainage systems, and modifying water uses. This will contribute to reducing stream temperature problems.

2. Restore channel-forming processes by reestablishing floodplains in incised channels, removing or setting back flood control structures, and rehabilitating stream channels that have been straightened.

3. Reestablish riparian vegetation to improve large woody debris (LWD) recruitment and create shade for streams.

4. Reduce fine sediment delivery to streams where it is increased caused by agriculture, road drainage systems (including undersized culverts), or other artificial sources.

5. Inventory, prioritize, and eliminate remaining artificial fish migration barriers.

Restoring wet meadows is important to all of these priorities, for when they function well in supporting thriving riparian vegetation, fine sediments are trapped, water is often shaded, groundwater discharge is enhanced, and surface runoff is reduced (Beechie et al. 2013, Pollock et al. 2007). In the Potlatch River watershed, as in many areas, the streamside meadows have been impacted by a variety of anthropogenic factors including removal of beavers, straightening of the channels for agricultural and railroad uses, berm installations, and upstream land-use changes such as clearing of forest cover for other agricultural uses (Latah SWCD 2007). These factors have caused widespread channel incision and have exacerbated flashy peak flows which cause further down-cutting of the channel. With reduced floodplain access, the water table has dropped (reference Figure 2 below), and the plant community has shifted to species that thrive on drier sites. In many cases, the wet-adapted species, including sedges, rushes, and willows, have been greatly diminished in meadows near degraded streams. The illustrations below (Figure 2) illustrate a typical degraded stream meadow system in the Potlatch River watershed paired with a “healthy” meadow system which showcases our meadow restoration project goals.

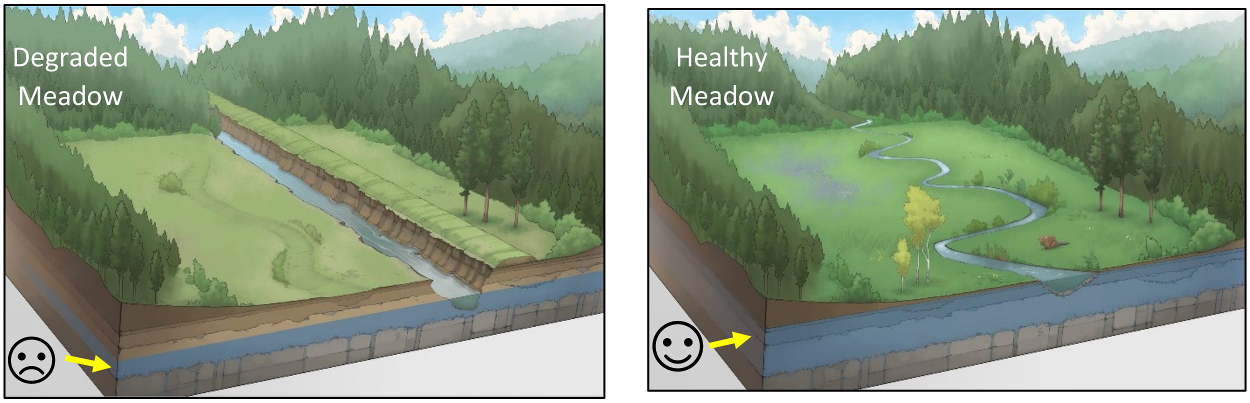

Figure 2. *Illustrations showcasing common conditions in degraded meadow systems in the Potlatch River watershed (left), and desired conditions following restoration resulting in healthy meadows.*

Since 2008, Latah SWCD has treated approximately 280 acres and 9 stream miles through wet meadow restoration to address these liming factors. Increasing the canopy cover of wet-adapted species in the plant community following wet meadow restoration is one indicator of success for Latah SWCD projects. At many project sites, landowners, land managers, and restoration practitioners have noticed an increase in sedges, rushes, and other wet-adapted species following Latah SWCD meadow restoration projects. Camas (*Camassia quamash*), American bistort (*Polygonum bistortoides*), and California false hellebore (*Veratrum californicum*) are three wet-adapted native forbs that have notably increased passively (without supplemental planting). To measure and document changes in the plant community following wet meadow restoration activities, Latah SWCD implemented a vegetation monitoring strategy for selected project sites within the Potlatch watershed (Erhardt 2015). The graphs and photos below represent a summary of the results to date on six Latah SWCD project sites. Here we focus upon riparian vegetation abundance (as reducing bare soil can increase infiltration and reduce surface movement of fine sediment) and composition (a higher proportion of wetland species are indicative of soil that is wetter for longer which suggests that the floodplain is functioning more effectively).

