

## **Comparison of City of Bellingham Revegetation Projects to Historic Forest Conditions**

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The term “restoration” is used to describe a variety of management actions. Some restorative actions are designed to re-establish historic conditions; others are designed to increase functional value and restore site stability; and some are designed to establish native vegetation. Native plants provide wildlife habitat and food sources, are adapted to local weather regimes, play a vital role in the development of sustainable plant communities, and help to lower project maintenance costs. Determining what native plants to install is important because species composition influences project success and the structure of the restored plant community.

In this write-up the species composition of City of Bellingham (COB) restoration projects is compared to historic species composition values. The city projects reviewed are: Upper Boulder Bend, Lower Boulder Bend, Grizzly, Valencia East, Valencia West, Salmon Park, Unity, and Anderson Creek. All projects except Anderson Creek have been planted; results from these projects are from total count sampling within one year of planting. The results from Anderson Creek are preliminary numbers from the initial revegetation prescription.

Historic conditions are derived from a report titled *Historical riverine dynamics and habitats of the Nooksack River* (Collins & Sheikh 2002). Archival materials, including maps and field notes from the General Land Office (GLO) cadastral survey (1859-1893) are used to develop information about historical forest conditions. General Land Office surveys provide a systematic sample of the forest vegetation as well as qualitative assessments of forest composition (DiDomenico 1982). “Historic conditions” refer to conditions that existed at the time of early settlement by Euro-Americans in the mid 19<sup>th</sup> century (Collins & Sheikh 2002).

GLO surveyors recorded bearing tree information at section corners. Section corners refer to grid junctions of Township and Range grids, which were established by Congress in 1792. In addition to section corners, bearing tree information was recorded at quarter-corners, at 1/16<sup>th</sup> corners on Indian Reservations, and at meander corner points. Meander corner points were established where section lines intersected a waterway and are used to identify streamside vegetation. The relative frequency of bearing trees at corner points is used to derive percent composition per species.

Knowledge of historical landscapes is inherently uncertain because historical materials are incomplete, can be inaccurate, are imprecise compared to modern mapping capabilities, and because of the spatial and temporal variability of landscapes and landscape processes. It is important in using archival sources to reduce uncertainty by using multiple sources and methods having different strengths and scales that overlap and cross reference (Collins & Sheikh 2002). Other archival sources, such as settler notes, explorer diaries, charts, and plat maps were used by Collins & Sheikh to corroborate survey records.

Species composition is assessed in various reaches of the Nooksack watershed (Table 1). The frequency of species found in streamside forests, valleybottom forests, and wetlands are documented by reach. From these results I synthesize percent composition values for comparison to City of Bellingham restoration projects.

| RIVER MILE     | REACH            | LOCATION                     |
|----------------|------------------|------------------------------|
| RM0 –RM6       | Delta            | Below Ferndale               |
| RM6 –RM24      | Lower mainstem   | Ferndale to Everson          |
| RM24 –RM37     | Upper mainstem   | Everson to Deming            |
| RM37—RM56      | North Fork       | Confluence to Maple Falls    |
| MF RM0—MF RM5  | Middle Fork      | Confluence to Heisler Bridge |
| SF RM0—SF RM16 | Lower South Fork | Confluence to Dyes Canyon    |

Table 1- Collins & Sheikh 2002, p 15

Because city project sites vary physically and geographically, different historic condition values are needed. Historic species composition values are generated for projects occurring within city limits (city sites), and projects occurring in the vicinity of the S. Fork Nooksack (fork sites). The distinction between city sites and fork sites is made to address geographical variations that influence species composition.

Within each of the two main groups (city/fork) three site types are designated: streamside, valley bottom-riparian, and valley bottom. The streamside designation is applicable to sites that are immediately adjacent to streams and are not elevated by fill or extensively modified by anthropogenic forces. Values for these areas are derived from Lower Mainstem streamside and South Fork streamside values respectively.

Sites that are immediately adjacent to a stream but are elevated by fill or extensively modified are classified as valley bottom-riparian sites. These sites are distinguished from streamside sites because, although they may exist in close proximity to the stream they experience altered groundwater exposure and hydrologic regimes due to bank hardening, fill and drainage modifications. Values for valley bottom-riparian sites are the average of streamside forests and valley bottom forests.

Valley bottom percentages are calculated as an average of Lower mainstem valley bottom and Upper mainstem valley bottom forests. Upper Boulder Bend for example is a valley bottom site in the city, Salmon Park is a valley bottom- riparian site, and Anderson Creek is a streamside fork site. These distinctions are designed to account for geographic differences between sites as well as physical differences between site characteristics.

