

Regenerative Riverscape Agroforestry

Regenerative Riverscape Agroforestry is a framework for landscape restoration and revegetation that restores not only the processes, structures, and functions of indigenous riverscapes including their wetlands and forests, but also human and cultural “relationships to place”, such that cultures are strengthened and revitalized alongside the lands with which they are inextricably linked. This definition is inspired by the “bio-cultural restoration” framework advanced by the State University of New York’s College of Environmental Science and Forestry¹. Our aim is to increase community investment in riparian landscapes, by increasing cultural relationships with riverscapes.

“Regenerative” describes the ability of an ecosystem to renew and recover from damage. In the case of Salish Sea riverscapes this includes the degradation of habitat forming processes, loss of keystone species and ecosystem architects², and reduced indigenous biodiversity caused by historical and ongoing impacts of deforestation, pollution, grazing, soil degradation, and species introductions. A “Riverscape” includes at minimum: active stream channels and their potential migration zones, floodplains, associated wetlands, and riparian zones, from headwaters to estuaries. A riverscape includes the physical and ecological processes that result in a cyclic disturbance regime.

“Agroforestry” is the intentional integration of trees, shrubs, crops, and animals into an integrated production system to create environmental, economic, and social benefits. Agroforestry is broadly inclusive, and has been practiced in the Salish Sea and around the world for centuries by both industrial and non-industrial societies. Agroforestry systems can vary widely in biodiversity, level of effort, and acre yield, and can produce foods, fibers, animal forage, medicinal products as well as ecosystem services. As an example under this broad definition, the deliberate cultivation of conifer logs to support in-stream habitat to cultivate fishery populations is a form of “agroforestry”.

Because of the importance of floodplains for a wide range of ecosystem services, we anticipate that floodplain stream-forest-wetland mosaics will involve active human involvement in their regeneration over time to support development biodiverse, self-organizing, and useful vegetation.

Our fundamental hypothesis is that current riverscale conditions are the product of both technical and cultural drivers, and that to change the future condition of our riverscapes we need to develop both cultural and technical strategies that change on-the-ground stewardship efforts. Cultural strategies will likely involve the cultivation of regenerative use and harvest by people.

¹ This definition follows the concept of biocultural restoration as developed by SUNY ESF (<https://www.esf.edu/research/restorationscience/biocultural.php>) and explored by River Restoration Northwest (<https://www.rrnw.org/biocultural/>)

² Including human indigenous cultural practices.

Principles

The following principles describe practices that may be necessary for the development of regenerative riverscape agroforestry systems.

1. **Map the Riverscape** - Regenerating riverscapes will require a spatially explicit and intimate understanding of hydrology, soils and land use, influenced by river, vegetation, economic and social and cultural processes. We assess landscapes at multiple scales to understand landscape potential.
2. **Mimic Natural Systems** - We design to target biodiverse self-organizing and self-sustaining ecosystems based on our understanding of coevolved indigenous flora and fauna. Creating productive systems that minimize dependency of energy-intensive management reduces input costs and increases carbon efficiency.
3. **Leverage Succession and Fill Niches** - We use accelerated succession to achieve ecological goals—replacing continuous resource use with light interventions over time. We restore soils and fill ecological niches with diverse vegetation to manage inevitable species introductions driven by globalization and climate change.
4. **Design Whole Treatments** - We predict how a site will respond to a treatment to develop strategies that anticipate and leverage natural ecological processes. We consider the cumulative costs of site preparation, propagation and aftercare over ten-year and hundred-year timescales to increase our efficiency in reaching goals.
5. **Cultivate Social Systems** - Riparian regeneration is a multi-generational process that will require deep social engagement. We design social niches into ecosystem stewardship, considering common-pool resource management, market development, and social relationships that support the flow of resources into and out of the riverscape.
6. **Put Skilled Eyes on the Ground** - Given the complexity of the task we need our treatments to be well documented and evaluated. This requires skillful work and consistent on-the-ground natural history observations, in addition to any quantitative methods.
7. **Retrofit The Operating Environment** - We design to optimize social and ecological implementation first, and then evaluate how the existing public funding and regulatory systems might more efficiently meet ecological and social needs. The public operating environment is an object of design.
8. **Optimize Provision of Public Trust Functions** - Endangered species act, wetland stewardship, riparian zone management, priority habitats and species, water quality, and agricultural production are all valuable elements of an interrelated public trust commons within the riverscape, defined by treaty, law, and rules. Decisions and tradeoffs can be explicitly and transparent.