Vegetative functional groups are used to illustrate the changes to the plant community composition following meadow restoration projects that address floodplain reconnection. An increase in vegetation abundance and in wet-adapted species are indicators of improved meadow hydrology on these sites. Baseline data were collected prior to the start of construction on all sites except for the Corral Creek Colby and Tee Meadow sites. On those two sites, baseline data were not collected because construction was completed prior to implementation of this monitoring program. Vegetation responses to meadow rehydration is a multi-year process. Therefore, Colby and Tee Meadows were included in the vegetation monitoring as we expected to see ongoing changes to the plant community.

METHODS

To date, this vegetation monitoring strategy has been implemented on 10 Latah SWCD riparian and meadow restoration project sites. This paper presents data from six of those projects and follows the Latah SWCD Riparian Vegetation Monitoring Cover Plot Methodology (Erhardt 2015). In summary, two to three permanent transects are established per project site within representative plant communities. Within the transect, two or three 1-m^2 plot frames are placed along the transect and cover values of all vegetative functional groups are estimated. When possible, baseline data are collected one time pre-construction. Post project implementation data are collected 3-5 years post construction on repeatedly measured transects and plots. Summarized data from transects measured annually are compared with the baseline data to examine project impacts on the plant community. These data are paired with visual observations by the landowners/land managers and project planners. Repeated photos at the transect locations also provide indications of plant community changes following project completion and are used to support conclusions from data collected. It is important to collect post-project data at roughly the same time each monitoring year as the baseline data to ensure accurate comparisons.

INDIVIDUAL SITE SUMMARIES

The Upper Corral Creek Five-Acre Meadow and Vassar Meadow sites are two meadow restoration projects in the Corral Creek subwatershed (Figure 1) constructed in 2015 on ground managed by the U.S. Forest Service. Goals for these projects were to restore meadow hydrology and to reduce sedimentation. To achieve these goals, the flow was removed from the incised straightened ditch, diverted into the historic creek alignment, and railroad berms that were interrupting floodplain access were removed. Five-Acre Meadow showed an increase in grasslikes and a decrease in non-native pasture grasses, along with a decline in bare ground (Figure 3). Meanwhile, at Vassar Meadow, grasslike cover remained constant but the amount of bare ground decreased significantly (Figure 6).

The Vassar Meadow site was a degraded pasture prior to meadow restoration and the meadow rehydration process appears to be happening slowly. A return monitoring visit in 2025 (10-years post-construction) may provide insight into ongoing changes.

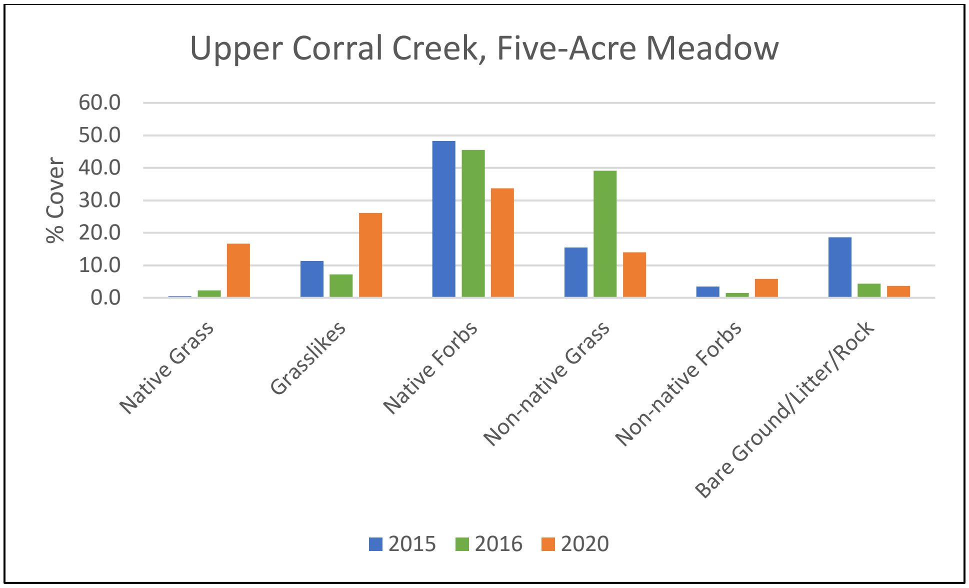

Figure 3. *Upper Corral Creek – Five-Acre Meadow vegetation data summary.*

Figure 4. *Five-Acre Meadow, Transect 2, Frame 2, June 28, 2016 – 1-year post-construction. Dry site pasture grasses like timothy (Phleum pratense) and Kentucky bluegrass (Poa pratensis) are the dominant species.*