The following species were used for comparison:

| Code         | Latin Name  | Common Name       |
|--------------|---|-------------------|
| <b>PSME</b>  | <i>Pseudotsuga menziesii</i>                          | Douglas-fir       |
| <b>PISI</b>  | <i>Picea sitchensis</i>                               | Sitka spruce      |
| <b>THPL</b>  | <i>Thuja plicata</i>                                  | Western redcedar  |
| <b>TSHE</b>  | <i>Tsuga heterophylla</i>                             | hemlock           |
| <b>ACMA</b>  | <i>Acer macrophyllum</i>                              | bigleaf maple     |
| <b>ACCI</b>  | <i>Acer circinatum</i>                                | vine maple        |
| <b>ALRU</b>  | <i>Alnus rubra</i>                                    | red alder         |
| <b>BIRCH</b> | <i>Betula papyrus</i>                                 | paper birch       |
| <b>POBAT</b> | <i>Populus balsamifera</i> (var. <i>trichocarpa</i> ) | black cottonwood  |
| <b>SALIX</b> | <i>Salix sp.</i>                                      | willow species    |
| <b>MAFU</b>  | <i>Malus fusca</i>                                    | Pacific crabapple |

Historic percent species composition at City sites and Fork sites:

| <b>City</b>   |                    |                               |                      |
|---------------|--------------------|-------------------------------|----------------------|
|               | <b>Stream Side</b> | <b>Valley Bottom-riparian</b> | <b>Valley Bottom</b> |
| <b>PSME</b>   | 0.0%               | 0.7%                          | 9.4%                 |
| <b>PISI</b>   | 5.6%               | 7.5%                          | 4.7%                 |
| <b>THPL</b>   | 31.5%              | 18.9%                         | 17.2%                |
| <b>TSHE</b>   | 0.0%               | 0.0%                          | 1.5%                 |
| <b>ACMA</b>   | 3.4%               | 5.4%                          | 9.1%                 |
| <b>ACCI</b>   | 18.5%              | 16.0%                         | 11.0%                |
| <b>ALRU</b>   | 31.5%              | 34.4%                         | 33.7%                |
| <b>BIRCH*</b> | 0.0%               | 3.7%                          | 3.7%                 |
| <b>POBAT</b>  | 18.5%              | 9.3%                          | 1.5%                 |
| <b>SALIX</b>  | 10.1%              | 11.8%                         | 8.2%                 |
| <b>MAFU</b>   | 8.4%               | 6.5%                          | 2.2%                 |

| <b>Fork</b>   |                    |                               |               |
|---------------|--------------------|-------------------------------|---------------|
|               | <b>Stream Side</b> | <b>Valley Bottom-riparian</b> | <b>Upland</b> |
| <b>PSME</b>   | 0.0%               | 5.0%                          | 13.6%         |
| <b>PISI</b>   | 0.0%               | 1.7%                          | 1.7%          |
| <b>THPL</b>   | 4.3%               | 5.3%                          | 17.1%         |
| <b>TSHE</b>   | 4.3%               | 8.2%                          | 7.5%          |
| <b>ACMA</b>   | 8.0%               | 5.7%                          | 7.1%          |
| <b>ACCI</b>   | 8.5%               | 13.6%                         | 13.7%         |
| <b>ALRU</b>   | 58.5%              | 48.0%                         | 33.8%         |
| <b>BIRCH*</b> | 1.9%               | 4.1%                          | 3.1%          |
| <b>POBAT</b>  | 6.1%               | 3.1%                          | 1.5%          |
| <b>SALIX</b>  | 14.9%              | 9.7%                          | 3.8%          |
| <b>MAFU</b>   | 0.0%               | 0.0%                          | 0.0%          |

The following is a table of species composition values for COB restoration projects.

