Restoration Highlights

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Elwha Ecosystem Restoration Project: Natural and Managed Revegetation in the Drained Reservoirs after Two Growing Seasons

By Joshua Chenoweth, David Allen and Steve Acker

The historic dam removal on the Elwha River, the largest of its kind in the country and possibly the world, is nearing completion. The 108' tall Elwha Dam, completed in 1913 and located at river mile 5, is no more; full removal was accomplished in the spring of 2012. The 210' tall Glines Canyon Dam, completed in 1927 and located at river mile 13, was reduced to 50' tall as of November 1, 2012. Full removal is expected to be completed by the summer of 2014. Despite the delay, both reservoirs formed by the dams, Lake Aldwell and Lake Mills are now only memories. The current scene is dynamic, a flow of sediment and water surrounded by gently sloping valley walls covered in ribbons of green (Figure 1).

Figure 1. View of the former Lake Mills reservoir (July 11, 2013). There is still 50 ft of dam left, so the river in its current location is 40-50 ft above the original valley bottom.

Prior to dam removal, Lake Aldwell held about 6 million cubic yards of sediment. Lake Mills, 14 years younger and eight miles upstream, trapped the bulk of the sediment eroded from upriver over the last 90 years, amassing an estimated 20-28 million cubic yards. Over half of the Lake Mills sediment is coarse-textured sand, gravel and cobbles deposited into a delta at the upstream end. At the start of dam removal, the delta was 80 feet deep and almost a mile long! Fine-textured sediments (silt and clay) make up just under half of the total sediment in Lake Mills and are nearly 50 feet deep on the reservoir floor and between 1 and 5 feet thick on the valley walls (Figure 2). This massive amount of sediment is now nearly as dynamic as the river. The coarse sediment is eroding forward toward the dam site, overtopping the thick layer of clay and silt on the reservoir floor. As of June 2013, nearly 7 million cubic yards have left the former Lake Mills reservoir. Once dam removal is completed 10-14 million cubic yards of sediment is expected to remain in the former reservoir, covering over 400 acres of historic valley bottom and slopes at Lake Mills. We expect that the texture and depth of sediment will influence species composition and overall success of revegetation efforts.

Figure 2. EWU researcher Rebecca Brown in front of a 5-6 foot deposit of silt and clay in the former Lake Mills reservoir.

The revegetation work began in November 2011 and is planned to extend through 2017. The novel environments created by draining the reservoirs require an adaptive management approach. Planted and naturally regenerating sites will be carefully monitored to determine what's working and to direct changes to revegetation plans as needed. Natural revegetation is expected to develop quickly in certain areas which will not be planted. A thin band of upland close to the former shoreline is expected to regenerate quickly due to proximity to natural seed sources. The floodplain will also be left to regenerate naturally, primarily from flood water depositing seed and willow and cottonwood stems capable of re-sprouting.

The first permanent drawdown of the reservoirs occurred in June 2011. The drawdown of 18 feet exposed a narrow band of land, allowing us two growing seasons to observe natural revegetation. We expected, and are beginning to see, somewhat different trajectories for the expected vegetation that would return relatively to quickly to the approximately 315 acres formerly inundated by Lake Aldwell relative to the larger landscape once inundated by Lake Mills. The Lake Aldwell area is relatively narrow (<0.3 mile), so seeds from surrounding forests have less distance to travel to newly exposed sites. The sediments are not as deep as in Lake Mills, ranging from 1' to 15' and the texture tends to be mixed, with silt and clay topped by thin layers of sand and organic material. In the two years since the June 2011 drawdown, natural regeneration of primarily willow, cottonwood and alder has occurred (Figure 3). The regeneration is patchy, but dense in some places, especially close to the surrounding forests. The success of natural recruitment is in part due to the fortuitous coincidence of lowering water levels and seed dispersal in June 2011. Plant trials we performed prior to dam removal suggest woody plants will not tolerate deep layers of silt and clay once they dry out, so the long-term fate of these plants is uncertain. The former Lake Mills reservoir is much wider and has sediment layers that are as deep as 60 feet with the top 10-20 feet composed of very coarse sand and gravel. The most common natural regeneration plant communities have been dominated by *Juncus* and *Carex* species (Figure 4). Red alder has colonized some areas at high density, and young seedlings of cottonwood, hemlock, and other conifers were evident in the spring of 2013.

Figure 3. A dense patch of naturally regenerating willow, cottonwood and alder in Lake Aldwell, August 2012. Stem density at this site exceeds 50,000 per acre!

Figure 4. Natural regeneration of *Juncus* in the former Lake Mills reservoir, July 2012.

Figure 5. Forb-only seed mix seeded in March 2012 in the former Lake Aldwell reservoir. Photo taken June 2013.

Invasive, exotic species have also colonized some of the new surfaces, with substantial invasions in Lake Aldwell. This was expected, since the surrounding area contains many weedy species such as reed canarygrass (*Phalaris arundinacea*), Scot's broom (*Cytisus scoparius*), Canada thistle (*Cirsium arvense*), and ox-eye daisy (*Leucanthemum vulgare*). The presence of so many invasive species in the newly exposed surfaces makes active revegetation efforts imperative.

The first planting season began in November 2011 and ended in March 2012. At Lake Aldwell, we conducted an herbaceous seeding trial on a 1.25 acre plot of fine sediment. The trial evaluated different mixes of grasses and forbs and two sowing rates. Everything performed exceptionally well (Figure 5). At Lake Mills we planted over 30,000 plants into newly exposed surfaces. These first plants were planted into both fine and coarse sediments. We wished them luck (no watering, weeding or mulching) and then monitored them during the growing season. As part of our monitoring program, a Master of Science student from Evergreen College, Marisa Whisman, tagged 860 plants representing five woody species. The plants benefitted from cool weather and rains at the start of June and again in early July. Mid-July began a long, warm dry spell, and the plants had to endure a record dry August and September. However, at the end of September we found a mere 8% mortality rate among the 860 tagged plants! This is an astounding result. We had expected the sediments to dry out significantly. However, periodic moisture readings from May through September revealed a slow drying of the sediments. The plants greatly benefited from the moisture holding capacity of the fine sediments which had been inundated by the reservoir the past year. The mortality rate was higher on the coarse sediment but still quite low. The moisture retained the first season after reservoir drawdown was a temporary benefit to plants. Over time, we expect less moisture to be available in all sediment types during the growing season. Preliminary readings from the 2013 season are already showing the moisture levels to be much drier in July compared to July 2012.

For more on the goals, objectives and methods for revegetation see: The Elwha Revegetation Plan by J. Chenoweth, S. Acker and M. McHenry at; www.nps.gov/olym/naturescience/elwha-revegetation.htm.