Figure 5. *Five-Acre Meadow, Transect 2, Frame 2, June 26, 2020 – 5-years post-construction. Note transition to sedge-dominated plant community.*

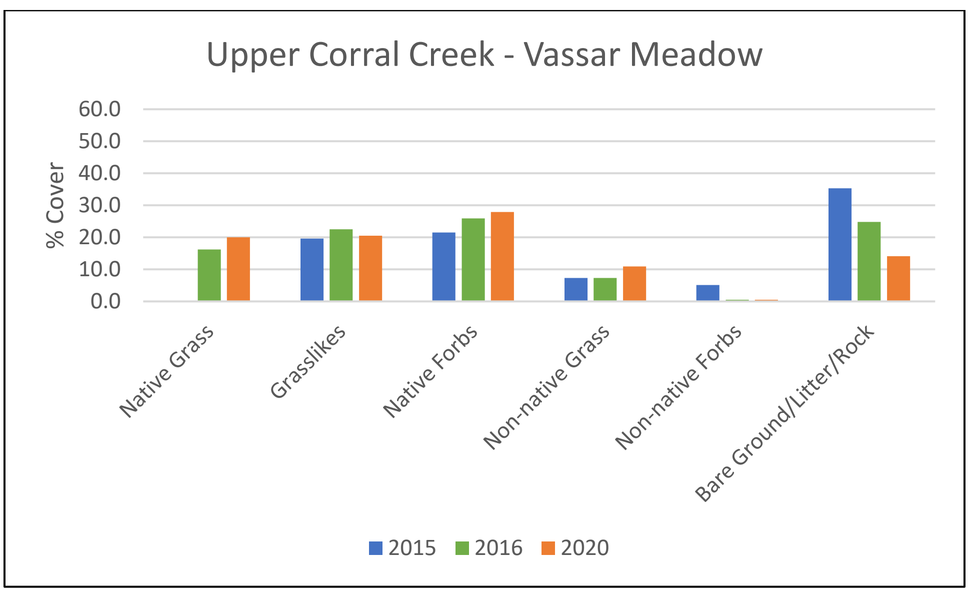

Figure 6. *Upper Corral Creek – Vassar Meadow vegetation data summary.*

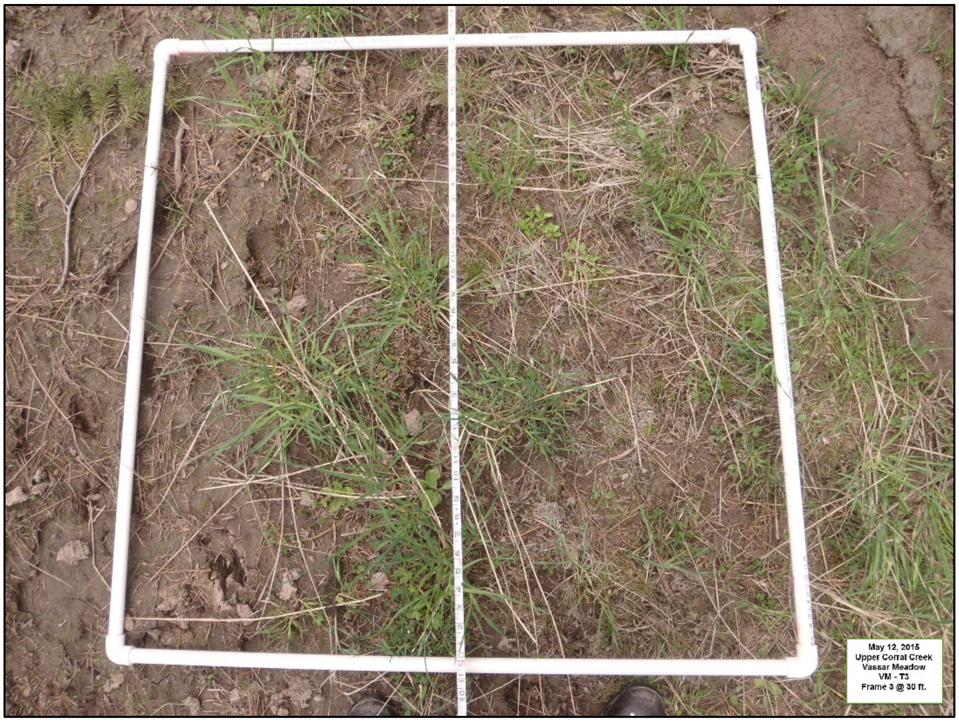

Figure 7. *Vassar Meadow along West Fork Corral Creek, Transect 3, Frame 3, May 15, 2015 – pre-construction.*