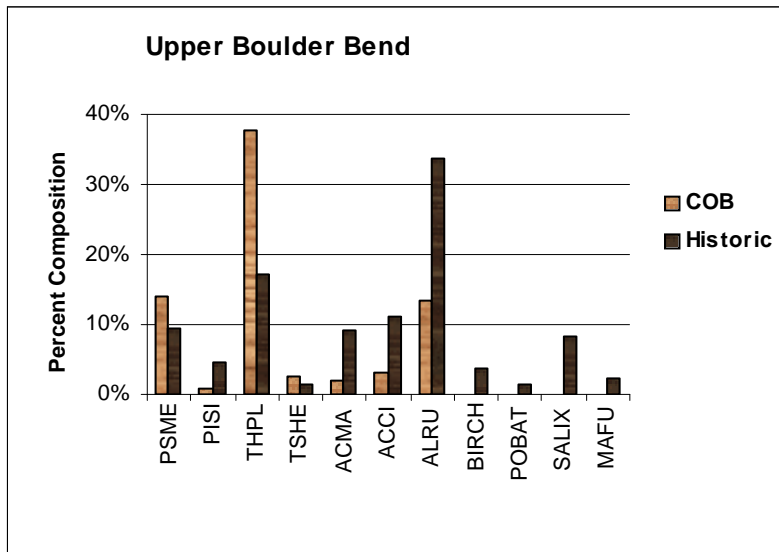
|               | <b>UpperBB</b> | <b>LowerBB</b> | <b>ValEAST</b> | <b>ValWEST</b> | <b>Grizzly</b> | <b>SalmonPark</b> | <b>Unity</b> |
|---------------|----------------|----------------|----------------|----------------|----------------|-------------------|--------------|
| <b>PSME</b>   | 14.0%          | 19.8%          | 10.5%          | 28.8%          | 44.5%          | 5.3%              | 5.5%         |
| <b>PISI</b>   | 0.9%           | 6.1%           | 3.8%           | 2.5%           | 0.0%           | 4.9%              | 1.4%         |
| <b>THPL</b>   | 37.7%          | 23.8%          | 4.7%           | 9.6%           | 8.0%           | 22.9%             | 4.9%         |
| <b>TSHE</b>   | 2.4%           | 8.5%           | 2.0%           | 1.7%           | 0.7%           | 1.4%              | 2.6%         |
| <b>ACMA</b>   | 2.1%           | 0.0%           | 6.1%           | 0.4%           | 1.5%           | 0.1%              | 2.6%         |
| <b>ACCI</b>   | 3.0%           | 0.0%           | 5.3%           | 9.6%           | 2.2%           | 6.0%              | 5.7%         |
| <b>ALRU</b>   | 13.4%          | 19.5%          | 9.4%           | 6.7%           | 18.2%          | 11.5%             | 10.6%        |
| <b>BIRCH</b>  | 0.0%           | 7.6%           | 1.5%           | 0.0%           | 3.6%           | 0.5%              | 3.9%         |
| <b>POBAT</b>  | 0.0%           | 0.0%           | 0.0%           | 0.0%           | 0.0%           | 0.0%              | 0.0%         |
| <b>SALIX*</b> | 0.0%           | 0.0%           | 0.0%           | 0.0%           | 0.0%           | 0.0%              | 0.0%         |
| <b>MAFU</b>   | 0.0%           | 0.0%           | 0.0%           | 0.0%           | 0.0%           | 0.3%              | 0.0%         |

\*salix cuttings not counted for COB projects so they do not reflect in these values or following graphs.

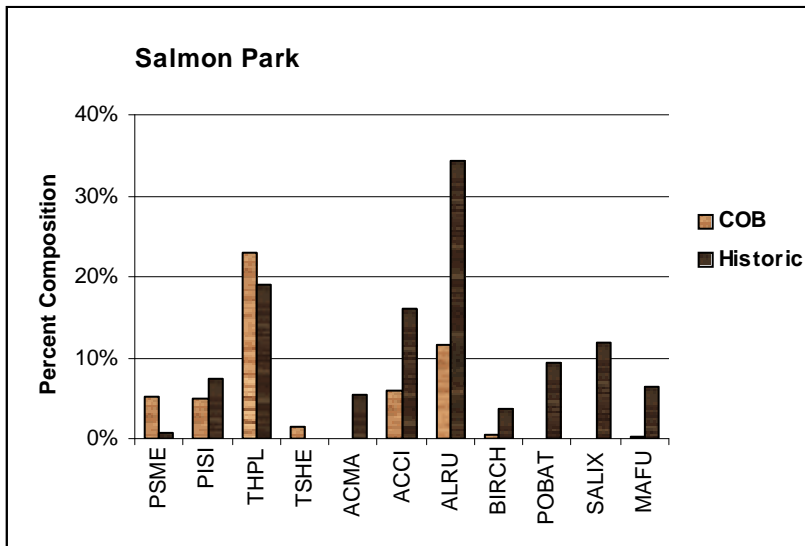
Having historic species composition values along with COB composition values allows for comparison of COB sites to historic levels. Comparison allows for better planning, management and analysis of COB revegetation efforts. Through analysis it is possible to increase project success and lower maintenance costs. Analysis can provide valuable information about species/site interaction and may help lead to a better understanding of success/failure causality. Understanding and knowledge about appropriate species for initial planting and inter-planting can be applied to project design and adaptive management.

