A Sustainable Strategy for Backyard Forest Restoration

E-book Formatted for Desktop Computers
February 2024
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---Introduction---

When we buy a house with a yard, we know that as long as we own it, we will have to maintain it, and if inspired we may choose to make improvements. I would argue that if the property includes a natural forest in the back yard, the same principles apply. We should accept certain minimum tasks that have to be done -- the "essential minimum[1]." And, if we're inspired by the idea of restoring a bit of forest ecosystem, then it would be important to know how to proceed efficiently and economically.

If I Were Starting Over

If I was starting over, by myself, in my own backyard forest, I would base my strategy on the Bradley Method and proceed as follows:

- Remove noxious weeds, if any.
- Make ring cuts on ivy growing up any trees.
- Remove scattered invasive plants from areas with established native groundcover plants and shrubs. These would be the "good areas." The rest would be the "bad areas." I would not try to clear all of the invasive plants from the bad areas.
- Create weed breaks to help deter weeds from spreading from the bad areas into the good areas.

The Intended Audience for this E-book

Though most of my experience has been working in a public park, I'm writing this primarily for the thousands of owners of private backyard forests in the residential subdivisions of the Puget Lowlands. I believe that on average,

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1 See Chapter 6, "The Essential Minimum."

these private backyard forests can be restored by one person working just two hours per month for ten months of each year (20 hours per *year* spread out over the entire year).

Though the Bradley Method will work anywhere, I intend this e-book primarily for small, private forests. In some respects, the strategy I propose may not really work in public parks for various reasons[2].

Why Am I Writing This E-book?

I decided to write this e-book because I came to believe there was a problem with some of the strategies of urban forest restoration that I had been taught and had been practicing for 16+ years in the Puget Lowlands of Western Washington. Because our beautiful, wet temperate forests are overrun with invasive plants, I hate to see restoration efforts spent on strategies that don't work. I've come to believe that we would benefit in the long run by employing the restoration methods developed by two sisters in Australia, the "Bradley Method."

Disclaimer

I do not claim to be an expert in forest restoration. What I suggest are things I have learned from reading, from mentors, and from my own successes and failures working on a voluntary basis on various forest restoration projects. You, the reader, should not interpret what I write to be professional advice. I'm not liable for any failures, damages, or injuries you sustain from working in the forest, attempting any of my forest restoration strategies, methods, or ideas.

Variation Among Sites

Obviously, each backyard forest is unique. Variables include, but are not limited to, soil, terrain, exposure, characteristics of existing vegetation, and extent

[2] See chapter "Forest Restoration on Public Land."

of invasive plants. Thus, the ideas and strategies in this e-book have to be thought of as generalizations and principles, not hard and fast rules.

Geographical Applicability

The focus of the e-book is on the Puget Lowlands of western Washington State because that is where my experience with forest restoration has been. However, I believe that the basic ideas also apply to any of the temperate forests of the Pacific Northwest located on the west side of the Cascade Mountains. Broadly speaking, I think the Bradley Method could be successful anywhere.

A Note on Style

Because of all the complexities of forest restoration, and because I am not an expert, I have struggled with how I should I express my advice. It would be most accurate, to preface almost every suggestion with phrases like, "Generally, in my opinion, you should do XYZ." Instead, in many cases, I simply state, "you should do XYZ," assuming that the critical reader will always remember that it is my opinion, and that it is a generality. Alternatively, I sometimes write, "I do XYZ." In rewriting this e-book several times, I have gradually shortened the text by editing out many of the qualifiers and using more "you" statements. I hope this blunt wording will not create negative reactions in you, the reader.

What This E-book is Not

This is not an e-book about planting a forest from scratch. Instead, it's about restoration of existing forests that are overrun with invasive plants.

This e-book focuses on areas of forest that are under a canopy of mature trees and only touches briefly on the restoration of forest edges[3].

This is not an invasive plant identification guide and for the most part it does not provide detailed advice on how to control specific weeds. There are

[3] See chapter "The Challenges and Opportunities of Edges."

already excellent sources of information on both subjects, beginning with the King County Noxious Weed website[4].

Though the skills of the forest steward and the skills of the gardener are much the same, this is not an e-book about gardening with native plants.

Thanks to My Mentors

All of my forest restoration practices began with things I learned from my mentors. There have been at least a dozen along the way beginning with my parents when I followed them around and tried to help in their garden and yard. I could tell a story about each of the persons who taught me. Some were old and had spent a lifetime tending plants. I am in gratitude to each of them.

Land Acknowledgment

I respectfully acknowledge that the forests of the Puget Lowlands are the traditional lands of the Coast Salish Tribes and other tribes of the Pacific Northwest.

Backyard Forest Restoration – Thesis Statement

Because of the terrain and natural vegetation of the Puget Lowlands, many tens of thousands of residential subdivisions have forests in their backyards[5]. The owners of these properties have the opportunity to foster biodiversity and mitigate climate change by working to preserve the existing trees and improve the health of the forests. The work begins with preventing ivy from growing up trees. More complete forest restoration, depending on the individual property owner's time and inclination, can include many further steps to control non-native and encourage native plants. The ultimate goal, a fully restored Puget Lowland ecosystem[6], consists of an enclosed canopy of mature native conifers

[4] See in appendices, "Resources on the Web."

[5] See "How Many Backyard Forests are There in the Puget Sound Region?" in the appendices.

[6] Puget Lowland Ecoregion: Chapter 2 in "Status and trends of land change in the Western United States--1973 to 2000", Professional Paper 1794-A-2, By: Daniel G. Sorenson, https://doi.org/10.3133/pp1794A2

shading an understory of native shrubs and groundcover plants that has sufficient density to slow the invasion of non-native plants.

1 -- Preliminary Steps

Before working on your backyard forest restoration, I highly recommend that you take the preliminary steps discussed below. Forest restoration is a slow, long-term process. In the big scheme of things, it doesn't really matter if it takes several years to accomplish these tasks. The time and expenses you invest in them will pay off in the long run.

First Hire an Arborist to Identify and Evaluate Your Trees

Before deciding on a strategy and beginning work in your backyard forest I recommend that you hire an arborist to identify and evaluate your trees. The arborist's written report should include an inventory of each of the mature trees, their species, and recommendations for any work that should be done to keep them healthy and safe. Personally, I prefer to hire an arborist that is not also in the business of tree trimming and removal so that I have more confidence in the recommendations.

Next Hire a Reputable Tree Service to Remove Dangerous Trees and Branches

Because safety always come first, hire a reputable tree service to remove dangerous trees and branches as recommended by the arborist.

Explore Your Backyard Forest

After the arborist's evaluation and the removal of any dangerous trees and branches, you should spend time exploring every nook and cranny of your backyard forest. Explore it during all of the seasons. Appreciate what you have.

Think about the slow pace of time in the forest compared with our quick-paced lives -- “forest time” as opposed to “people time.”

Trees live a long time. The trees in your forest began growing before you were there and will, hopefully, be there when you are gone. You are a temporary resident caretaker in their midst -- a “forest steward.” Those of us who have spent time restoring patches of forest want to believe that others will fill our roles when we are gone. Backyard forest restoration is not a one-time, quick fix. Ideally, it is an ongoing, rewarding, integral part of our lives.

Identify Your Plants

Exploring your backyard forest includes gradually getting to know all of the different species of plants. Presumably, your arborist has helped you identify species of trees you have, but you also need to be able to identify the shrubs and groundcover plants, both native and non-native. For this, I recommend subscribing to one of the plant identification applications for your phone. These apps are fairly good at identifying the more common plants and can usually at least identify the correct genus of less common plants. For the less common plants, you may need to follow up with resources in books or on the web[7].

One reason identifying your plants is important, is to learn if you have any noxious weeds on your property for which removal is required by county ordinance[8].

Take Photographs

Spend some time taking photographs throughout your backyard forest documenting the way it looked before you started working. Along the way take more photographs to mark progress.

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[7] See in appendices, “Resources- Books,” and “Resources on the Web."
[8] See “Remove Noxious Weeds,” below

Make a Plan

Before actually beginning to work in your backyard forest, make a written plan including the following elements:

- an estimate of how many hours per month you want to commit to working in your forest,
- an estimate of how many dollars per year you want to spend on purchasing native plants.

The plan should include a sketch map of your backyard forest with

- overall dimensions,
- approximate areas on the map with good existing native groundcover plants,
- approximate areas on the map with serious infestations of weeds, especially ivy, holly, laurel, and Himalayan Blackberry, and
- approximate locations of trails.

This plan will not be the final word by any means but will get you thinking and give you a direction to begin.

Begin Keeping Records

In the long run, you will be grateful for having taken the time in the beginning to create a simple system of record keeping that you can maintain over the years. It could be a spreadsheet on your computer, notes on your phone, or maybe the best, a blank notebook where you spend five minutes writing down the date, how long you worked, where you worked, and what you did. You're going to have successes and failures. I encourage you to try different things. Documenting what you have done and how things progressed will help you learn what works and refine your strategies over time.

2 -- Safety First

Safety comes first, always. Below are some of the things you should consider every time you venture into the woods, either to work or to play.

Get Dangerous Trees and/or Large Branches Removed

As discussed in "Preliminary Steps" above, to reduce the risk of time spent in your backyard forest, begin by having an arborist evaluate the health of your trees and a reputable tree service remove any dangerous trees or branches.

Wear Work Clothes

Forest restoration consists of manual labor in the outdoors. It's important to always wear gloves, long-sleeve shirts, long pants, and adequate shoes.

Use Tools Properly and Safely

Though very few tools are needed for forest restoration work, each has the potential to cause injuries if used carelessly. If you have never been instructed on tool safety, there are many good resources on the web. Very briefly, some of the guidelines for using tools safely include:

- Carry tools at your side with the points down and be careful with them around other people.
- Be mindful of the hand that is not holding the sharp saw or hand clippers. You don't want to accidentally saw your thumb or clip your finger.
- Make sure nobody is standing close to you when you are using a shovel or a hand tiller and be careful where and how you leave them when they are not in use.

Be Careful with Trash

Part of the work of the forest steward is to pick up trash. Sometimes trash can be hazardous, so be wary, careful, and always wear gloves.

Watch Footing and Avoid Falls

Watch your footing, especially when working off trail. You don't want to fall, or twist an ankle, or hyper extend a knee. I'm especially careful when moving down steep terrain, through heavy brush, and over fallen logs and branches. I look out for holes in the ground, especially where Mountain Beavers live.

Stay Out of the Forest During Windstorms

The forest floor is littered with fallen trees and fallen branches, most of which have come down during windstorms. You don't want one falling on you, hence, stay out of the forest during windstorms.

Protect Your Back

Forest restoration work requires a lot of bending over and is not suitable for anyone with back problems. You don't want to injure your back or aggravate an existing condition. When my back starts to get tired, I take a break, stand up straight, and relax for a few minutes. If, at any time, I start to feel pain, it's time for me to stop for the day and come back only when my back is no longer sore. I also do regular floor exercises to maintain my strength and flexibility, including several that target my back.

Avoid Mosquitoes

Mosquitoes can become quite thick and persistent at times. As soon as they appear in the spring, I carry mosquito repellent in my pocket and apply it as soon as one starts buzzing around. They are annoying, even in small numbers, and can carry West Nile Virus. Certain years in certain places they can become so thick, that for me, work in the woods is only tolerable wearing a head net.

Keep Hydrated

It's always important to drink enough water when working, especially in hot weather.

Expect Minor Scratches

Even when wearing work pants with heavy fabric, my legs get scratched at times by broken branches or blackberry thorns. I often get minor scratches on my lower wrists where they are exposed between my sleeves and gloves. When working around fallen trees, I've learned to watch out for sharp stubs left where branches have broken, especially when they are hidden in the foliage. I often take my hand saw and cut these off cleanly next to the trunk to remove the hazard.

Stay Away from Yellow Jackets, Wasps, and Bees

Yellow Jackets become aggressive during later summer and early fall especially near their nests in the ground. If one or more starts buzzing around, I don't idly try to swat them away and keep working. I immediately leave the area in haste and move far away, taking care to watch my footing. I go at least 10 yards away from the spot, stop for a moment, and determine if I have been followed. If so, I keep moving away quickly. I've learned the hard way that if I don't act this way, I can get stung repeatedly by yellow jackets that keep pursuing far from the nest. I don't go back to an area near a nest until winter.

The other types of wasps don't seem to be as aggressive as Yellow Jackets, but I stay away from them as well. Most bees are friendly, except for the little fuzzy ground nesting bees. They can be almost as bad as Yellow Jackets and should be treated the same.