Figure 8. *Vassar Meadow along West Fork Corral Creek, Transect 3, Frame 3, June 28, 2016 – 1-year post-construction. Note that Latah SWCD seeded and mulched areas disturbed by construction activities. This frame provides an example of such an area.*

Figure 9. *Vassar Meadow along West Fork Corral Creek, Transect 3, Frame 3, June 26, 2020 – 5-years post-construction.*

The Colby and Tee Meadow restoration projects on Corral Creek began in 2009. Project goals included restoration of the flow into the historical alignment of Corral Creek, enhanced floodplain access and subsequent meadow hydration, and reduced erosion. To achieve these goals, the project diverted flow out of the borrow ditch, which resulted from past railroad activity in the area, diversion of flow into the existing historic channel alignment, and removal of railroad berms. To further enhance floodplain access and meadow hydration, beaver dam analogs (BDA) were installed in Tee Meadow in 2016.

One notable change in the Colby Meadow plant community was an increase in grasslikes from 6- to 10-years post-construction (Figure 12). Although there is no baseline data for this site, the Latah SWCD project planner indicated that this meadow was highly degraded prior to meadow restoration efforts (Trish Heekin, Latah SWCD pers. comm. 2021). At Tee Meadow, grasslikes and native grasses are also increasing which corresponded with a decline in native forbs (Figure 15). Both Colby and Tee meadows currently have an active grazing program, and meadow restoration protection strategies include cattle exclusion fencing in the riparian zone. Meadow dehydration that resulted from channel incision and floodplain disconnection coupled with concentrated, season long grazing contributed to the degradation of the plant community. Restoring functionality to the meadow via process-based meadow restoration (Beechie et al. 2010) along with the addition of cattle exclusion fencing, development of upland off-site watering, and an increase in early-season standing water throughout the meadow (cattle don't like to get their feet wet) has reduced grazing pressure during the wet and most sensitive times.

This has corresponded to cattle use being reduced in timing, intensity, and duration, which results in a healthier native plant community. Keeping the cattle out of the meadow until late summer allows the native species to set and shed seed before grazing commences for the season.

Figure 10. *Corral Creek ditch through Colby Meadow, June 15, 2009, pre-construction. Note lack of floodplain access in incised and eroding ditch that conveyed most of the flow for Corral Creek before the diversion into the historic alignment.*

Figure 11. *Corral Creek in Colby Meadow, June 10, 2010, 1-year post-construction. Corral Creek with flow following flow diversion from incised ditch and into historic channel alignment.*

