Biodiversity in Restoration

In many ecological restoration projects, restoring the abiotic *process* takes priority over biological *biodiversity* as the primary objective and is often the logical first step. However, the pollination process is a critical one. Incorporating diverse species, particularly flowering plants, into the plant palette, allows the native plant-pollinator relationship to support restoration projects in meeting long-term goals.

The autogenic regeneration process of a native ecosystem relies on the pollination feedback loop. Resilience of the ecosystem is backboned by pollinators, in tandem with seed dispersers, because they enable long-distance gene flow within a site and between neighboring habitat fragments. A healthy pollinator population facilitates a higher percent cover of more genetically diverse native plants than does a site without pollinators. This is a critical factor in the first few years of restoration, establishing cover in the spaces that invasive plants would race to fill following initial removal. Furthermore, many invertebrate pollinators themselves provide an important source of fats and proteins source for the food web.

Native Pollinators

The native plant/pollinator mutualism is facing grave threats. Habitat is increasingly being lost to development, and the slivers that remain are fragmented or degraded by air, noise, and light pollution. The ubiquity of pesticides in modern agriculture and landscaping damages pollinators, such as the implication of neonicotinoids in disrupting the homing mechanisms in bees, leading to Colony Collapse Disorder (Lu, 2014). In many areas, the proliferation of non-native plants and pollinators has introduced disease, outcompeted, and ultimately displaced the abundance and diversity of native species. Moreover, climate change alters the rates and patterns of temperature and moisture, placing different selective pressures on plants and pollinators. Life cycle adaptations to climate change have been shown to disrupt dynamics, such as temporal mismatches between plant flowering and pollinator arrival, or the spatial mismatch when migrating plants are forced to seek out cooler or moister areas (Burkle, 2013; Steltzer, 2009).

About the Pollinator Plant Lists

Plant species on the pollinator plant lists are all native to the Puget Trough and are attractive to native pollinators. Plants were chosen according to site type, moisture, and light levels. Other factors include positive associations with other plants on the same list and availability at local nurseries. It is intended that each list have plants of different bloom colors, and bloom times that are as sequential as possible. The lists are arranged according to bloom time to emphasize the importance of this consideration for planting plans.

The lists are intended to complement restoration plans and are not exhaustive by any means. The intention is simply to diversify restoration plantings and encourage habitat for native pollinators.

Planting Notes

Select the right plants to fit soil, moisture, light exposure, and other conditions on your site. Place plants according to the *aspect* and appropriate *micro-topography* to maximize plant survivorship: hummocks, hollows, downed logs, and any small-scale roughness in the landscape all provide microsites that can dictate a certain plant's survival.

Depending on the site and desired plant spacing, some plants can mutually exclude each other; for example, in a tightly planted hedgerow, short herbs might become shaded or boxed out by shrubs.

In many restoration scenarios, herbaceous plants are most appropriate for a secondary planting, two to five years after initial restoration. This planting can often be accomplished at the same time that a crew returns to the site to maintain the initial restoration plantings.

Plant in clumps of the same species, rather than as solitary individuals. This aggregates the smell and color of a species, increasing its visual and olfactory attractiveness to pollinators.

Many herbs have sister species in the same or a closely related genus that will also serve similar pollinators. For example, a certain nursery may carry one species of lupine that does not match the species chosen in these lists but will still meet restoration goals and serve native pollinators.

Hedgerow: Sunny/Dry

These plants are generally either thorny, thicket-forming, tenacious, or somehow complementary to forming a living barrier under mostly sunny and dry conditions.

For more information on hedgerows: King Conservation District, http://www.kingcd.org/pub_fis_hed.htm

Understory or Hedgerow: Partial Shade/Moist

Happy to live in partial or full shade and requiring moist or wet soil, these plants can be planted as a living barrier hedgerow, or in a forest understory.

Road/Trailside

Many beautiful and colorful flowering plants will do great along a road, bike path, walking trail or along a median in a parking lot. Many of these thrive in disturbed or logged areas, and several do well in poor soils. Watch out: some are potentially weedy and will do best where they can be physically constrained, such as along a parking lot median or a sidewalk strip.

Slopes

A full spectrum mix of erosion control plants from shallow and fibrous root systems for topsoil stabilization, to deep and strong taproots for structural integrity. Control erosion right away with quick-growing groundcovers, mat-forming herbs, thicket-forming shrubs and live willow and red osier dogwood stakes.

For more information: Department of Ecology Slope Stabilization Erosion Control Using Vegetation manual, http://www.ecy.wa.gov/programs/sea/pubs/93-30/index.html

Riparian

A combination of stream/river bank, wetland, floodplain, and riparian corridor plants. The list is split into trees/shrubs and herbaceous only because together it is quite long.

Rain Garden

Stormwater runoff is recognized as a major cause of water pollution in the urban environment, sending oil and grease, bacteria, heavy metals, and other pollutants untreated into streams, lakes, and Puget Sound.

Green stormwater infrastructure utilizes the natural processes of plants, soils, and microbes. This infrastructure reduces the *quantity* of stormwater flows by increasing onsite infiltration and improves the *quality* by taking up inorganic pollutants and degrading organic pollutants. Plants on this list serve a secondary purpose by attracting pollinators to green stormwater infrastructure projects, such as rain gardens or bioswales.

Although sedges and rushes are not included in the list since they are generally wind pollinated, they are key plant families necessary for Zones 1 and 2 and should be planted in most all rain gardens in the Pacific Northwest.

The three planting zones are characterized by soil moisture, as described in *Rain Garden Handbook for Western Washington*, available online https://fortress.wa.gov/ecy/publications/publications/1310027.pdf.