Weather

One of the reasons I like the Puget Lowlands is that I can be outside in the forest on almost any day, year-round. The cool temperatures of the wet season are ideal for outdoor manual labor. I can work under the canopy of the forest in light rain or drizzle and not even realize it's precipitating. After a day or two with significant rainfall, the understory remains wet even when the rain has stopped, but if I choose to work despite the wet, I know that I have a warm house and dry clothes at home.

Nevertheless, there are some weather conditions that keep me inside:

- High Winds -- A falling tree or even a large limb coming down can kill.
- Heavy Rain – I don't like getting altogether soaking wet.
- Snow and Freezing Temperatures – Weeds can't be removed from frozen ground anyway, so stay inside and keep warm.

3 -- Categories of Native and Non-Native Plants

In practicing forest restoration, we work to encourage or discourage various species of plants in various situations. It's worth spending a moment to define the various terms used to characterize these different categories of species. In this e-book I try to adhere to the definitions below.

Native and Non-Native Plants

Native plants are those that were already growing in a particular area prior to the arrival of Europeans in the 1600s or the arrival of Americans from other regions through westward expansion. Non-native plants are those that were introduced by explorers, colonists, travelers, merchants, etc., purposely, or accidentally.

Invasive Plants

Some non-native plants, after being introduced into a new ecosystem, grow rampantly in their new environments, partly because they lack the natural enemies that controlled their populations in the ecosystems in which they evolved[9]. In short, they become invaders that can rapidly take over their new habitats to the detriment of the existing native plants.

[9] See "The Ecology of Ivy" in the appendices.

Weeds

Merriam-Webster defines it well -- "a weed is a plant that is not valued where it is growing and is usually of vigorous growth, especially one that tends to overgrow or choke out more desirable plants." **In this e-book, if I use the word "weed" by itself, it means any non-native plant, be it noxious, invasive, or non-invasive.**

Noxious Weeds

"Noxious Weed" is essentially a legal term for certain non-native, invasive plants that landowners are required to control on their property. Washington's noxious weed law sets out statutory and administrative regulations whereby a nine-member appointed weed control board adopts and maintains a list of plants that they have determined to be highly destructive or difficult to control. The list of weeds is separated into three categories (A, B, and C) based on distribution, abundance, and how dangerous the plants are to humans, animals, private and public lands, and native habitats. The state weed law further provides the legal basis for imposing civil penalties on landowners who fail to control noxious weeds on their properties.

4 -- The Bradley Method

The forest restoration strategy I propose in this e-book is based on the principles and methods advocated by two sisters in Australia. Eileen Bradley (died 1976) and Joan Bradley (died 1982) developed their ideas based on years of work restoring portions of Ashton Park in Sydney. The best resource on their approach is the book *Bringing Back the Bush – The Bradley Method of Bush Regeneration*, published in Australia in 2002.

The essence of the Bradley Method is the need to increase the efficiency of our efforts. Changing areas full of weeds, "bad areas," into areas with good native groundcover, "good areas," is done gradually as natural regeneration fills in

narrow strips separating good areas from bad areas. Though the method was developed for the Australian Bush, the basic principles work anywhere. Their principles include:

Make minimal disturbance to the environment.

The Bradley sisters worked on perfecting “the gentle art of weeding” with the least possible disturbance to the soil and existing native plants. They hand-weeded slowly but efficiently using minimal tools, always trying to improve their methods for each size and type of weed. They wore soft soled shoes, tread carefully, replaced duff, and avoided stepping on native plants.

Weed Breaks

“Weed breaks” are narrow, cleared strips, separating “good areas” from ”bad areas.” If properly maintained, they deter the spread of invasive plants and other weeds into the good areas. Good areas expand gradually as native plants fill in the cleared strips and the weed breaks gradually advance into the bad areas.

5 -- The Vicious Circle of Weeding

Weeding encourages more weeds. Every time we remove a weed, the soil is disturbed, and in many instances that triggers the germination of more weeds. This vicious circle can repeat itself several times each year for many years and does not substantially end until groundcovers of perennial, native plants are sufficiently dense to deter weeds. Because the perennial groundcover plants in the Puget Lowlands are very slow growing, that process can take years.

Do not overclear.

They found that any cleared ground not adjacent to established native plants quickly filled up with weeds. In fact, they found that overclearing was almost always worse than doing nothing, taking longer for native plants to

become established and requiring more work overall. In other words, overclearing triggered a vicious circle of weeding which I describe in the next section.

Why Does the Removal of Weeds Result in the Emergence of New Plants?

In a pristine forest, the thick understory of native plants, stable soil, and intact layer of duff make it difficult for seeds to get into the soil and find suitable conditions to germinate. Seeds can lie dormant in the duff for years waiting for a disturbance of the ground that mixes the seeds into the soil triggering them to germinate. Removal of weeds is exactly the kind of disturbance of the duff and top layer of soil that causes new plants to sprout. Some of these new plants are desirable natives adapted to colonize disturbed ground, but the majority will usually be weeds.

Below the ground a similar process occurs. The root systems of a thick understory of native plants are at least as thick as the vegetation above the ground. Plants that spread by rhizomes can find it difficult to spread into ground full of roots. Removal of weeds creates openings in the soil for nearby plants that spread by rhizomes. Some of these, like Oregon Grape and Salal are desirable native plants, but others, like Hedge Bindweed, are invasive.

The Failure in Forest Park

Between 2007 and 2023, 21 acres of the City of Everett's Forest Park were cleared of weeds as the result of 3,000+ hours of volunteer labor in 60 city-sponsored work parties plus an additional 3,000+ hours of my own solo work. In 19 of these acres the invasives were scattered amidst pretty good native groundcover which, for the most part, deterred the return of weeds. However, this was not the case for about 2 acres in which the ground was basically devoid of any plants after being cleared of Himalayan Blackberry, thickets of ivy or laurel, or dense blankets of ivy. In about half of that area, one acre, the conditions were just right to set off an unsustainable vicious circle of weeding. I estimate that it

would have taken 35 hours per week, 50 weeks per year, to keep up with the weeds in that one acre, as shown in the calculations below.

Hours Per Week of Required Weeding		
Cleared Area	1	Acre
	43,560	square feet
Assumed Rate of Weeding	100	square feet per hour
Time Requred for One Weeding	436	hours (43,560 / 100)
	4	weedings per year
	1740	hours per year (4 x 436)
	35	hours per week (1740 / 50)

For unknown reasons, the City-sponsored work parties had failed to generate a community of committed, trained volunteers to keep cleared areas free of weeds so that by the end I was the only one working on the weeds. I enjoy weeding, but not 35 hours per week! I ended up stopping my work in Forest Park because I simply could not keep up with the vicious circle of weeding.

Avoiding an Unsustainable Vicious Circle of Weeding

The failure in Forest Park was mainly the result of overclearing to begin with. If I were starting over with my own backyard forest, I would limit the amount of ground I would clear in the first place based on how much time I wanted to spend weeding. Furthermore, as I discuss later, the weeding would be mostly limited to:

- scattered weeds growing amidst established native groundcover, and
- weed breaks separating good areas from bad areas.

Limited Time

Each of us has a limited amount of time that we can spend to achieve our goals. If one of our goals is the restoration of a backyard forest, then to be successful, we need a strategy that addresses the vicious circle of weeding. This means that once we clear an area of weeds, we have to be able to weed that

same area again and again, until the native groundcover plants gradually reduce the return of weeds.

To avoid an unsustainable vicious circle of weeding, we begin with a realistic appraisal of how much time we can commit to the task of removing weeds and limit the initial amount of area we should clear based on that figure.

Sustainable Cleared Area

How much time do you want to spend weeding? For the average homeowner, I think a realistic commitment would be one hour per month for ten months of the year – 10 hours per year[10]. It's necessary to spread the work out over the year because each time we clear an area of weeds, a new wave is triggered, and we end up having to go over the same area about 4 times per year. I estimate that based on a commitment of one hour per month for 10 months, the sustainable amount of area that could be initially cleared of weeds is about 250 square feet.

Sustainable Cleared Area		
Time Commitment	1	hour per month for 10 months
	10	hours per year
Assumed Rate of Weeding	100	square feet per hour
	4	weedings per year
Cleared Area	**250**	square feet (10 x 100 / 4)

Feel free to question my assumed weeding rate of 100 square feet per hour. That is about my pace for selective hand weeding[11], but yours may be different. As you get started, keep track of how much area you clear per hour and use that figure to calculate your own sustainable cleared area. You may think you want to spend more than ten hours per year weeding but bear in mind that forest restoration is a slow process that takes many years of sustained effort. Thus, you

[10] Early in the book I said that the average backyard forest could be restored in 20 hours per year. That's because in addition to 10 hours per year weeding, you would probably want to spend at least 10 hours per year on planting, watering, trail work, and other miscellaneous tasks.

[11] See "Selective Hand Weeding" under "Weeding Methods."

may think you want to clear more than 250 square feet to begin with but it's better to under-clear than overclear, especially when starting out.

The Strategy Proposed in This E-book

Given our limited time, and given the vicious circle of weeding, the strategy proposed in this e-book becomes obvious. First of all, we have to be committed to working in the forest on a regular, ongoing basis. Then, we make a sober assessment of how much time we want to spend weeding and limit the amount of area we initially clear of weeds accordingly.

- For some folks, the amount of time may be zero, and I would recommend the essential minimum as described in Chapter 6.
- For those who choose to commit time to restoring their backyard forest, then I would recommend using the Bradley Method as described in chapter seven.

6 -- The Essential Minimum

After you have completed the preliminary steps discussed in Chapter 1 you may realize that you don't really want to commit **any** time restoring your backyard forest. In terms of the Bradley Method, I don't think you should clear **any** ground at all if you can't realistically commit to a certain number of hours per month to working in your forest. If that is the case, then I would recommend only two essential tasks:

- Control any noxious weeds that happen to be growing on your property,
- and make ring cuts on ivy growing up any of your trees.

Accomplishing these two tasks will help preserve your existing trees while avoiding the vicious circle of weeding. The only ongoing work will be continued control of noxious weeds and the maintenance of the ring cuts.

Remove Noxious Weeds

In the unlikely event that your yard has any noxious weeds, you should deal with them as required by your county Noxious Weed Control Board. In most backyard forests this will not be necessary because by definition most of the weeds for which control is required by law are not widespread. Once they become widespread, they are usually consigned to the list of weeds for which control is recommended but not required.

Get Ivy Off the Trees

Ivy is considered invasive in the Puget Lowlands, but is it a "noxious weed?" It is on the state list as a "Class C" invasive plant in which control is not mandated by the state but may be mandated by individual counties. However, in the Puget Lowlands ivy is already so widespread (and still sold in nurseries) that requiring control would be impractical, and in the Puget Lowlands control of ivy is encouraged, planting it is discouraged, but removing it is not mandated.

Is Ivy Detrimental to Trees?

Heeding the words of Arthur Lee Jacobson from his book *Wild Plants of Greater Seattle*, we should treat ivy "like an outlaw" and allow it to grow "only under strict supervision." At minimum, when it grows up trees two bad things can happen.

- Ivy can create "wind sails" that make trees more susceptible to being toppled in high winds ("windthrow").
- Once the ivy reaches the top of the canopy and has access to direct sunlight, it can produce fruits that are consumed by birds that spread the seeds throughout the forest.

How to Easily Keep Ivy from Growing Up Trees

Ring Cuts

I believe that Ring cuts to control ivy are probably the most important task in backyard forest restoration. I use my hand saw, loppers, or clippers to sever all the stems growing up the tree at a height that is comfortable for me to work at. The height is usually about 4' above the ground but can vary depending on where the vine stems are easiest to access. The Ivy above the ring cut will die within a year or so. Don't try to pull the Ivy out of the tree above the ring cut, because doing so may harm the tree's bark and may disturb wasp nests.

Ring cuts don't kill ivy plants and will have to be maintained annually to cut the new growth emerging from the tops of the cut stems and continuing their climb up the trees. Personally, I am not opposed to the application of an herbicide to the ends of the cut stems. This method of invasive plant control is known as "cut stump" treatment and is mainly used on the freshly-cut stumps of invasive trees and shrubs. It works on ivy as well, though it may have to be repeated for several years to completely kill the plant.

Why Preserving Existing Trees is Important

Preserving existing large trees is the single most important priority for backyard forests, especially in light of climate change. These trees provide the foundation of the natural ecosystem of the Puget Lowlands. They are also fundamentally important in sequestering carbon to help mitigate climate change[12].

Over the past century the Pacific Northwest has gotten hotter, and summers have gotten longer and drier. I believe that we must expect that this general trend will continue into the foreseeable future. Even though winters may be wetter and milder, year to year variations are expected to become more

[12] See chapter, "Big Trees Grow Faster than Small Trees

extreme. In its predictions for the Northwest, the most recent National Climate Assessment states: “Average winter precipitation is expected to increase over the long term, but year-to-year variability in precipitation is also projected to increase. Years of abnormally low precipitation and extended drought conditions are expected to occur throughout the century, and extreme events, like heavy rainfall associated with atmospheric rivers, are also anticipated to occur more often.”