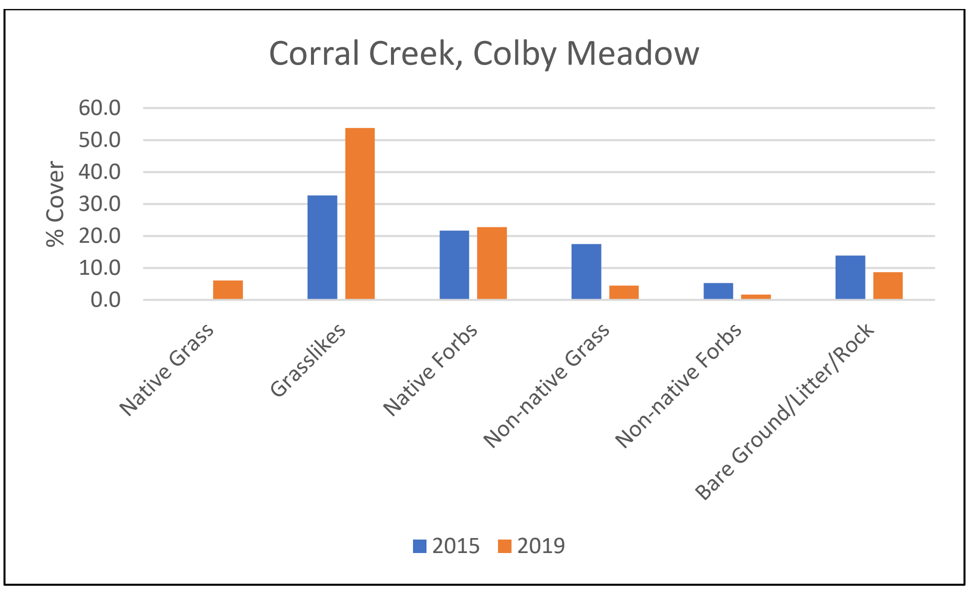

Figure 12. *Colby Meadow vegetation data summary.*

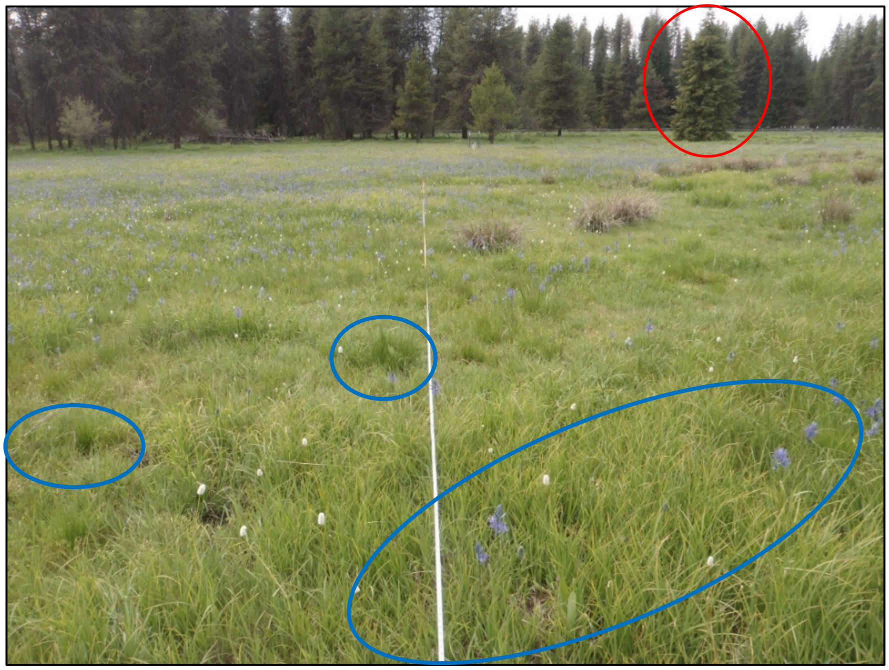

Figure 13. *Colby Meadow Transect 3, May 11, 2015, 6 years post-construction. Note the sedge (Carex spp.) clumps, circled in blue as examples. Red circled tree for repeated photo comparison.*

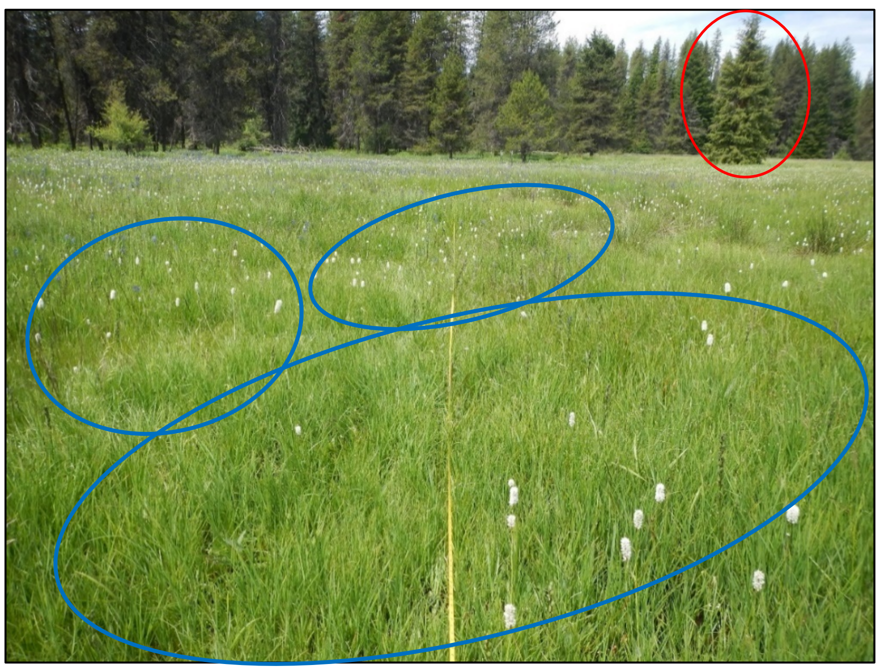

Figure 14. *Colby Meadow Transect 3, June 5, 2019, 10 years post-construction. Note the clumps of sedges from 2015 have expanded into a mat formation, blue circles for comparison with previous photo. These photos were taken 3 weeks later than the 2015 pictures, but the phenology of the American bistort, which is the white-flowering plant, shows that we are within a similar stage in the season to allow for a good comparison of the plant community. Red circled tree for repeated photo comparison.*