Graphical examples of COB/Historic value comparisons:

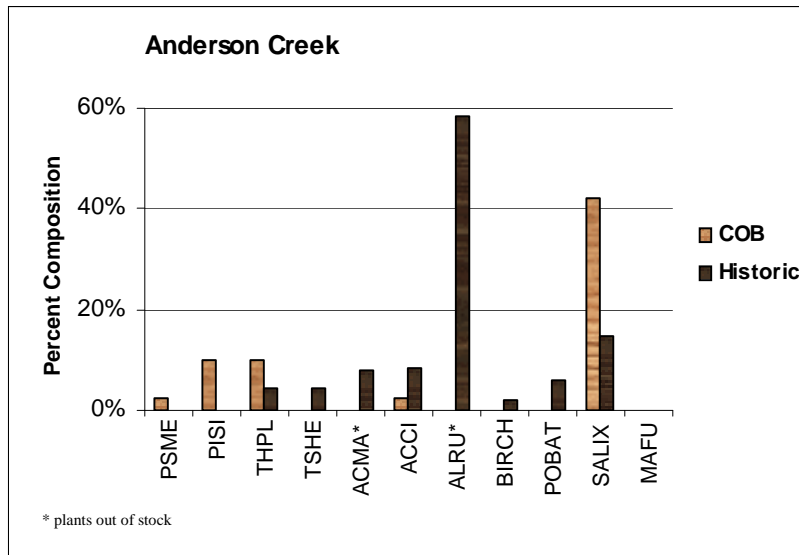
Upper Boulder Bend project compared to valley bottom historic species composition values:



Salmon Park species composition values are compared to valley bottom-riparian historic values:



Anderson Creek values are compared to streamside South Fork historic values. Some of the species are missing from COB prescription due to unavailability of nursery stock.



## Conclusions:

The absence of Pacific crabapple (*Malus fusca*) from COB restoration projects accounts for the most common difference between city restoration projects and historic forest conditions. Black cottonwood (*Populus trichocarpa*) is also absent from many COB projects. Black cottonwood is an important species because it contributes large wood to streams and provides shade to the stream corridor. Black cottonwood was the only hardwood in the Collins report to attain a large diameter (mean diameter 49 cm, median 35 cm, maximum 172 cm). In the lower mainstem, black cottonwood would have augmented spruce as a source of recruitable large wood (Collins & Sheikh 2002).

Bigleaf maple and vine maples are absent or well below historic values on many COB sites. According to a report on NSEA restoration projects, vine maple has had consistently low survival rates and big leaf maple has had poor survival rates (NSEA 1999). On COB projects, low survival is not causing species absence but rather a low number of plants installed; survival for vine maple is 94.9% and bigleaf maple 100%. Only fifty bigleaf maples have been planted on monitored COB projects. Bigleaf maple has fast growth rates, and when mature, this species provides excellent shade (NSEA 1999).

In regards to Anderson Creek, differences between prescribed and historic compositions are in some cases the result of unavailable nursery stock. Knowing the types of native plants and the desired numbers to be planted can help with nursery management. Projection of future project needs along with a listing of current maintenance and upkeep needs may help to manage nursery inventory.

Understory species are absent from this report. A source of information about historic understory species is *Vegetation Pattern at the time of American Settlement in the Nooksack River Lowland, Northern Puget Trough, Whatcom County, Washington*; a thesis written by Anthony Thomas DiDomenico (1982). This thesis is focused on trees and large shrubs since they

play a significant role in shaping the forest strata and plant community. Focusing on native tree and shrub species can help facilitate the survival and development of some understory species. Prescription of understory vegetation should be based on the composition of tree species and shrub species, as well as other physical site factors.

Comparing COB projects to historic forest conditions is not a comparison of right and wrong or good and bad. An understanding of historic forest conditions can assist ecological restoration efforts. Defining target species composition for a restoration site can help to guide revegetation prescription and maintenance efforts. Combining information about historic forest assemblages and current site characteristics with site potential can help to increase project success. On many sites the historic legacy of native plants is gone. In these cases information about species composition is limited to off-site reference reaches, and in many cases these reference reaches are incapable of providing reliable reference. Information about historic conditions can help provide reference values. Combined with other site information, historic values can help to guide restoration planning and project maintenance and hopefully assist with the establishment of ecologically sound and sustainable sites.

### **Bibliography:**

Collins, B and A. Sheikh. 2002. *Historical riverine dynamics and habitats of the Nooksack River*. Interim report to Nooksack Indian Tribe Natural Resources Department, Deming, WA.

DiDomenico, A. T. 1982. *Vegetation Pattern at the time of American Settlement in the Nooksack River Lowland, Northern Puget Trough, Whatcom County, Washington*. WWU-Thesis.

Durkee-Nueman, M. 1999. *Monitoring Salmon Habitat Enhancement Projects: a report summarizing monitoring activities and results to date*. Nooksack Salmon Enhancement Association report.