Many of the second or third growth forests in the region have good stands of mature native trees that are already more than fifty years old. Many of these trees will likely die in the upcoming decades, casualties of climate change, root rot, velvet fungus, and many other natural causes. The native deciduous trees rarely live beyond 100 years of age.

For the native conifers, however, those growing in the best spots for their respective species have the potential to live another 100 years or even longer. Whatever forest restoration work continues in our backyard forests, achieving the preservation of existing trees, especially the conifers, should be the highest priority in the Puget Lowlands. To this end, I believe that all property owners in the Puget Lowlands should at least undertake the minimal effort required to keep ivy from growing up their trees.

7 -- Working Towards Complete Restoration

If you decide we want to work towards a complete restoration, then after doing the essential minimum described in Chapter 6, I encourage you to use the principles of the Bradley Method.

- Establish the good areas,
- accept weeds in the bad areas,
- create weed breaks to deter weeds from spreading from bad areas to good areas,

- facilitate the establishment of native plants in gaps in the good areas and in weed breaks, and
- expand the good area after the native groundcover in a particular weed break is sufficiently dense to deter weeds, by clearing the next swath of weed break out of the adjacent bad area.

How long will it take using this approach? There are so many variables that it's barely worth speculating. Nevertheless, if I were to risk making a very wild guess, I would estimate that for ½ acre of forest, with moderate infestations of invasive plants, for a person working in their forest 20 hours per year, 20 years would not be an unreasonable expectation. In short, it's a long, slow process – the strategy of the turtle, not the hare. Restoring your backyard forest will be a work in progress for as long as you own the property and as long as you are capable of doing the work.

Start by Establishing the Good Areas

The process begins by removing scattered weeds from those patches of ground that have the highest concentration of native plants and limited numbers of scattered weeds. The best of these become the "good areas." All work thereafter proceeds outward from the good areas towards the "bad areas" dominated by weeds.

I believe that in the Puget Lowlands, to qualify as a good areas, the groundcover should be dominated by native perennials with very few areas of disturbed ground from the initial weeding greater than about 12" in diameter. Cleared ground of this size is less likely to trigger a vicious circle of weeding and fills more quickly with native plants.

It's best to begin this process during the wet season when the leaves are off the deciduous trees and the annual/biennial plants have died back. During this part of the year, it's easier to identify the extent of the evergreen native and non-native plants in the understory. In the Puget Lowlands, the main native

groundcover will consist of Sword Fern, Salal, and Oregon Grape. The main non-native plants to be removed will be holly, laurel, ivy, and Himalayan Blackberry.

Holly and Laurel

Holly and laurel are nearly as invasive as ivy in the moist, temperate forests of the Puget Lowland. Being shade tolerant and evergreen, they grow slowly but steadily under the canopy. They produce small fruits that the Robins, Varied Thrushes, and other birds eat, eliminating the seeds throughout the forest. Holly and laurel also spread by layering in which low-growing branches touch the ground and sprout roots. Through layering, a single holly or laurel that sprouts from seed can grow into a dense thicket that expands outward and deters the growth of all other plants.

Holly and laurel of all sizes can be cut down but will continue to resprout unless the stumps are painted with herbicide. In my opinion, the cut stump treatment is preferred for scattered holly and laurel because it causes minimal disruption of the soil.

When holly and laurel are relatively small and scattered their removal can be accomplished without creating large areas of disturbed ground. Individual shrubs/trees in which the diameters of the trunks are less than 2" can be removed with a shovel[13] or weed wrench.

Holly and Oregon Grape can look similar, so make sure you can tell the difference. Use your plant ID app for help. The key difference is in the configuration of the leaves on the stems. With Oregon Grape the leaves come out opposite each other on the stems, with holly they alternate. I tell untrained volunteers to think "NOGO," which translates as "**N**o, don't pull **O**regon **G**rape, with leaves that are **O**pposite."

[13] See "Pry and Pop" under "Weeding Methods."

Scattered Ivy

Scattered ivy plants growing amidst native groundcover can also usually be removed without triggering the vicious circle of weeding. Ivy is one of the easier plants to identify. It's the only *evergreen* vine growing in the Puget Lowlands, another reason for removing it during the winter wet season. It can sometimes be hard to spot if it's growing amidst Salal since they both have relatively roundish, leaves with a similar shade of green.

Himalayan Blackberry

Himalayan Blackberry thrives in the Puget Lowlands, especially in open areas or forest edges where it gets at least a few hours of direct sunlight each day in the summer. Under the canopy it persists but is usually not as dominant. It is fairly easy to remove individual blackberry plants, and if they are growing scattered amidst native plants, then their removal may be accomplished without disturbing enough ground to trigger a vicious circle of weeding. I also recommend the cut stump treatment for scattered non-native blackberry.

One caution on the removal of blackberry plants is the fact that both native and non-native species grow in the same habitats. Telling them apart is not easy, so take the time to research the differences. In the context of establishing your good area(s) under the canopy, removal of scattered Himalayan Blackberry is much less a priority than the removal of ivy, holly, and laurel.

Accepting Weedy Bad Areas

The rest of the backyard forest, outside the good areas, will be the "bad areas." Much of the bad areas will likely be covered with weeds of all kinds. The only work that should definitely be done in the bad areas is the essential minimum, controlling noxious weeds, and making ring cuts on ivy growing up trees.

With the Bradley Method, the most important thing is to preserve the good areas and accept, for the time being, the weeds in bad areas. You preserve the

good areas with weed breaks and limited repeat weeding. Over time, as native groundcover becomes densely established in the weed breaks, we expand the good areas and nibble away at the bad areas. However, trying to keep the bad areas free of weeds is likely to be unsustainable.

Weeds in Bad Areas

If the forest steward has ample time a case can be made for removing some scattered ivy, holly, laurel, and Himalayan Blackberry in bad areas that have moderate densities of native plants, since the annual/biennial weeds that replace them will likely not be quite as damaging to the ecosystem. However, if their removal leaves large areas (more than about 100 square feet) of completely bare, disturbed ground, then it is probably best to leave them be, and get to them eventually as the good areas expand.

Letting weeds grow in bad areas, especially the annuals and biennials, actually provides some benefits to the forest restoration effort.

- Weeds, like any groundcovers, help protect and enrich the soil.
- The bad areas usually have at least some native plants growing in them, some pre-existing, and others emerging later. In this way, they can serve as native plant nurseries that function as good sources for transplants into good areas and weed breaks.

Native/Non-Native, Invasive/Not Invasive

Some non-native plants are not invasive, and the forest steward can spend a lot of mental energy trying to decide whether or not to remove certain weeds in certain situations. With the Bradley Method, however, because the weeding is limited to gaps in good areas and weed breaks, I simply remove any non-native plant. The decision on whether or not to remove a plant then, is not whether the plant is invasive or not, but whether or not it is native.

The one complication is that with a few plants the exact species is difficult to determine. After reading about plants like this in different books and different

on-line sources, I think forest stewards have to make their own decisions on which to treat as weeds and remove. There are hybrids, and subspecies to contend with. With several plants like stinging nettle, self-heal, and cleavers, it's fairly easy to identify the genus, but hard to separate the species and subspecies. Sometimes one needs to be a trained botanist to determine the exact species of a given plant. Furthermore, with some plants not all botanists agree, and the science changes over time, especially with the advent of affordable DNA testing.

Preserve Good Areas with Weed Breaks

"Weed breaks" are narrow, cleared strips, separating "good areas" from "bad areas." If properly maintained, they deter the spread of invasive plants and other weeds into the good areas.

- In the classic Bradley Method, strips of cleared ground are used to surround good areas after which further weeding proceeds outward.
- I also use them sometimes to surround bad areas after which I proceed inward.
- In some cases, in which the separation between good areas and bad areas is more gradual, the lines are not even visible as cleared strips, but are broad, gradual separations.
- I also use narrow weed breaks between the canopied forest and edges which receive more sunlight and are often full of weeds. These open edges include areas of meadow, mowed turf, or garden beds[14]. Keeping grass out of weed breaks can be especially challenging since it can spread both from seed and from rhizomes.
- Weed breaks can also be used on property boundaries unless the neighbors are actively controlling their weeds.

The actual creation and maintenance of weed breaks consists of clearing strips (or swaths or bands) of ground by removing weeds. The Bradley sisters' lines were often ten feet wide, but I think this is far too wide for the Puget Lowlands because of the intensive effort required to establish a good native

[14] see "The Challenges and Opportunities of Edges

groundcover in bare ground. Depending on the situation, mine are typically about 18” wide. Wider is better to keep weeds from spreading into the good areas but wider results in more bare ground, requires more time spent reweeding, and takes longer and/or costs more to fill with groundcover plants.

Ideally, the strips are cleared using selective hand weeding[15], removing weeds one at a time, and if necessary, using some kind of hand tool to loosen the ground around roots. The term “selective” is used to emphasize the importance of not removing the existing native plants. Hand tools are best to minimize soil disturbance. In some cases, larger tools may be appropriate, but keep in mind that the more the soil is disturbed, the more weeds are likely to erupt in the bare ground. Also, using a hoe or tiller is more likely to harm existing native plants.

Maintaining the Weed Breaks

Maintaining the weed breaks requires repeat weeding several times each year to prevent any weeds from going to seed, and to keep perennial weeds from spreading via stolons or rhizomes.

Trails as Weed Breaks

Trails are natural weed breaks in which the growth of weeds is deterred by foot traffic. If some of your trails double as weed breaks, it will reduce the time spent repeat weeding.

Selective Hand Weeding Along Trails

In addition to preserving good areas with occasional reweeding, ongoing selective hand weeding is required along the edges of any trails going through or abutting the good areas. Some of weed species produce seeds that stick to shoes, clothing, paws, and fur and then spread into the forest along trails. Some forest

[15] See “Selective Hand Weeding” under “Weeding Methods.”

stewards go so far as to brush their shoes off before entering the forest, but coyotes, raccoons, squirrels, and other animals spread seeds as well.

Limited Sustainable Length of Weed Breaks

Using the Bradley Method, the cleared areas take the form of weed breaks. The length of these weed breaks is limited by how much time you want to spend weeding. If you want to commit to 10 hours per year of weeding, then the cumulative length of your weed breaks would be about 170 feet.

Sustainable Length of Weed Breaks		
Time Available	1	hours / month for ten months
	10	hours / year
Rate of Weeding	100	square feet / hour
	4	weedings / year
Cleared Area	250	square feet
Width of Weed Breaks	1.5	feet
Length of Weed Breaks	167	linear feet

This in turn puts a further limitation on the sustainable size of the good area. Using the same limits as in the previous example suggests the diameter of a sustainable good area might only be 25 feet square (625 square feet). This scenario assumes that one weed break about 67 feet long would run along the edge of the forest separating the landscaped portion of the backyard from the canopied forest. Then, a square-shaped good area of 625 square feet would be established back in the forest.

Sustainable Size of Good Area		
Length of Weed Breaks	167	linear feet
Length of Weed Break at Forest Edge	67	linear feet
Length Around Good Areas	100	linear feet
Length of Edge Assuming Square Good Area	25	linear feet
Size of Good Area	625	square feet

This is yet again a reason, at least at the beginning, to start small in establishing your good area. If you have a backyard forest of 1/3 acre surrounded entirely by a weed break, it might take nearly 30 hours per year to maintain, or 3 hours per month for 10 months of the year just to weed the weed break.

Length of Weed Break Around Entire Backyard Forest		
Size of Backyard Forest	0.33	acre
	14,375	square feet
Length of Edge (assume square shape)	120	linear feet
Length of Perimeter	480	
Width of Weed Breaks	1.5	feet
Cleared Area	720	square feet
Rate of Weeding	100	square feet / hour
Time Requred for Weeding	7.2	hours
	4	weedings / year
	29	hours / year

Repeat Weeding in Good Areas

Even the most careful hand weeding fails to get all of the roots out. Furthermore, the soil everywhere in the forest contains the seeds of plants, many of which are weeds, that lie dormant until a disturbance triggers their germination. Thus, even the good areas will require some repeat weeding, and each weeding causes further disturbance to the soil and potentially more growth of weeds. Typically, a second weeding of good areas will be needed a year after the initial weeding, and every 2-3 years thereafter until the cleared gaps are covered with dense, perennial groundcover. This ongoing need for repeat weeding is one of the reasons to keep the good areas small to begin with.

Establishing a Dense Groundcover

In the long run, the goals is to transform the entire understory of your backyard forest into a good area through natural regeneration supplemented by installations of native plants. This process begins by filling any gaps within your initial good areas that were created by the removal of weeds.