Hypotheses Underlying These Principles

The following hypotheses inform principles, and the practice principles are a response to this set of hypotheses:

- A. **Riverscapes contain diverse public and treaty trust rights-holders** - in riverscapes, private land rights are co-mingled with public trust functions and treaty rights, including shared waters, shared lands, shared infrastructures, shared habitats for fish and wildlife populations, and an obligation to protect the public health, safety and general welfare. Thus riverscapes include comingled common pool resources and public goods that require collaborative and integrated management.
- B. **People invest in landscapes that provide a “yield”** - By obtaining a yield from a landscape you strengthen human will and attention to that landscape. That yield need not be economic, and may include personal, social, cultural or spiritual returns, and may involve conviviality and kinship among people and with other-than-human communities, education, and appropriate recreation³. Our challenge is to increase complex yields.
- C. **Biodiverse and resilient ecosystems may include human disturbance** - A natural ecosystem includes damage and regrowth and varied environments that create diverse ecological niches. These patterns of natural disturbance and stress have included the tending activities of humans as well as other species and cultures that have been removed from the land. We currently lack cultural systems to tend complex ecosystems well.
- D. **Scientific generalization does not replace place-based knowledge** - scientific methods of observation and hypothesis testing are powerful and valuable tools that may not apply well to specific instances of ecological management. Thus a “craftiness” is necessary to apply scientific knowledge well. Craft cannot be replaced by policies or best practices, but must be developed within a community of practice in relationship with places.
- E. **“Restoration” to historical states is unlikely** - Climate change and colonization have changed and will continue to change the underlying drivers of ecological systems. This does not mean that we don’t study and emulate evolved ecological systems, but the pursuit of historical states may not reflect a reasonable or viable strategy for restoration of ecological functions.
- F. **We must invest in the cultivation of knowledge** - Regeneration of biodiverse wild vegetation in a floodplain environment under climate change and after massive ecological degradation is a nuanced and challenging craft and science that may take generations to develop. Our methods should encourage humility, learning, responsibility and the examination of assumptions and difficult questions.
- G. **Riverscapes are critical for adaptation**⁴ - is a dry summer climate, leveraging the productivity of moist fine textured soils in river bottoms for calorie and resource production provides a critical adaptation pathway under climate change in a society currently dependent on globalized and energy-intensive food and resource production.

³ There are potential negative impacts of recreation on ecosystems and treaty rights.

⁴ <https://www.ipcc.ch/srccl/chapter/chapter-5/executive-summary/>

Public Trust Functions of the Riverscape Commons

Diverse functions are defined for riverscapes under tribal treaties, local, state and federal laws.. These ecosystem services are potential yields of well designed riverscape agroforestry systems.

- a. **Endangered Species Act** - protection of water quality, water quantity, flood volumes, flood velocities, spawning substrate, and/or floodplain refugia, stormwater, riparian vegetation, bank stability, channel migration, hyporheic zone, wetland and large woody debris.⁵ Listing criteria identify “physical and biological functions” of “critical habitat” as including forage, refuge, unobstructed migratory pathways and water quality.
- b. **Riparian Functions for Salmon Recovery** - Kubo et al (2019) recently summarized these as: shading; large wood recruitment; biotic and prey inputs; nutrient, sediment and toxin filtration; bank stability; and microclimate moderation.
- c. **Shoreline Management Act** - rivers with over 1000 cfs of flow and associated wetlands are “shorelines of statewide significance”. Management requires “no net loss” of “current and potential ecological functions” but does not itemize those functions.
- d. **Tribal Harvest Opportunities** - tribal treaties reserve the perpetual right for tribal members to fish, hunt and gather in usual and accustomed areas. The extent and details of these broad commitments are under continuous consideration.
- e. **Wetland Functions** - Functional assessment methods identify the following functions: remove sediments, nutrients and toxins; reduce peak flows; decrease downstream erosion; recharge groundwater; provide habitat for invertebrates, amphibians, resident and anadromous fish, and wetland associated birds and mammals; support primary production and native plant richness.⁶
- f. **State Priority Species and Habitats** - A list of 269 species and 20 uncommon habitats are defined as targets for state management, and are considered under the Growth Management Act and Shoreline Management Acts.
- g. **Water Quality** - Federal and state laws and rules attempt to remedy violations of water quality standards, which vary from system to system. Temperature, nutrient and fecal coliform violations are common systematic drivers of degraded water quality, and water quality may be exacerbated by low summer flows.⁷
- h. **Agricultural Land Conservation** - The Washington State Growth Management Act valued and defines agricultural land as “land primarily devoted to the commercial production of [a wide range of products]”⁸