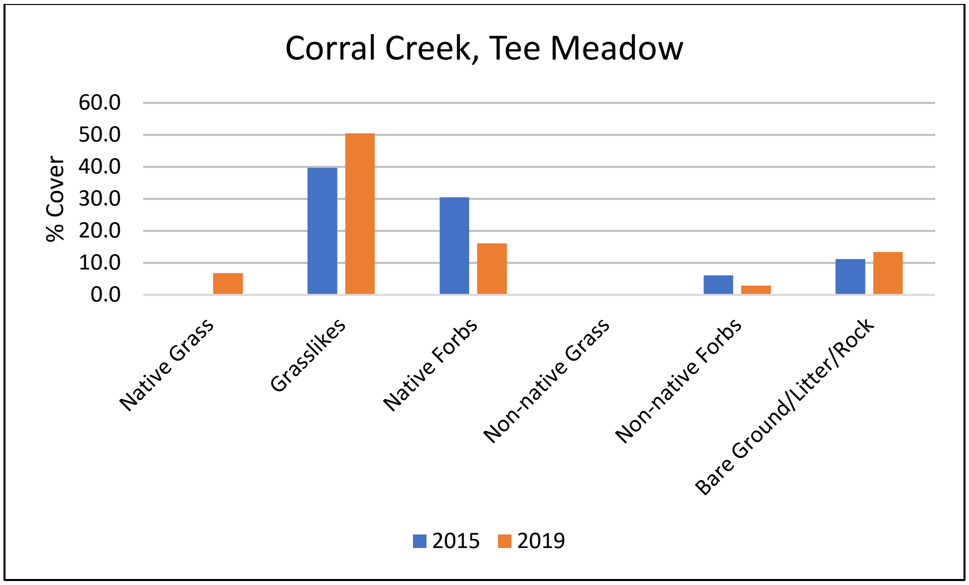

Figure 15. *Tee Meadow vegetation data summary.*

Figure 16. *Tee Meadow Transect 3, May 15, 2015, 6 years post- initial construction.*

Figure 17. *Tee Meadow, Transect 3, June 5, 2019, 10 years post initial construction. Beaver Dam Analogs (BDA) were installed in 2016 to expand floodplain access and enhance meadow hydration. Increased meadow rehydration is evident in this photo based on the increase in grasslike species.*

Racetrack Meadow is another Latah SWCD restoration project in the Corral Creek subwatershed (Figure 1) and the project was implemented in 2013. For this project, the flow was diverted from a straightened and incised ditch into the historic alignment. Grade control structures further addressed floodplain connections and flow velocity. To date, vegetation data have been collected in 2013 (baseline pre-construction), 2015 (2 years post-construction), and 2021 (8 years post-construction). It should be noted that 2021 received record low rainfall through the spring and summer months and experienced extreme heat in early summer. Despite this, an increase in grasslikes post construction was detected in the 2021 monitoring data (Figure 18). Due to the dry conditions and the timing of the monitoring, few of the grasses and grasslikes had flowering heads making specific species identification difficult. Additional monitoring during an average rainfall year would help to confirm the differentiation between species, especially when comparing the non-native and native grasses.

Racetrack has a grazing history similar to Colby and Tee Meadows. Livestock exclusion fencing and crossings were installed during restoration activities, and we anticipate that these factors have also contributed to an improvement in the plant community.