Next the focus is on filling in the bare ground in the weed breaks. The weed breaks move once the groundcover in the cleared strips becomes sufficiently dense to deter weeds. In the Puget Lowlands it will likely take at least three years

and often longer to reach this point. Thus, in many cases, complete restoration of a backyard forest can be a very slow process.

Note that there may be places in your good areas that are devoid of any plants at all, native or non-native. Perhaps the most common of these are areas of dense shade under Western Redcedar that have a thick duff of cones, needles, and small branches. If the ground is not disturbed in these spots, then the duff alone may sufficiently deter most weeds.

Filling Gaps in the Good Areas

As mentioned above, some repeat weeding will likely be needed in your good areas, but filling gaps will reduce this need. Ideally, your good areas don't have many gaps larger than about 12" across to begin with. I use this "rule-of-thumb" because gaps of this size, surrounded by established native perennials, especially Salal and Oregon Grape, will likely be filled by natural regeneration within a reasonable time.

A cleared area amidst native groundcover more than 12" across may take a long time to fill naturally, hence the benefit of installing native groundcover plants and/or shrubs[16]. Filling these gaps will reduce the need for repeat weeding. In the Puget Lowlands, the strongest groundcovers consist primarily of Sword Fern, Oregon Grape, and Salal. Likewise, most of the plants to install will consist of the same three slow-growing perennials. Neither Oregon Grape nor Salal can be transplanted easily, and only Sword Fern can be successfully divided. Thus, most of the effective groundcover plants have to be purchased from native plant retailers, and the costs add up quickly as shown in the table below. On average, one of the three main groundcover plants currently costs about $10 when purchased from a reputable nursery in a one gallon pot. Installing plants less densely than 16" spacings saves money but takes much longer to fill the gaps.

[16] Note that planting trees is basically limited to areas in which the forest canopy is deciduous. See "Plant Shade-Tolerant Conifers in Aging Deciduous Forests."

Escalating Costs of Filling Gaps					
Diameter of Gap in Inches	12	16	32	48	60
Area of Gap in Square Feet	1	1.4	5.6	12.7	19.8
Number of Plants Needed on 16" Centers	0	1	4	9	14
Estimated Cost	**$0**	**$10**	**$40**	**$90**	**$140**

Establishing the Groundcover Within the Weed Breaks

Good areas can be expanded once a dense groundcover is established in the adjacent weed breaks. There are several ways in which dense groundcover can be established within weed breaks including,

- the growth of native plants already growing in weed breaks,
- the spread of native plants from the adjacent good areas,
- the installation of transplanted plants, and
- the installation of purchased plants.

The installation of plants significantly speeds up the process, especially if they are closely spaced. Relying totally on the installation of purchased plants is expensive as shown in the following table.

Escalating Costs of Filling Bradley Lines					
Length of Weed Break in Feet	10	20	40	80	100
Number of Plants Needed (One Plant every 16")	8	15	30	60	75
Estimated Cost	**$80**	**$150**	**$300**	**$600**	**$750**

Even with installations it can take up to a decade after planting for Sword Fern, Salal, and Oregon Grape to become fully established. The gardener's rule of thumb for perennials is "first year they sleep, second year they creep, and third year they leap." My experience in the backyard forest is "first two years they sleep, then they begin to creep."

Irrigating Newly Installed Plants

Without irrigation, especially for the first 2-3 years, many newly-installed plants ("newbies") are likely to perish. However, there is some evidence that plants kept watered may fail to develop the deep roots needed to survive long dry seasons once the irrigations stops. After watching quite a few newbies die after I

quit watering them, I've gradually begun to think that "tough love" may be the best approach – limit the irrigation, force them to find water on their own if they can, and simply accept that many of them are going to die. Take consolation in the idea that our tough love has given the survivors the tools to survive our changing climate's longer, hotter, drier summers.

Summary Conclusion

The strategy for backyard forest restoration proposed in this e-book is based on the principles of the Bradley Method. After certain preliminary steps the work begins with the control of noxious weeds and ring cuts on ivy growing up trees. Then, for persons who want to achieve a more complete restoration, good areas are cleared of scattered weeds. Weed breaks are created to deter weeds from spreading into the good areas from the adjacent bad areas. The establishment of dense native groundcovers in the weed breaks enables the good areas to expand.

8 -- The Skills of the Forest Steward

Backyard forest restoration is similar to gardening with native plants. The skills of the forest steward include:

- removing weeds while minimizing disruption of the soil and harm to existing native plants,
- composting and disposing of weeds
- transplanting native plants from bad spots to good spots,
- installing new plants from nurseries,
- installing new native plants propagated on site,
- pruning, and
- managing paths and trails.

Weeding

Note: In an effort to keep things simple, I use the general term “weeding” instead of more-wordy phrases like “controlling non-native plants,” or “removing invasive plants.”

Weeding Methods

Selective Hand Weeding

I use the phrase “selective hand weeding” to mean the careful removal of weeds, one at a time, while protecting the existing native plants and minimizing disruption to the soil. It involves slowly and methodically moving over the ground, being careful not to trample native plants, identifying each plant, carefully removing the weeds, and trying to minimize disruption to the soil and top layer of duff. In short, it’s the Bradley sisters’ “gentle art of weeding.”

Getting the Root

With weeding, it’s essential to remove as much of the root as possible. With almost all of the weeds, in almost every situation, leaving the root or even part of the root in the ground does not kill the plant. Sooner or later, it will grow back. That is not to say that one can always succeed, because every time we weed an area, we inevitably leave roots behind. Hence, one of the reasons that repeat weeding is necessary. Nevertheless, we do our best, and techniques like “wiggle-and-pull” and “pry-and-pop” which I describe below help.

Wiggle and Pull

I have learned that in most situations the “quick grab and yank” is ineffectual. It’s more effective to “wiggle and pull” to successfully remove plants from the ground without breaking their stems and with their roots still attached. Wiggle-and-pull does not perfectly describe the method, but it’s the term I use. The key is the wiggle instead of the straight pull. For smaller weeds, this whole

process takes no more than a second. Here's a step-by-step breakdown of wiggle-and-pull.

- First, grip the stem of the weed down low where it is strongest.
- The side-to-side wiggle, or rocking motion comes next, combined with a gentle pull, to test how firmly the plant is anchored in the ground.
- Then, being careful not to break the stem, lean the plant to one side and gently wiggle and pull with enough force to loosen the lateral roots on the opposite side of the plant.
- Then bend the weed to the opposite side and gently wiggle-and-pull to loosen the lateral roots on the other side.
- Wiggle and pull, side to side, forward and backward if necessary, working the roots out of the ground until the whole plant comes free.

Why wiggle and pull? It has to do with the structure of the root system. A typical plant is anchored securely in the ground by either a taproot that goes straight down and/or lateral roots that branch off the base of the stem into the surrounding soil. All the roots combined hold the plant in the ground firmly enough, so that if you try to pull straight up and too quickly the stem will often break before the roots pull free.

Pry and Pop

For weeds with deep taproots, wiggle-and-pull without a digging tool may not be enough. Good examples include the perennial invasive shrubs like holly, laurel, and non-native blackberries. Even small forbs sometimes require a digging tool when the root attachment is stronger than the stem. Large weeds require a shovel or garden fork, small weeds a weeding dagger or narrow trowel.

Here's a step-by-step description of what I call "pry-and-pop" as used on a medium size holly or laurel.

- First, sink a shovel or garden fork into the ground as deeply as possible, 6-12 inches back from the base of the plant. A root-slayer or trenching shovel can help, because of their longer, straighter, narrower blades.

- Next, pry back on the shovel handle to loosen the ground and apply upward pressure on the taproot. Pry back until, ideally, you hear and/or feel a “pop” when the taproot pulls loose.
- Once the root has popped, return the shovel to its upright position, and pull it straight out of the ground minimizing disruption of the surface of the soil.
- Reach down, get a good grip on the plant at the base of the stem, and wiggle-and-pull it out of the ground.
- Then tamp the disturbed soil back down with your foot and restore the layer of duff.

Some Other Weeding Hints

Down on My Knees

Sometimes, getting down on one or both knees can be the best position for weeding. True, I get my pants dirty and mash down some vegetation, but it gets me close to the ground where I can better find the right stems to pull. It’s also easier on my back than stooping for long periods, and if I am pulling on a particularly stubborn, thick stem, I won’t fall over backwards if it suddenly breaks or pulls free.

Sorting Through Stems

Sometimes native plants and weeds are so intertwined, that it becomes very difficult to remove the correct plants. At times, I find myself down on my knees, sorting through the plant stems one by one and looking at the leaves to separate the native plants from the weeds.

Replanting Accidentally Pulled Native Plants

Sometimes I pull out a native plant accidentally. It happens. Then I simply replant it, right then, in the same spot. Nothing to lose, and it may live.

Keeping Track of Where I Am

As I weed, busily engaged pulling weeds, it’s easy to lose track of what spots I have covered and what I have not. It helps me to stop frequently, stand

up, look around, and mentally note where I have finished and plan where to go next. When I stop for the day, I make an extra effort to drill into my brain some distinctive placemark to ensure that when I come back the next time I can start working where I finished before. Sometimes I even take a distinctive-looking dead branch and stick it upright in the ground as a placemark.

Snipping the Stems in Some Situations

In some situations, it can make sense to snip the stem of a native (knowing that it will grow back from the roots) rather than pull the adjacent weed and risk uprooting the native. This is especially true of Trailing Blackberry which is often rooted at both ends of a runner. Snipping the stem in the middle won't hurt the plant very much, and it is then easier to get the adjacent weeds without uprooting the native blackberry.

Using the Garden Fork with Patches of Small Weeds

To remove a patch of smaller weeds mixed with native plants, like Creeping Buttercup growing with Large Leaved Avens, or Herb Robert growing with Siberian Miner's Lettuce, I sometimes use a garden fork to pry up a small section of ground, loosening the ground beneath the plants just enough to better pull the weeds without completely uprooting the native plants. This can be more efficient than using a hand-held digging tool to loosen the soil around each individual weed. After weeding a patch like this, I gently tamp the ground down so the native plants maintain good root contact with the soil.

Replacing Duff

Ideally, if I disturb an area of ground by removing a weed from a gap amidst native plants, I take a moment to cover the bare ground with some duff and secure it with dead twigs or branches. It's the reverse of making a compost heap since the dried leaves and small twigs go on the bottom where they are in contact with the soil, and the larger branches go on top and weigh them down. Covering disturbed soil in this way will reduce erosion, add nutrients to the soil, and help deter annual weeds.

Disposal of Weeds and Composting

As an experiment, sometime take a weed you have just pulled and lay it on the ground in a spot where it won't be disturbed and see what happens. Unless it's the middle of the dry season and the surface of the soil is bone dry, there's a good chance that any roots touching mineral soil will keep growing. The plant will continue to photosynthesize, the main stem will lift off the ground, bending up towards the light. The plant's reproductive cycle will continue, and the plant will flower and produce seeds. If the weed was already flowering when it was pulled, it may even produce seeds without sinking new roots into the ground.

After going to the trouble of removing a weed from the ground, it's worth taking the extra step of "disposing" of it intelligently rather than just tossing it aside. Here are some of the principles to consider when deciding:

- Composting is preferred. Adding weeds that have been pulled to a compost pile ensures that the plant's essential elements are recycled back into the earth. However, care must be taken to prevent the compost pile from spreading weeds.
- If the weeds have gone to seed, begun flowering, or even formed flower buds, they shouldn't be added to compost piles. Ideally, they can be added to a municipal yard waste bin where "industrial scale composting" produces temperatures hot enough to kill seeds. If you don't have a yard waste bin, you will probably have to bag the weeds and add them to your trash.
- Because of the risk of spreading weeds, don't put your compost piles in your good areas. It's best to put them in the bad areas.
- Because of the risk of spreading weeds, the rich humus soil produced by your compost piles shouldn't be added to your good areas. I've tended to use it only outside the canopied forest in small flower or garden beds for vegetables which have to be weeded anyway.
- Because of the limited use of compost derived from weeds, there is no hurry to convert the raw plant matter into compost. I don't try to speed the process by stirring the compost piles to keep them oxygenated.

- Compost piles have to be checked frequently during the growing season to keep weeds from becoming established on top of them. Usually this just means turning over the top layers of plant debris and smothering any growing weeds.

Gathering Weeds as You Go

Careful disposal of weeds begins with gathering them as you weed, rather than simply tossing them aside. My preference is to add them to a five gallon bucket as I go. I pack them in tight and when the bucket can't take any more, I carry it over to a compost pile and empty the bucket.

Making Compost Piles

I have ended up using one or two large compost piles located in bad areas and several smaller ones in weed breaks located next to mowed turf.