⁵ FEMA BiOp sets standard for habitat compliance

https://www.fema.gov/pdf/about/regions/regionx/nfip_esa_biological_opinion_checklist_final.pdf

⁶ Hruby et al. 1999. <https://apps.ecology.wa.gov/publications/documents/99115.pdf>

⁷ <https://apps.ecology.wa.gov/publications/documents/1303104.pdf>

⁸ <https://app.leg.wa.gov/rcw/default.aspx?cite=36.70A.030>

Floral Production Opportunities

Harvest of plant materials aims to support restoration and resilience while accelerating development or not negatively affecting development of ecosystems.

1. **Seeds** - seeds to support nursery propagation or seed-based restoration.
 - a. **Flowering Meadow (following trials by [NW Meadowscapes](#))** - *Prunella vulgaris*, *Achillea millefolium*, *Camassia leichtlinii*, *Grindelia integrifolia*, *Lupinus rivularis*, *Lupinus polyphyllus*, *Sidalcea campestris*, *Eriophyllum lanatum*, *Ranunculus occidentalis*, *Erigeron speciosus*, *Camassia quamash*, *Potentilla gracilis*, *Festuca romerii*, *Deschampsia cespitosa*, *Horedum brachyantherum*.
 - b. **Nursery Seed Production** - areas may be cultivated for nursery seed production.
2. **Cuttings** - cuttings to support biotechnical erosion control and restoration plantings; cultivation can result in more efficient harvest of higher quality products.
 - a. **Stem** - *Salix*, *Populus*, *Cornus*, *Syphoricarpos*, *Lonicera*, *Physocarpus*.
 - b. **Root** - *Corylus*?, *Crataegus*?, *rhizomatous forbs*
3. **Divisions** - active cultivation of rhizomatous species for harvest of bareroot stock - *Rubus*, *Epilobium*, *Rosa*, *Symphoricarpos*. Additional species may be cultivated through field layering (e.g. *Mahonia*, *Corylus*, etc.).
4. **Craft Materials** - a variety of materials are valuable for basketry and other hand crafts.
 - a. **Fibers** - *Populus trichocarpa* (bark), *Salix* spp. (bark & stem), *Cornus sericea* (stem), *Thuja plicata* (bark, root), *Picea sitchensis* (root), *Schoenoplectus* spp. (shoots), *Typha latifolia* (shoots).
 - b. **Dyes** - *Mahonia* spp., *Alnus rubra*, ??
5. **Food & Medicine** - many species have seasonal household food or medicinal value.
 - a. Shoots - Spring harvest of young shoots and perennial greens - *Rubus spectabilis*, *Urtica dioica*, *Hydrophyllum*, *Mianthemum Racemosa*,
 - b. Berries - *Rubus* spp, *Rosa* spp, *Vaccinium* spp,
 - c. Nuts - *Corylus cornuta*, *Quercus garryana*, integration of non-native tree nuts (e.g. *Castanaea* or *Julans*) into buffer edges may increase calorie production.
 - d. Mushrooms - log-based cultivation can use *Alnus*, *Populus*, *Quercus*, and potentially softwood logs for production of edible or medicinal mushrooms.
 - e. Medicinal - Wide range of species have specialty markets, and opportunities for value added products.
6. **Floral** - Cuttings may provide tested and novel products for floral markets.
 - a. Forced and cut woody stems - *Ribes*, *Physocarpus*, *Spirea*
 - b. Floral greens - Swordfern, Gaultheria,