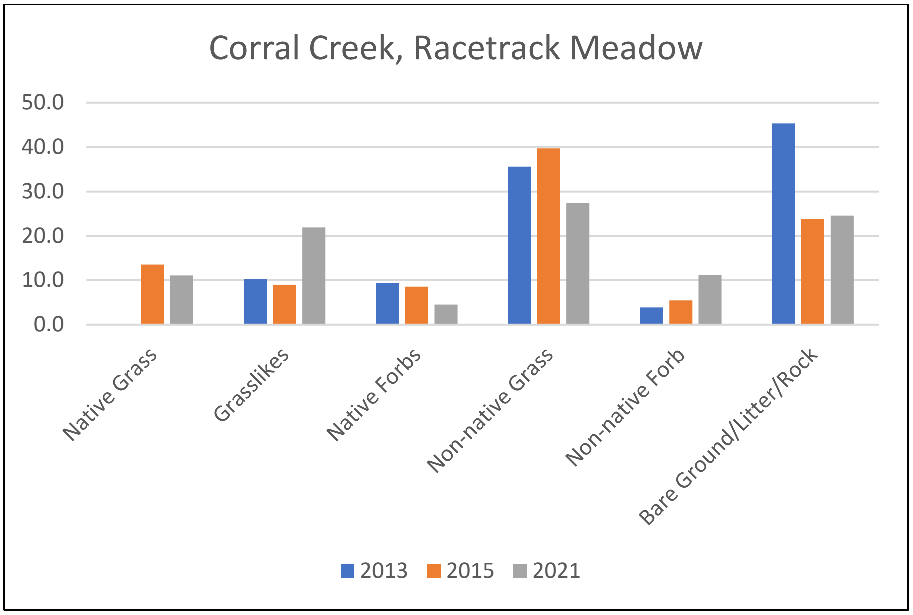

Figure 18. *Racetrack Meadow vegetation data summary.*

Figure 19. *Racetrack Meadow, Transect 1, October 22, 2015. Note bare ground extent and sparse vegetation. This transect is located outside of the livestock exclosure fencing.*

Figure 20. *Racetrack Meadow, Transect 1, September 16, 2021. Note grasses and sedges have increased in spite of the transect being located outside of the exclosure fencing. Much of the vegetation visible is sedge with some native and non-native grasses mixed in.*

Figure 21. *Racetrack Meadow, Transect 3, September 11, 2013. Monitoring site to showcase revegetation efforts on disturbed location within a meadow restoration project site. Site is within livestock exclusion fencing.*

Figure 22. *Racetrack Meadow, Transect 3, October 22, 2015 (2 years post-construction). Note seeded and mulched areas in the foreground as revegetation process continues. Taller grasses in the background are native perennial grasses seeded directly following construction in fall 2013. Most vegetation visible is meadow barley (Hordeum brachyantherum).*

Figure 23. *Racetrack Meadow, Transect 3, September 16, 2021 (8 years post-construction). Note that bare ground continues to decline at this transect site in spite of the the rocky soil conditions.*

The Two-Mile Meadow project is located on the perennial East Fork Potlatch River on land managed by U.S. Forest Service. Project construction began in 2018. Baseline data were collected in the summer of 2018 prior to start of construction. The purpose of this project was to repair degraded meadow and stream conditions by increasing floodplain access, improving meadow hydrology, enhancing riparian vegetation, and improving over-wintering habitat for juvenile steelhead trout. Post-construction data show the plant community response just 2-years following construction. The wet-adapted species responded quickly to restoration efforts. The data show an increase in grasslikes 2-years post-construction along with a decline in native forbs and non-native grasses (Figure 24). During monitoring we also noticed a visual decline in non-native forbs, including common tansy (*Tanacetum vulgare*). While tansy does not show up in the monitoring data, it was noted in the data sheets that a large infestation of tansy present pre-construction was noticeably absent during the follow-up monitoring post-construction. Latah SWCD will return to these transect locations to continue monitoring 5- or 6-years post-construction (2023 or 2024).

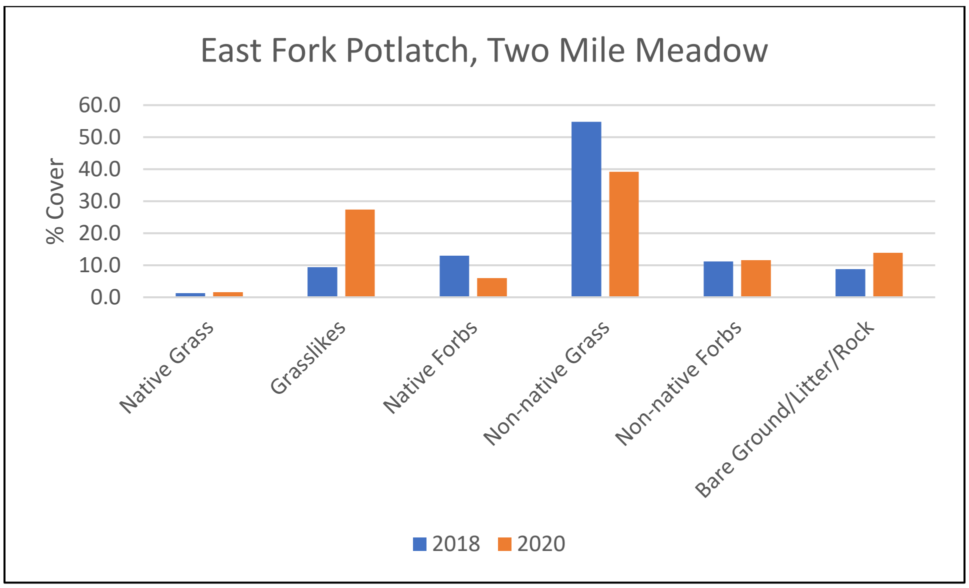

Figure 24. *Two Mile Meadow vegetation data summary.*

Figure 25. *Two Mile Meadow, Transect 3, June 12, 2018, pre-construction. Transect vegetation dominated by non-native pasture grasses. Red circled tree for repeated photo comparison.*