Large Compost Piles

My largest compost piles ever were about 10' in diameter, stacked up to 6' high. To build a compost heap I look for a spot with little or no vegetation, especially native plants. Sometimes I have to transplant a few native plants to a good location nearby. I remove any weeds and temporarily pile them nearby. They'll go on top of the compost heap when the base is finished. It doesn't work to build a compost heap on top of weeds -- some will grow up through it. I avoid getting too much dirt in the heap that weeds can grow in, but a little bit of dirt mixed in with the plant debris will speed up the decomposition.

I build a base consisting of dead branches, with the largest on the bottom. I gather branches from the nearby forest and use my hand saw to cut them if they are longer than the diameter of the heap. I like to be able to walk entirely around the base without having to step over branches. I'll want to keep my heap contained within its area and not spilling over the sides. The crisscrossing branches should form a meshwork deep enough and dense enough so that weeds won't fall through the cracks and touch the ground. Also, the meshwork of the base allows some air to circulate under and through the heap.

In weed breaks next to mowed turf I've ended up making tiny compost piles with a base only slightly wider than the mouth of a five gallon bucket. These are designed to hold one bucketful of weeds that have not begun to flower. If the gathered weeds are packed tightly enough in the bucket, then when emptied onto the base they stay together as a clump where they rapidly decompose.

Planting

Note on Terminology

A gardener "plants plants." The verb and the noun are the same. How annoying that the English language does not have a better verb for the act of planting. Because of this, I often use the verb "install" as in "the gardener *installs* plants."

For simplification, instead of writing "newly-installed plant" or "recently-installed plant" I use the general term "newbie" for any plant that has been installed in the past several years.

Installing Plants Grown in Pots

I find that installing plants grown in pots is almost always challenging. Each situation and each plant, varies, and I think that a lot of experience is needed to consistently do a good job. Since there are plenty of good resources on this topic elsewhere, I won't go into a lot of detail, except to offer a few principles and hints from my experiences.

Choosing the Planting Spot

The first step is to choose the exact spot where the plant will be installed. To site the exact planting spots for each new plant, look for spots large enough to accommodate the plant at maturity. Each planting spot can be checked for soil depth with a garden fork or other tool to locate any major obstacles like large

roots that required finding a different spot. Basic information about the soil also helps to inform the choice of plant for each spot.

Clearing the Duff in the Planting Spot

When the plant is installed, the soil that is backfilled around its roots should be free of organic debris like needles, cones, leaves, and twigs. Thus, before starting to dig a hole, the existing duff should be raked back from the center to the edges or even better, temporarily placed in a five-gallon bucket.

Depth of Planting

As all of the resources on planting make clear, it's important to install most plants at the proper depth. This is especially important for trees, shrubs, and ferns. In general, I believe it's less critical with forbs and grasses. Usually, the plants in pots from nurseries are filled with soil to the correct depth for the plant within, so that simply matching that level with the surrounding ground will usually suffice.

I think of it this way – roots can turn into stems, but stems cannot turn into roots. Picture a tree growing in a spot where erosion has stripped soil away from some of its roots and the roots are now covered with the same kind of bark as on the trunk. But if the lower part of the trunk is buried, it does not usually sprout new roots. Instead, the outer bark is likely to rot, leaving the inner, living bark vulnerable to infection.

Preparing the Hole

Keeping in mind the proper depth of planting as described above, then a hole is dug.

- As I dig, I recommend temporarily placing the soil into one or more five-gallon buckets to keep it clean of organic debris. Sometimes I use two buckets, one for the upper layer of topsoil and one for the lower layer of pure mineral soil. Then, when I backfill, I retain some of the original soil profile.

- The hole dug for the plant should be wider than the width of the pot. To disturb less ground, I tend to favor planting holes that are less wide than those recommended by many sources.
- I think that if it's a small plant, then as little as 6" greater than the diameter of the pot (3" on each side) suffices. For a large plant, the distance can be as little as 12" greater than the diameter of the pot (6" on each side).
- I believe the depth of the planting hole depends on several factors. Especially with shrubs and trees the hole needs to be as deep as the longest taproots to avoid "J-rooting" the plants (see "placing the roots" below). If there are no taproots, as with many forbs, the hole does not need to be deeper than the depth of the pot, unless that is not deep enough to keep the plant securely embedded in the soil.

Preparing the Root Ball

- You need to spend some time preparing the root ball rather than just plopping it into the hole straight out of the pot and pushing dirt around it.
- When the plant is root-bound in the pot, I use a small folding saw or sharp knife to cut some of the outside roots, especially any that were growing round-and-round inside the pot.
- You want the plant to get used to its new soil. Potting soil is like candy to the plants, so massage the root ball and get a lot of the potting soil off the roots. Capture the soil in a five-gallon bucket to be sprinkled on top of the soil or saved for starting plants from seed. If the roots don't make good contact with the mineral soil, they may never venture outside the original root ball. I've come across quite a few plants from volunteer planting parties that lived for a few years after installation and then died. When I pulled them out of the ground the original root ball was still intact, and the roots had not penetrated the adjacent soil.

Backfilling and Mudding In

Backfill little by little, all around the plant, using one hand to hold the plant in place and the other to put the soil in one handful or trowel full at a time. Use your fingers or trowel to push the soil down around the roots. It should be packed in enough to eliminate any large pockets of air and tightly enough to hold the plant upright. Test it by tugging gently up. If the plant comes easily out of the ground start over and pack the soil tighter.

Roots don't like dry soil. For installations in late winter and early spring, if the soil is already saturated to planting depth, then you may be able to get by without adding water during planting. Otherwise, you'll want to add water even if it has to be carried to the spot in jugs or buckets.

- First, fill the planting hole with water and let it sink in once or twice before planting.
- Next, I sometimes physically mix soil and water in the hole with a shovel or trowel creating a viscous mud before adding the plant, and "mudding it in."
- Alternatively, as I gradually backfill soil around the plant, I add a layer of water on top of each layer of soil and mix it into the soil with the shovel or trowel, working the mud into the roots.

Placing the Roots

Especially with trees and shrubs, some of the major roots will continue to grow in the direction in which they were planted. If a taproot is bent like the letter "J" in the planting hole, it will grow up instead of down, and the tree can die from being "J rooted." A major root that encircles the root ball, can continue to grow in that circle and as it gets thicker gradually strangle the tree. As much as possible, try to align the roots in the hole as you backfill so that they will spread evenly in all directions from the base and grow out and down.

Dressing the Surface of the Soil

After the plant has been placed to the proper depth, and the soil has been backfilled to match the surrounding surface of the ground, the plant can benefit from some finishing touches.

Ring Mulching

Mulching with raw plant material, like wood chips, reduces evaporation of moisture from the soil and smothers some small weeds by reducing their air supply and blocking sunlight. My mentors from planting parties have often practiced “ring mulching,” spreading a collar of wood chips around newbies after installation. With any mulching, however, it is widely believed that mulch piled against the stems can induce rot, hence the doughnut-like shape of ring mulching that leaves a couple of inches of bare ground around the stem.

Sheet Mulching

One of the standard practices of our restoration work in Forest Park was sheet mulching with wood chips after clearing large patches of ground. What I observed, however, was that the practice also deterred the natural regeneration of native groundcovers and helped the spread of some unwanted weeds.

- Several unwanted species, including Herb Robert and non-native grasses, are able to establish themselves on top of mulch, and in this way actually increase the spread of weeds.
- The saprophytic fungi that decompose cellulose in mulch use up most of the nitrogen in the top layer of soil making life difficult for new seedlings, both native and non-native.
- The saprophytic fungi can also deter the beneficial mycorrhizal fungi that help plants access soil nutrients and water.

- Though mulching increases soil fertility in the long run, many native plants are adapted to growing in the rather infertile soil typical of the Puget Lowlands[17].

Marking the Newbies

My experiences with marking newbies have primarily consisted of regrets for not having done more of it. I frequently forget what I've planted where, so when a suddenly robust native plant appears it's a wonderment. I don't like marking plants with plastic tags, so my preferred method of marking plants are simple arcs of small, rounded rocks.

Arcs of Rounded Rocks

Many of us gardening in the Puget Lowlands experience the pleasures and perils of glacial till. Books could be written on both. One of the pleasures are the rounded rocks, each one a treasure in its own right, having utilitarian as well as aesthetic value.

- To mark a newbie, rounded stones can be placed like a necklace in semi-circular arcs on the edges of drip lines. The sizes of the stones are relative to the sizes of the newbies.
- Stones laid in an arc perpendicular to the fall line essentially create a small, weak, retaining wall that can be used to make informal terraces and irrigation pans (see below).

Irrigation

I don't have much advice on irrigation other than I hate to see newbies die, be it after one year or after five. In fact, it's worse when they die after five. In the short run, irrigation helps, but in the long run they have to establish a good root system.

[17] See "Puget Lowland Soils" below.

Ideally, newbies should be watered when they need it and not before. They should not be allowed to perish from thirst, but they should be encouraged to develop their own roots. Thus, a little exploration is preferred prior to watering a plant. All I've ever done is to poke my finger a couple inches into the soil just outside the plants drip zone.

In practice, I've tended to give each newbie 1-2 gallons of water every couple of weeks from late spring until the wet season is well underway for up to three years. Lately, however, I've begun to think I may have been overwatering. Rigorous academic evaluations of forest practices are still in their early years, but one study of California ornamental trees found that once irrigated, trees became dependent on it. Just enough water to keep them alive might be better so that they are forced to grow their roots further into the ground to find moisture. If one can accept higher mortality rates in the first few years, then keeping them thirsty may pay off in future dry seasons.

Creating an Irrigation Pan

On steeper slopes, especially with trees and shrubs, I like to shape the ground around newbies into shallow water pans that will help retain rainfall and make it much easier to irrigate. To accomplish this, I usually take soil from the uphill side to the plant and build a berm on the downhill side. Often, I add an arc of rounded rocks on the berm to make it stronger. For trees and shrubs, I like the water basin to hold at least one gallon of water. Without a basin, water often just runs down the surface of the soil without penetrating.

Transplanting

Rescue Plants

Because plants are so expensive, it literally pays to take full advantage of what I call "rescue plants." There are usually existing native plants growing in spots where they are not needed or are in danger of being damaged. Most of

these are small, and it only takes a few moments to move each one. Examples of rescue plants include those growing in:

- regularly mowed turf areas,
- trails and trail edges,
- landscape beds on the edges of the forest,
- weedy bad areas, and
- shallow soil on the edges of paved walkways, sidewalks, and roads.

Rescue plants also include:

- sapling trees or shrubs that will not have enough room to grow where they are, and
- plants that have sprouted too close together and will need more room to get big.

Many of these plants can be "rescued" and easily moved into weed breaks and gaps in the good areas under canopy. Many resources on the web provide information on what plants can be transplanted well and which cannot[18]. I have had good success transplanting Fringe Cup, Youth-on-Age, Large-Leaved Avens, and other non-woody plants. Sword Fern and Lady Fern transplant well, but not Deer Fern. Trailing Blackberry and Blackcap are easy to transplant but can take over sunny spots with good soil. I have had very poor success transplanting Oregon Grape or Salal. Most trees and shrubs transplant well, though not Red Huckleberry.

Installing Rescue Plants

I love transplanting, especially when I take the time to do it right.

- It begins by finding a rescue plant.
- Before digging it out, it's really best to first find a good "planting spot" for the plant.

[18] See "Gardening with Natives" in "Resources on the Web" in the appendices.

- Prepare the planting spot for the transplant in much the same way as for a potted plant[19], except that the diameter of the hole can be less if the transplant comes with most of its soil intact.
- To remove the rescue plant, take time to completely encircle it with straight-down cuts of the shovel or trowel. Pry and lift it out carefully so that it lies on its side on the blade of the shovel or trowel. Use one hand to hold the soil on the blade, walk the transplant over to the planting spot, and carefully ease it into the planting hole.
- Finish up much the same way as a potted plant, going lighter on the water.

Multiplying by Dividing

Many gardeners fill their flower beds by dividing existing plants. Basically, the method consists of digging up all or part of an existing plant, dividing or separating the roots into two or more parts, and then planting the individual pieces where they will have room to grow into full-size plants. Sometimes the pieces are just sections of roots or rhizomes. Other times they include both roots and leaves.

A sharp knife, hand clippers, or even a small pruning saw will work to cut roots, root masses, or rhizomes into separate pieces. Sword ferns, for example, can be divided fairly easily, especially where smaller rhizome “pups” can be separated from the side of a large “mother” plant. There are good sources available on the web for specific instructions on how to divide numerous native species.