"Zone 1: Areas of periodic, or frequent, standing or flowing water. Zone 1 plants should also tolerate the seasonally dry summers in western Washington without extra watering (except during the initial 1 to 2 year establishment period).

Zone 2: Periodically moist or saturated soils during larger storms. Plants are typically planted on the side slopes in this zone and can help to protect against erosion once established.

Zone 3: Drier soils, infrequently subject to inundation or saturation. May be planted on a berm or just outside the perimeter of the rain garden. This zone can blend with the existing landscape of the site if desired."

For more information: 12,000 Rain Gardens in Puget Sound, http://www.12000raingardens.org/

Meadows

Meadow is a general term for an open space dominated by herbaceous grasses or forbs. Plants on this list can be used to restore or complement an abandoned city lot, to restore a rare prairie, a pasture, or a forest clearing, or as a planned garden alternative to lawn.

Grasses, sedges, and rushes are not on the lists because they are pollinated by wind and not animals. However, they are the key plant forms in many meadow ecosystems and are essential to restoration.

A wet meadow refers to a grassland with waterlogged soil near the surface but without standing water for most of the year. A dry meadow is often nutrient poor and receives limited precipitation, requiring drought-tolerant plants. Many plants from both the wet and dry meadow lists would do well in mesic meadow conditions.

Pay close attention to the elevation when planting meadow plants; a few thousand feet can exclude several of these species.

The South Puget Sound prairies are an endangered grassland ecosystem unique to the Pacific Northwest, carved out by retreating glaciers and historically maintained for millennia by Native Americans. A shallow water table and gravelly, well-drained, nutrient-poor soils, allow wildflowers, bunch grasses, and oak trees to create a rare habitat for butterflies and other pollinators.

For more information: Center For Natural Land Management, http://www.southsoundprairies.org/cnlm/

Glossary

Aspect. The cardinal or compass direction that a slope faces, such as a northwest-facing slope.

Autogenic restoration. A self- sustaining process of restoration, where biotic factors, such as plants, engineer or remediate a system.

Biodiversity. A variety of different types of organisms living together in a system.

Ecological process. The physical, chemical, and biological phenomena and dynamics that shape and define an environment. Includes the cycling, fluxes, and flow of water, soils, nutrients, and energy over space and through time.

Hemi-parasite. Utilizes a host for some of its water or nutritional requirements. Hemi-parasitic plants combine parasitism with photosynthesis.

Herbaceous. A non-woody stemmed plant that dies back after the growing season. Includes graminoids (grasses, sedges, rushes) and forbs.

Mesic. A balance of moisture between wet and dry.

Micro-topography. Small scale variation in elevation on the landscape; for example, hummocks and hollows.

Pacific Northwest Plant Resources

Audubon Society of Portland: http://audubonportland.org/files/sanctuaries/guide

BackyardGardner.com: http://www.backyardgardener.com/Plant-Index/

Burke Museum of Biology and Culture, UW Herbarium: http://biology.burke.washington.edu/herbarium/imagecollection.php

Buza, Mary Jo, Rain Garden Plant List: http://olympiawa.gov/OlympiaWA/city-utilities/storm-and-surface-water/~/media/Files/PublicWorks/Water-Resources/RainGardenPlantList_Version21.pdf

Forest Service Fire Effects Information: http://www.fs.fed.us/database/feis/plants/index.html

Hansen's NW Native Plant Database: http://nwplants.com/index.html

Lady Bird Johnson Wildflower Center Native Plant Database: http://www.wildflower.org/plants/

Turner, M., and P. Gustafson, 2006. *Wildflowers of the Pacific Northwest*. Timber Press.

Pojar, J., and A. MacKinnon, 1994. *Plants of the Pacific Northwest Coast*. Lone Pine.

Portland Nursery: http://portlandnursery.com/plants/natives/

USDA Forest Service: http://www.fs.fed.us/wildflowers/

WSU Clark County Extension PNW Plants: http://pnwplants.wsu.edu/FindPlant.aspx

WSU Extension Choosing Rain Garden Plants: http://raingarden.wsu.edu/plants.html#list

Pacific Northwest Pollinator Resources

Butterflies and Moths of North America: http://www.butterfliesandmoths.org/species_browse

Butterfly and Moth Websites, maintained by Bill Oehlke. For King County, Washington: http://www.silkmoths.bizland.com/waKingsph.htm

Butterfly Food Plant List for Portland, Oregon, Willamette Valley, and the Colombia Gorge. http://www.lensjoy.com/butterfly_plant_list.htm

Butterfly Gardening: http://www.boskydellnatives.com/plantlist_butt.htm

Capital Region ESD 113, "Pollinators in the Pacific Northwest." http://www.esd113.org/cms/lib3/WA01001093/Centricity/Domain/295/Pollinator%20Guide%20November%202014.pdf

Gilbert, R., and Potter, A. 2014. “A Region Specific Guide to Butterflies of South Puget Sound, Washington.” http://cascadiaprairieoak.org/wp-content/uploads/2014/04/Guide-to-Butterflies-of-South-Puget-Sound-2014_updated.pdf

Washington Department of Fish and Wildlife, “Butterflies and How to Attract Them.” http://wdfw.wa.gov/living/butterflies/

Xerces Society: http://www.xerces.org

Literature Cited

Burkle, L., J. Marlin, and T. Knight, T. 2013. Plant-pollinator interactions over 120 years: Loss of species, co-occurrence, and function. *Science* 339(6127): 1611–1615.

Lu C., K.M. Warchol, and R.A. Callahan. 2014. Sub-lethal exposure to neonicotinoids impaired honey bees winterization before proceeding to colony collapse disorder. *Bulletin of Insectology* 67(1): 125–130.

Steltzer, H., and E. Post. 2009. Seasons and Life Cycles. *Science* 324 (5929): 886.