Figure 26. *Two Mile Meadow, Transect 3, June 19, 2020, 2-years post-construction. Grasslikes increased from 18% pre-construction to 57% just 2 years post-construction at this transect. Wood/slash visible in this photo was placed on the floodplain for roughness following construction. Slash slows and disperses flow across the meadow and provides microsites for seeds and plants which aids in revegetation success. Red circled tree for repeated photo comparison.*

SUMMARY

On most sites sampled for this vegetation monitoring study, an increase in wet-adapted grasslike species was found. The transect locations chosen for each site were representative of the larger site and were used to show the plant community transitions occurring at the sites following meadow restoration activities. At the Corral Creek sites, these findings are supported by the groundwater well monitoring study, which found an increase in meadow saturation across all sites (Dansart 2020).

Cumulative Corral Creek Monitoring Discussion

Data from several of the Corral Creek project sites (Colby, Tee, Vassar, Five-Acre, and Racetrack meadows) can be cross-referenced with the Latah SWCD Corral Creek Monitoring Summary (Dansart 2020). Dansart 2020 used groundwater elevations, photopoints, and a modified Stream Visual Assessment Protocol (SVAP) to measure various physical and biological characteristics of the meadows before and after project implementation. Dansart found that riparian and stream condition and meadow hydrology improved at all sites, total meadow saturation was found at Racetrack by 2015 and meadow saturation improved at all other meadow sites, depth to water level improved at all but one site, and baseflow was extended at Racetrack (no-flow period dropped from a range of 171 to 116 days pre-project to as little as 28 days post-project). Dansart explored these results in depth in his report. In summary, overall condition of the stream and associated meadows improved post-restoration across all monitored sites. Given the extensive nature of the groundwater monitoring and the need for multiple years of baseline data, which is not always available, Dansart (2020) recommended that the use of imagery and vegetation monitoring "would document comparative changes in meadow hydration in addition to the recovery and expansion of the vegetative community".

Overall Monitoring Summary

It is notable that on all sites except one (Vassar Meadow), grasslikes (sedges, rushes, and spikerushes) increased following project implementation. This increase frequently correlated with a decline in drier site species like pasture grasses and dry site native forbs. On Upper Corral Creek - Vassar Meadow, the cover of grasslikes stayed the same, native grass cover increased, and cover of bare ground decreased. Cover of native forbs declined on most sites. It is likely that many of the native forbs commonly observed during baseline monitoring (e.g., western yarrow, *Achillea millefolium*) favor drier conditions and were displaced by the increasing grasslike and wet-adapted species. Our monitoring results did not discover an increase in the wet-adapted camas and American bistort, however, professional knowledge of the sites and photo documentation show that both seem to be increasing and are blooming more prolifically through the years following the restoration.

DISCUSSION

Vegetation monitoring is an efficient and cost-effective strategy to indicate meadow hydration in meadow systems and is used by Latah SWCD as a measure of project effectiveness. With greater floodplain access, wet-adapted species can thrive following decades of dehydration. Latah SWCD has a significant revegetation strategy that includes seeding and planting with native species on all disturbed sites following restoration construction activities. However, these results primarily show the passive restoration of the plant community in undisturbed locations. The herbaceous plant community can respond quickly to an increase in meadow hydration while woody species may take decades to return and provide stature and shade to the stream systems. Woody species are planted along the stream corridor to speed up this process, as needed.

Latah SWCD meadow restoration project goals include improving instream flow and affecting high stream temperatures by addressing channel incision and floodplain connectivity, and by restoration of the native plant community. Meadow restoration has been shown to have a positive impact on meadow d stream conditions, but flow responses are variable and require multi-year baseline data to measure a response (Dansart 2020). While the literature is inconsistent with respect to post-construction effects of meadow restoration on stream flows, (Hammersmark et al. 2008; Bristette 2017; Hunt et al. 2018; Tague et al. 2018; Dansart 2020), there is general agreement that highly functional wetlands are critical to the resiliency and health of a watershed, and therefore beneficial to the aquatic organisms dependent on healthy ecosystems. Monitoring vegetation composition, as is examined in this paper, is one way to measure wet meadow functionality.

Additional Latah SWCD meadow restoration project sites have baseline vegetation data collected. Vegetation monitoring results at these locations will be added to this paper as results are available.

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