Planting from Seed

My experience with seeding has begun only lately and is still a work in progress. So far, I prefer germinating the plants in separate planting beds and then transplanting them straight into adjacent ground instead of into interim

[19] See ”Installing Plants Grown in Pots” below.

pots. This has worked better for me than seeding directly into gaps or weed breaks.

Planting Trees

This e-book does not address the aspects of forest restoration dealing with planting new forests on open ground. Thus, the discussion below is focused on the planting of trees under the canopy of the backyard forest.

The Two Main Backyard Forest Habitats

The discussions in this e-book assume one of the two main types of Puget Lowland forests, the coniferous or deciduous as described below. Mixed coniferous and deciduous forests are also common but are not called out as a separate category.

Puget Lowland Coniferous Forests

Three native conifers, the Western Redcedar, Western Hemlock, and Douglas Fir provide the backbone of our Puget Lowland coniferous forests. The best of these forests have closed canopies of mature trees that produce year-round shade on the forest floor in which direct sunlight is limited to sunflecks. With luck, and perhaps with the benefits of our restoration efforts, many of the conifers will live another century or longer. As these forests age, many trees will perish, but the remaining will grow their branches into gaps thus maintaining the closed canopies. Though some trees will continue to sprout on the forest floor, and the most shade-tolerant of these saplings may live for many years, they will remain stunted unless the canopy opens, and they gain access to significant amounts of direct sunlight.

The groundcover of the ecologically viable Puget Lowland coniferous forest is dominated by evergreen ferns, mainly Sword Fern, and two low-growing

evergreen shrubs, Salal, and Oregon Grape. In the intermediate level of the forest understory grow a diverse mix of shrubs[20].

Puget Lowland Deciduous Forests

Three native deciduous trees, Red Alder, Bigleaf Maple, and Black Cottonwood, dominate our deciduous forests. Compared to the native conifers these are all short-lived species, and in stands over 50 years old many of these trees are approaching the ends of their natural life spans. When the trees are leafed-out the forest canopy is closed, and little direct sunlight reaches the forest floor. When the leaves are off the trees, more sunlight reaches the ground, though the angle of the sun is lower, the days are shorter, and the skies are often cloud covered. Gradually, however, the canopy in these forests opens up to summer sunlight as the trees die off or are toppled by windthrow.

The understory in the Puget Lowland deciduous forests includes not only the same groundcover plants as the coniferous forest, but more deciduous shrubs as well. Of these, Salmonberry especially can establish thick groundcovers.

Forest of the Past and Forest of the Future

In the Puget Lowland forest of long ago, the climax trees consisted of shade-tolerant Western Hemlocks and Western Redcedars with Douglas Firs growing in areas that had been cleared by major forest fires. Then in the late 1800s and early 1900s the forests were clearcut, and natural regeneration often favored the sun-loving firs so that today, many of our second and third growth forests are dominated by Douglas Firs. This accident of history (i.e., the timing of industrial logging in the Puget Lowlands) could turn out to be a lucky break since Douglas Firs are perhaps the most likely of our three climax conifer species to survive the upcoming century of increasingly severe dry seasons and more frequent wildfires. The region's Western Redcedars and Western Hemlocks are already showing signs of climate-change stress, but if we take care of them the

[20] See "38 Common Plants of the Puget Lowlands" in the appendices.

Douglas Firs have the potential to live another century or longer, accumulating ever-increasing biomass each year and capturing more carbon than young trees[21].

Hopefully it won't be until the next century that our big Douglas Firs begin to slowly die, and the carbon they emit in respiration will be greater than the amount they capture in photosynthesis. When this happens, it would be ideal if there were younger climax conifers waiting beneath them, ready to spurt up and take their place in the canopy. However, at this point in time, planting trees in the Puget Lowlands only makes sense in the deciduous forests as discussed below.

Don't Plant Trees in a Conifer Forest

For several reasons, it usually does not make sense to plant new trees in the Puget Lowland conifer forests.

- Not enough sunlight penetrates the canopy to support any but the most shade tolerant trees.
- The highest priority in backyard forest restoration is preserving the existing trees, and the existing conifers may live for another century or more. Planting conifers beneath them not only creates possible fire ladders (as discussed below), but also introduces competitors that take some of the soil moisture the existing trees rely on to survive the long dry seasons.
- Planting in a conifer forest should be focused on establishing groundcover plants. Planting a few small deciduous trees may be okay, like the shade-tolerant Vine Maple, or Cascara, because they will not significantly jeopardize the health of the existing trees and provide some diversity of tree species.

Preventing Fire Ladders

One potential threat to the existing trees in Puget Lowland forests is fire. Though major wildfires are rare west of the Cascades, when they do occur mature Douglas Firs can usually survive if the fire does not climb into their crowns. Unlike

[21] See below chapter "Big Trees Grow Faster than Small Trees."

thin-barked Western Hemlock and Western Redcedar, Douglas Firs, can usually survive ground fires because of their thick bark.

One way fire gets into the crowns is through “fire ladders” — low hanging conifer branches that provide a pathway for flames from a ground fire to climb up into the canopy[22].

In our region, shade tolerant Western Redcedars and Western Hemlocks (which often grow beside and beneath Douglas Firs) often have lower branches that continue to grow right down to ground level. One of the things forest stewards can do when working in an area with mature Douglas Firs, is to prune lower branches of conifers so that none are growing into the tops of shrubs or groundcover beneath them. Then, should a fire occur in the understory, it will not have a “ladder” by which to climb into the canopy and kill the Douglas Firs. Removing the lower branches on the conifers also increases visibility in the forest which helps visitors feel more secure.

If neither fire ladders nor visibility are issues, as in aging deciduous forests away from trails, then I see no reason to remove the lower branches. Note that when the lower branches of Western Redcedar grow so long that they touch the ground they can sprout new roots and spread by layering. In this way the redcedars can gradually take over larger areas.

Plant Shade-Tolerant Conifers in Aging Deciduous Forests

In the Puget Lowlands, we have many urban forests where the Red Alder and Bigleaf Maple have neared the end of their life spans and for various reasons often lack good replacement trees coming up in the understory. These aging deciduous forests are a good place to plant new trees, but what species?

Though these forests often have gaps in the canopy from the deaths of mature trees, the amount of direct summer sunlight reaching any one spot on the forest floor can be limited to winter sun. Thus, trees planted in these forests must

[22] Chris Maser, Forest Primeval, The Natural History of an Ancient Forest: Stoddard Publishing, 2001

be shade tolerant. That means that Douglas Fir, Sitka Spruce, Shore Pine, and Giant Sequoia are not good options. Six shade-tolerant species in our region are Bigleaf Maple, Pacific Yew, Cascara, Western Redcedar, Western Hemlock, and Grand Fir, but none are perfect choices because of other factors as shown in the following chart.

Factors Influencing Which Tree Species to Plant in Puget Lowland Forests

	Tree Species									
Factors to Consider	Bigleaf Maple	Grand Fir	Western Redcedar	Western Hemlock	Cascara	Pacific Yew	Sitka Spruce	Douglas Fir	Shore Pine	Giant Sequoia
Shade Tolerant?	☑	☑	☑	☑	☑	☑				
Drought Tolerant?	☑	☑			☑			☑	☑	☑
Root Rot Resistant?	☑		☑		☑		☑			☑
Climax Species?	☑	☑	☑	☑			☑	☑	☑	☑
Native to PNW?	☑	☑	☑	☑	☑	☑	☑	☑	☑	

Bigleaf Maple

Bigleaf Maple survives some shade and summer drought, but it really needs full sun and ample moisture to grow to full size. Because maple seeds germinate readily from seed, there are often saplings already growing in Puget Lowland forests. However, before allowing any maple sapling to grow, make sure it's the native Bigleaf Maple and not the many naturalized non-native and even invasive maples that are common in Puget Lowland forests.

Also, make sure it's growing in a good spot where it could potentially grow into a full-size Bigleaf Maple. In your backyard forest another consideration for

planting any tree is proximity to your house or other structure. Don't plant a tree that when full-grown will become a hazard and have to be removed.

Yew and Cascara

Though Yew and Cascara are beautiful small trees, they are not "climax" species that will eventually grow tall enough to reach the sun-filled canopy with the big trees. However, planting a few of these in your backyard forest can add biodiversity.

Western Hemlock and Western Redcedar

Though shade-tolerant, neither Western Hemlock nor Western Redcedar are drought tolerant, a factor becoming even more important in the face of climate change. Extended periods of abnormally low precipitation are expected throughout this century with summer precipitation decreasing by as much as 30% by the year 2100. Western Redcedar and Western Hemlock will, hopefully, continue to do okay in low sites with year-round moisture in deep soils

Grand Fir

Grand Fir appears to be the only native conifer that is both moderately shade tolerant and drought resistant, but it is not resistant to root rot. Western Redcedar is resistant to root rot, Western Hemlock is often infected but usually survives, but Grand Fir is supposedly very susceptible.

So where does this leave us?

Since there is no perfect climax species to plant in your backyard forest, the best strategy is probably to plant a mix. Personally, I have been planting a mix of Grand Fir, Western Redcedar and a few Western Hemlock. I've put the redcedar and hemlock in low, moist spots, and the more drought-resistant Grand Fir in drier spots.

Planting Shrubs

Small gaps in the good areas can be good spots to plant native shrubs. One positive outcome of this approach is to increase diversity in the forest by planting some of the less-common shrubs like Red-Flowering Currant, Beaked Hazelnut, and Oceanspray. Vine Maples are shade tolerant and can be a good choice for a small tree under a canopy of conifers. Good candidates for transplanting include Ocean Spray, Osoberry, Snowberry, Thimbleberry, and Elderberry.

I almost always have allowed existing native shrubs to continue growing where they are, not wanting to disturb the natural ecosystem. On occasion I have transplanted shrubs growing near trails to spots further back in the forest to increase visibility. In places where salmonberry dominates the understory it makes sense to replace some of it with other species.

Growing shrubs under the canopy of your backyard forest is basically a trade-off between biodiversity for the ecosystem and sight distance when you spend time there. In terms of biodiversity, there are quite a few native shrubs that do well in our Puget Lowland forests and help support ecosystem robustness. However, they also reduce visibility, especially when fully leafed-out. For this reason, I don't encourage shrubs within ten feet or so of trails. If you want a more "people-friendly," open forest, then you may want to avoid planting a lot of shrubs.

I don't think it makes sense to plant shrubs in weed breaks. It's better to focus on establishing groundcover plants that will deter weeds and allow expansion of the good areas.

Planting Groundcover Plants

Establishing Groundcover in Weed Breaks

Establishing robust native groundcover in weed breaks is necessary to allow the expansion of good areas. As groundcover becomes more dense it deters weeds for several reasons:

- Increased shade dampens the growth of weeds.
- Fewer weeds means less soil disturbance from repeat weeding. The duff and top layers of soil become more stable.
- As native plants replace weeds, the balance in the soil seed bank gradually changes and fewer weeds sprout to begin with.

Native groundcovers may regenerate naturally over time, but it's often desirable to speed up this process by installing plants. The best long-term groundcover for the Puget Lowlands is comprised of Sword Fern, Salal, and Oregon Grape. Of these three plants, only Sword Fern can be easily divided or transplanted, hence Salal and Oregon Grape will probably have to be purchased.

Filling Small Gaps in the Good Areas

In the good areas, where the weeds are thinly scattered through the forest, then the disturbed ground is limited to just a small area, often no larger than the size of the root system of the plant removed. Natural regeneration will often fill these small, disturbed areas with new plant growth. Small areas like this can also be good spots for increasing biodiversity by planting other species of shade-tolerant ferns and forbs purchased from nurseries. One surprising planting success for me has been Wild Ginger. About 10 years ago I did some scattered plantings of Wild Ginger in shaded areas, and I've been surprised to find several patches that have become established and are spreading well.

When to Plant

The timing of planting is dictated by the type of plant, soil moisture, and the availability of water to irrigate. In the Puget Lowlands, late October and November have long been touted as a good time to plant in the Puget Lowlands because historically the rainy season has begun. It was thought that over the course of the mild winter the roots would begin to grow, and enough rain would fall to prevent the need for supplemental irrigation. I'm not sure this really applies anymore for several reasons:

- The dry seasons are lasting longer so that the ground is no longer saturated by the beginning of winter,
- winter rains are becoming more erratic,
- roots actually grow better when the soil is warmer, and
- nurseries usually have more selection in the Spring.

February through April are perhaps better for planting in the Puget Lowlands, though irrigation will likely be needed at the time of planting unless the ground is thoroughly saturated.

Pruning Trees and Shrubs

Note on terminology -- For simplicity, I use the word “branch” to describe both branches and limbs.

Pruning of trees and shrubs is needed primarily in trail corridors to keep pathways open and improve visibility in the immediate surrounding forest. I’m not an expert at pruning, but two principles I’ve been taught by mentors are as follows.

- Unless you are trying to create a dense hedge, cutting back trees or shrubs by trimming the ends of branches is not particularly helpful. It’s usually better to thin trees or shrubs by retaining the best branches and removing lesser branches entirely.
- When removing a branch, cut it off next to the trunk (or larger branch) in such a way that it does not peel any bark below the cut. To accomplish this, first make an undercut, sawing upwards into the underside of the branch, close to the trunk. Then start a new cut downward from the upper side of the branch, aiming the cut so that it meets the undercut. If this is done well, the branch will drop off cleanly without peeling any bark off the trunk.
- Though many experts recommend pruning in the winter when plants are dormant, others suggest warmer months when the plants are actively growing and can seal wounds more quickly.

About the only pruning I've done on trees away from trails is the removal of the lower branches of Western Redcedar and Western Hemlock growing beneath mature Douglas Fir to prevent fire ladders. If your arborist recommends the removal of large branches higher in the canopy you should have the work done by a reputable tree service.

Fallen Branches

As I weed the forest, I find myself contending with lots of fallen branches. It's often necessary to move these branches when they are on top of native plants or when I need to remove weeds beneath them. When I move a branch, I try to put it in a place that I've already weeded, and where it doesn't hurt native plants. Furthermore, if I can find a spot where the dead branch is touching the ground, it will decompose more quickly, returning nutrients to the soil. I sometimes use dead branches as the base for compost heaps or to delineate trails, but I don't like to make unnecessary piles of dead branches. Instead, I prefer to scatter them randomly about the forest floor creating a more natural look and spreading their benefits around.

Windfalls -- A Sprinkling of Slow-Release Fertilizer

"Windfall" from the online Meriam-Webster Dictionary is aptly defined as something (such as a tree or fruit) blown down by the wind or an unexpected, unearned, or sudden gain or advantage. For northwest forests, the "sudden gains" are the large amounts of coarse woody debris scattered over the ground after windstorms. Although the growth of many individual trees may be temporarily slowed by the need to heal dozens of small wounds, they will gain immediate benefit from increased sunlight and air circulation in the canopy. In the long term, they will reap a bounty of essential plant nutrients as fungi gradually decompose the organic matter on the forest floor, improving the fertility of the soil.

Useful Branches

In addition to providing nutrients into the soil, fallen branches have other uses for the forest steward.

- Branches laid parallel to the contour of the slope act like check dams to slow water runoff and increase saturation. Duff collecting on the uphill side of such branches acts like mulch, helping to retain moisture and build topsoil. These mini terraces also provide good spots for new plants and trees.
- Branches can be cut to length and used as the base for compost piles.
- Branches up to 6” in diameter can be used to define the edges of trails and block unwanted social trails.

Mosses and Lichens from the Canopy

Among the detritus that litters the forest floor after windstorms are mosses and lichens from the canopy. Unattached fragments of moss can be pushed into cracks in rocks or fallen logs or pressed flat on bare ground and anchored with small stones or chunks of woods. Some of the larger fallen branches that are covered with beautiful mosses and lichens can be placed in gaps in the undercover to add visual appeal to the forest floor, especially in the winter.

Paths and Trails

Creating Permanent Trails

It’s best to have some permanent trails to access work areas, to be able to walk around your forest for pleasure, and to avoid destruction of groundcover plants by trampling. Some of the principles on creating trails that I’ve picked up over the years include the following.

- As deer and other animals make their way through the forest, they end up using the same routes again and again as dictated by factors such as terrain and groundcover. If we follow these game trails each time we go through the forest, then our trampling will gradually create permanent trails.

- Natural trails in the forest are rarely straight. Using a trail with twists and turns and a few ups and downs is more interesting to follow than a straight shot.
- The main trails don't have to be completely free of obstacles like fallen logs or small streams to cross.
- It's better to traverse slopes than go straight up and down especially if the slope is steep and slippery when wet. For long slopes this sometimes means creating switchbacks.
- It's best to route trails around wet areas if possible. Low spots in trails turn muddy with foot traffic. Sometimes a little shovel work can enable them to drain off to one side. Sometimes "corduroy" trails across muddy spots can be created by adding a carpet of trail-wide branches laid perpendicular to the path direction.
- Trails can double as weed breaks, especially semi-permanent weed breaks like those located along property lines in the backyard forest, or at the edge of the backyard forest where it abuts a landscaped backyard.
- Try to have just enough trails to serve their main purposes, but not so many as to create a lot of bare ground. Trails are by definition bare ground, and though weeds don't grow in them, trails help to spread weeds along them through seed dispersal. Hence, it's best to not have unnecessary permanent trails through your forest. If you don't want to create a permanent trail in an area, then take different routes each time you have to move through it. Move slowly, pay attention to each footstep, and try to minimize stepping on plants. Try not to crash through the vegetation in a beeline and instead take twisty routes go around each minor obstacle.

Maintaining Permanent Trails

Trail Brushing

Annual maintenance of permanent trails includes "trail brushing." I like to walk down the trail with my hand clippers in my right hand and prune any branch that is growing out into the trail. Then, having brushed the right-hand side of the

trail I turn around and walk back brushing the other side of the trail. Sometimes trail brushing includes some pruning to remove branches that are too big to clip with hand clippers and necessitate the use of a hand saw. You can gather the clippings and add them to the compost pile, or if the plants along the trail are all natives, then you can just leave the clippings in the trail.

9 -- The Forest Edges

The Challenges and Opportunities of Edges

When I picture the typical backyard forests in the Puget Lowlands, I think of single-family residences that have lawns and formal landscaping in the front yard, and some open areas with garden beds and/or mowed turf in the backyard between the house and the natural forest. Depending on the exposure, the edge area between the open areas and the forests can receive up to six hours of direct sunlight during the middle of the summer. A southern exposure, in theory, could get up to twelve hours of sunlight in mid-June, whereas a northern exposure at the same time of year might only get a little sun just after sunrise and just before sunset. Because of the increased sunlight, understory plants generally grow more prolifically in edges than in the deep shade of the canopied forest.

Deterring weeds from spreading into the adjacent forest, requires a weed break along the forest edge. I believe this is important regardless of whether or not the area under the canopy is a good area, and regardless of the nature of the open area on the outside of the forest edge. The open area on the outside of the weed break can be manage as turf and mowed right up to the weed break or permanent landscape beds can be created for flowers (preferably natives) or vegetables.

Managing the Open Areas as Turf

Mowing the open areas right up to the weed break can be a good, option for areas of turf on the edge of the forest. If done regularly through the growing

season, mowing will help to minimize the extent to which the grasses, dandelions, and other weeds go to seed and spread into the forest. The mowing can be done with a mower, string trimmer, or even a manual grass whip. Of course, mowing doesn't kill the plants in the turf, but if done every couple of weeks throughout the growing season, it does keep them from growing to full size and producing immense numbers of seeds.

Ideally, the weeds in the turf area itself are not controlled with herbicides, and the grass is not kept green with fertilizer and irrigation. The turf should be allowed to turn brown by the end of the dry season because it will come back in the wet season. Deep-rooted weeds in the turf like Cat's Ear, can be dug out by hand if you want. Most of the plants that pop up in the input-free turf will be weeds, but some will be native plants like Avens and Fringecup that can be rescued and transplanted into weed breaks.

Managing the open area as turf is the best option if you would like to gradually expand the forest closer to your house.

Garden Beds on the Edge of the Weed Break

Open areas on the edge of the forest are the only sites where the homeowner can grow vegetables and flowers that require direct summer sun. In fact, edges are the only place to grow a wide diversity of sun-loving native plants. These garden beds don't threaten the forest, provided that the weeds growing in them are not allowed to go to seed and the weed break is maintained.

---Appendices---

Gear for the Forest Steward

Sturdy Work Clothes

You don't have to look stylish to work in your backyard forest. I never work in the woods at any time of the year without wearing long pants, long-sleeve shirts, and heavy-duty work gloves. I prefer baggy work pants made of heavy fabric. The same principles apply to long-sleeve shirts. If the fabric is too thin or the fit too tight, nettles and mosquitoes can still bite.

On hot days I have tried getting by with just a T-shirt, but always ended up regretting my decision because of thorns, nettles, or mosquitoes. When the weather gets hot, I still wear long pants and long sleeves. There are other ways to beat the heat. I wear a sun hat. I try to stay out of the direct sun and work in shady areas. I drink more water. I start early in the day when its cooler.

I keep two sets of work clothes specifically for working in the forest. They get wet and dirty, so I hang them up in a spot where they dry and don't have to be washed every time.

The forests of the Puget Lowland are some of the most people-friendly anywhere, almost devoid of poisonous snakes, spiders, or plants. Still, the sharp thorns on Himalayan Blackberries are very unfriendly and mosquitoes get thick at times. I've seen many volunteers come out to work parties and end up having bad experiences simply because they wore shorts, T-shirts, or sneakers with no socks. I even suspect that not wearing protective clothing is one of the reasons that I have not seen more repeat attendees at work parties over the years.

Gloves

I always wear gloves when working in the forest. I prefer the heavy-duty, fabric gloves that have a latex coating on the palm and fingers. I buy pairs that are larger than the minimum I need, so that I can wear them over liners in cold weather or when dealing with non-native blackberry. The fabric back allows them to “breathe” and dry out within a day or two after they’ve gotten wet. I own several pairs, so that I can rotate them and give them time to dry out between uses. Unlike leather gloves, they don’t get stiff and hard after they’ve been wet.

Footwear

I wear old sneakers (e.g., athletic shoes) with breathable fabric instead of boots. Compared to sneakers, I think heavy boots with lug soles cause more disturbance of the ground and more damage to native plants when working off trail. I have several pairs of sneakers and rotate them to give them more time to dry out between uses. I tried leather shoes, but they cracked and split after they got wet and then dried out, so I prefer shoes made of synthetic materials. I use low gators to keep debris out of the shoes and keep burrs and sticky seeds from collecting on my socks.

Phone

I carry a phone in the woods. I think it’s important to have with me, in case I ever needed to call for help. I also use it to take pictures, make notes, and help identify plants. To keep it dry, I keep it in a plastic bag whenever the day or the foliage is wet.

Tools

The following describes the basic tools I find helpful, sorted from most to least useful. Always keep safety in mind when using tools.

Hand Clippers and Holster

I always carry a pair of hand pruners, “clippers,” in a holster on the side of my leg where I can reach down and grab them, clip a branch or vine, and return them to the holster without looking and without having to use my other hand. I prefer the “classic forged bypass hand pruners” which are made of high-carbon steel and last for years without needing maintenance. About the only thing I’ve ever done is to sharpen them every few years. There are lots of inexpensive clippers available, but I don’t think they work as well or last as long.

The holster is important, too. Without a holster I’m more likely to set them on the ground and forget where I put them.

Folding Saw

I usually carry a 7” folded pruning saw in the pocket of my work pants on the same side as my hand pruners. The saw sticks out of my pocket an inch or two but doesn’t fall out. I can easily grab it, saw a branch that is too big for the hand pruners, and return it to my pocket. I use the “razor tooth” saws made of carbon steel which are extremely sharp when new. These saws don’t stay sharp for long, so I end up buying a new one every couple years. But even when they are getting dull, I am CAREFUL with these saws, not to accidentally cut the hand that holds whatever I am sawing.

Shovel

A strong digging shovel may be required at times to remove larger weeds like holly, laurel, and non-native blackberries. My new favorite shovels are the so-called “root slayers.”

Hand Trowel / Weeding Dagger

A strong hand trowel can often accomplish many of the same tasks as a shovel and can be carried in a holster. I use one with a narrow blade which enables me to use it both as a weeding dagger and as a hand trowel for installing or transplanting small plants.

Loppers

Loppers are used mainly for cutting branches that are too thick for hand clippers. The “rule of thumb” that applies to clippers and loppers is that if it’s thicker than your thumb, use loppers instead of clippers. I almost never use them since a folding saw can also cut branches thicker than my thumb and is much easier to carry.

Garden Fork

The garden fork is a useful tool for loosening soil prior to removing weeds and for planting native plants, while doing less damage to the roots of adjacent native plants than a shovel. Provided it’s a well-made fork with tines and shank forged from one piece of steel, it’s strong enough for even the toughest jobs.

In planting, I use the fork to probe the ground at the spot where I would like to dig the hole to see if there are obstacles like large roots or stones. Once I find a good spot, I rake the duff away from the planting spot with the tines of the fork. This also reveals where any small native plants are rooted that can be rescued. Next, I use the fork to loosen the ground to the desired width and depth before scooping out the soil with a shovel. In this way roots of adjacent native plants are less damaged, and there is one more benefit -- fewer earthworms are cut in two by a shovel blade!

Tillers

Lightweight hand cultivators and long-handled tiller hoes can be used in weed breaks that are heavily overrun with non-woody weeds. These tools have a double-sided head. One side of the head has a small hoe, the other side has prongs or tines.

Losing Tools in the Forest

I have lost some tools in the forest. Many times, I have been using a hand clipper or hand saw, set it down on the ground, gone on working and then realized sometime later that I didn’t know where it was. Sometimes I’ve searched

for up to an hour before finding the tool, and sometimes I was never able to find it again. I've sometimes tied a foot of bright orange surveyor's tape to my hand tools to make them more visible lying on the ground amidst foliage.

Terminology

Categories of Plant Species

Native Plants -- Species of plants that have been growing in the local ecosystem for thousands of years. The term "indigenous plants" is synonymous.

Non-native Plants -- Species of plants that never grew in the local ecosystem prior to European exploration and colonization. The term "introduced plants" is generally synonymous.

Weeds -- Species of non-native plants growing where they are not wanted.

Naturalized Plants -- Species of non-native plants that successfully reproduce in the local ecosystem. Arguably, some of these may have limited negative effects, but many are invasive or noxious.

Invasive Plants -- Species of non-native plants that grow so rampantly and reproduce so successfully in the local ecosystem that they deter and/or displace native plants.

Noxious Weeds -- Species of invasive plants for which removal and/or control is recommended and sometimes required by state and/or county law.

Rescue Plants -- Native plants growing in inopportune spots, that can be "rescued" by transplanting. The term "salvage plants" is generally synonymous.

General Terms / Main Concepts

Forest Restoration -- An ongoing effort to conserve and improve the local forest ecosystem by systematically removing invasive plants and other weeds and nurturing the growth of native plants.

Forest Restoration Areas -- Specific, defined areas in which restoration efforts are ongoing. Examples include select portions of forested public lands and individual backyard forests.

The Bradley Method -- A strategy for native plant restoration developed by Joan and Eileen Bradley based on years of work restoring portions of Ashton Park in Sydney, Australia.

Good Areas and Bad Areas -- In the terminology of the Bradley Method, "good areas" are dominated by native plants and "bad areas" are dominated by weeds.

Weed Break -- A strip of cleared ground around good areas that helps deter the spread of invasive plants and other weeds from adjacent bad areas. The term "Bradley Line" is synonymous.

Vicious Circle of Weeding – An ongoing, repetitive cycle caused by the rapid colonization of weeds in disturbed ground. Removing weeds disturbs the ground, causing more weeds to grow. Removing these weeds disturbs the ground again, resulting in another flush of weeds. This cycle can continue indefinitely.

Overclearing -- A situation in which too much ground is cleared at any one time, making it impractical to keep up with the vicious circle of weeding.

Puget Lowlands -- The low-elevation areas (generally less than 500') around the Puget Sound (a.k.a. the "Salish Sea"). This area is almost entirely within the Seattle Metropolitan Area. The term "Puget Sound Region" is generally synonymous.

Three Seasons in the Puget Lowlands

Wet Season -- The time of year after most of the leaves have fallen and frequent rains have saturated the soil. In the Puget Lowlands this typically lasts from November into March and is usually interspersed with short spells of winter weather.

Growing Season -- The time of year when plants are most actively growing. In the Puget Lowlands this typically lasts from March through July.

Dry Season -- The time of year when rains have diminished and most of the plants have finished producing seeds. In the Puget Lowlands this typically lasts from August through October, though climate change is tending towards making the dry seasons longer, hotter, and drier.

Other Terms in Alphabetical Order

Blanket Ivy -- Ivy that covers the ground so thickly that it chokes out other plants leaving mostly bare ground if it is removed.

Duff -- The thin layer of decaying plant matter that covers the ground between plants. Disturbing this duff and exposing bare soil invites colonization by other plants, mostly weeds.

Forest Steward -- Anyone working to restore the forest.

Groundcover -- The layer of low-growing plants on the forest floor.

Input-Free Turf -- An area in which the only maintenance is regular mowing. No fertilizer or herbicides are used. The turf is not irrigated but allowed to go dormant in the dry season.

Natural Regeneration -- The spread of native plants naturally through seed germination, rhizomes, stolons, or layering.

Artificial Regeneration -- The establishment of native plants through installations of plants propagated outside the restoration areas or by transplanting rescue plants.

Pry and Pop – A technique to remove a deeply rooted invasive plant like Himalayan Blackberry. First, sink a shovel into the ground as deeply as possible, about 6" back from the base of the plant. Next, pull back on the shovel handle to loosen the soil and apply upward pressure on the taproot. Pull back until a "pop" signals that the taproot has pulled loose. Tilt the shovel back up to an upright position and remove it from the ground with minimal disruption to the surface of the soil. Reach down, get a good grip on the main stem of the plant, and "wiggle and pull" it out of the ground. Note that the same technique using a hand trowel or weed dagger can be used on small weeds.

Soil Disturbance -- Anything that disturbs the duff and top layer of soil. Soil disturbance promotes the growth of weeds.

Soil Seed Bank -- The myriad of seeds of both native and non-native plants that persist for many years in the duff and top layer of soil. These seeds lie dormant until the right conditions exist to trigger their germination.

Under Canopy -- The shaded areas beneath mature stands of trees.

Understory -- The shrubs and groundcover plants growing under the canopy.

Wiggle and Pull – A technique to remove a weed in which the main stem is grasped close to the ground and simultaneously "wiggled and pulled" to work the plant out of the ground with its roots still intact.

Why Restore Your Backyard Forest

Over the last decade or two there has been a growing awareness of the harm caused to natural ecosystems all over the world by invasive plants. Whether by reproducing more prolifically, growing faster or bigger, or having fewer pests, they outcompete native vegetation. They are typically less desirable than native

plants in terms of their role in the food chain, their value to the soil, and their aesthetic value to humans. The Puget Lowlands have not escaped these invasions. Left uncontrolled, the beautiful forests of the Puget Lowlands could one day become sterile monocultures of ivy, holly, laurel, Himalayan Blackberry, broom, bindweed, Herb Robert, Garlic Mustard, and others.

Supporting the Food Chain

Because they are the foundation of the food chain, robust populations of native plants are the key to maintaining ecosystems. Native plants support an entire suite of insects and other invertebrates that have evolved with the plants, enabling the native fauna to maintain the niches their species have carved out over the eons. Invasive plants do not, typically, provide food for the native fauna. In fact, one of the reasons many invasive weeds do so well in areas outside their native range is that their populations are not controlled by local insects or herbivores. In terms of dazzling displays of color, most native plants in our region may not compete with banks of ornamental flowers like petunias or geraniums but focusing on color misses the underlying beauty of native plants – they are part of our natural ecosystem.

How Do Healthy Forests Benefit Humans?

Healthy forests are like combination air conditioners and water purifiers. They help to keep us cooler in the short term by providing shade and cooler in the long term by removing carbon from the atmosphere. Like giant sponges they soak up the rainfall and charge the aquifers. They reduce the quantity and rapidity of runoff, reducing erosion, downstream flooding, and the build-up of sediments in streams and rivers.

Forests help many of us with our physical and emotional well-being. Forests can be a gathering place for social activities. Forests can stimulate our imaginations and our intellects. For me, aesthetic values also inspire my work in the forest. I take great pleasure in visiting areas in the forest that appear vibrant and healthy. I don’t like to see ivy climbing the trees, or holly and laurel forming

dense thickets, or weedy annuals going to seed. The more time I spend in the forests of the Puget Lowlands, the more I have become aware of what looks natural here, and how beautiful that can be.

Legacy Forests

Prior to World War II, when lumberjacks still relied on two-man crosscut felling saws, many less-than-perfect trees were left standing. When those forests naturally regenerated, they often grew into a diverse mix of conifers and deciduous trees that are now over 75 years old. Many of these forests are now considered "legacy forests" because they have retained much of the "biological, structural, functional, and genetic legacies of old growth forests.[23]" After World War II, with the advent of the modern chainsaw, it was easy to cut every tree, and naturally regenerated forests were likely to be a less-diverse mix of Red Alder and Bigleaf Maple with few conifers regenerating naturally.

Big Trees Grow Faster Than Small Trees

One of the benefits of preserving existing trees is sequestering more carbon than would be achieved by smaller trees in the same area. In 2014, *Nature* published the results of a comprehensive study showing that contrary to widely held assumptions, large trees actually grow faster than small trees. In the study, 38 scientists took repeated measurements over time to estimate the mass of over 670,000 individual trees belonging to 403 species in forests all over the world. This massive data set was then analyzed statistically to show that for almost all species of trees, their rate of growth increases continuously for their entire lives. The study found this to be true for 87% of tree species of all sizes and for 97% of large trees.

[23]https://www.wlfdc.org/legacy-forests

Why is Biodiversity Important?

From an ecological point of view, biodiverse ecosystems are more resilient to changes in the environment. In agriculture the main benefit of biodiversity is in the control of pests, including not only insects but, more importantly, viruses and bacteria. In monocultures, outbreaks can quickly wipe out entire crops. The same principles apply to forests though over a much longer time frame.

For example, consider the effects of longer, hotter dry seasons on forest ecosystems. If a particular forest is comprised primarily of a single species of trees, and that species cannot withstand the changing climate, then all of the trees may perish, and the forest become a shrub steppe. However, if the forest has multiple species of trees, there is a greater chance that some will be able to survive the changing climate and the forest will remain a forest, but with a different composition of trees.

The Ecology of Invasive Ivy

In their idealized conceptualization, ecosystems function as perfectly-balanced wholes which by their near unimaginably complex machinations inspire comparisons with living, sentient beings. However, the real world is forever pushed out of balance by numerous forces. In geologic time, forces like plate tectonics and stellar evolution, drive changes on a global scale that open some ecological niches and close others, causing the populations and ranges of living species to continually change over time.

Why then, are some species considered invasive, with its very negative connotations? Some ecologists suggest that the growth of ivy in Puget Lowland forests should simply be considered the natural succession of a species expanding into a niche opened up by changes in the environment. Given thousands of years, the current suite of plant and animal species will adapt to the presence of ivy, and it will no longer be so dominant.

Ivy has only been in North America since the 1600s when Europeans brought it from Europe. That is not nearly enough time for enemies to evolve that could contain it. Thus, in areas where its growth is not constrained by physical factors (e.g., long-lasting hard freezes), ivy grows rampantly, establishing thick blankets that out-compete existing native plants. In short, in some places it can literally take over, significantly reducing biodiversity.

Why Isn't Ivy Invasive in the British Isles?

One reason that ivy is not considered invasive in the British Isles is that its spread has been contained by the many animals that eat it. Since ivy has been in Europe for almost six million years, it makes sense that many species have evolved to feed on it. According to a 2005 paper by Daniel J. Metcalfe and published in the Journal of Ecology[24], sheep in Europe "relish ivy" and help to keep it controlled in forest understories. Red, Roe and Fallow deer are all found to graze on ivy, especially in the winter. He lists over 70 invertebrates that feed on ivy. He states that ivy hosts two plant parasites, over a dozen fungi, and is food for over 70 species of invertebrates.

How Many Backyard Forests Are There?

In the Puget Lowlands, there are literally tens of thousands of households with backyard forests.

- Over 80,000 households in Snohomish, Pierce, and King Counties live on parcels between one and five acres in size. I believe that many "large lots" like these contain patches of natural forest. The total area of these 80,000 parcels is over 280 square miles. Thus, if only 10% of that area is backyard forest, it would add up to 28 square miles, or almost 18,000 acres.

[24] Journal of Ecology Volume 93, Issue 3 p. 632-648
"Hedera helix L.," DANIEL J. METCALFE, First published: 03 May 2005, Journal of Ecology

- In Snohomish County, over 10,000 single-family residential parcels have year-round streams running through them. I presume that many of these streams would have natural riparian vegetation growing along their banks.
- In Snohomish County, almost 1,000 parcels in residential subdivisions were designated as “common areas” comprising 10 square miles. These are often forested and managed by homeowners’ associations.
- In Snohomish County, over 50,000 households are within walking distance of a County park. (This does not include City parks.) However, because working on public land requires authorization and supervision from the appropriate government officials and staff, this e-book focuses on privately owned forests in the Puget Lowlands.

Forest Restoration on Public Land

Forest restoration on public land is constrained by several factors, including lack of funds, limitations of volunteer labor, and conflicting priorities.

Lack of Funds

Forest restoration on public lands suffers from lack of funds. It is safe to say that government agencies at all levels (federal, state, county, and city) are suffering from a situation in which tax revenues have failed to keep pace with increasing expenses. When I began volunteering in Everett’s Forest Park in 2007 the City landscape crews had about two dozen full-time staff, including several devoted solely to work “under the canopy.” When I left in 2023 there were no more than a dozen in total and just one arborist to deal with all of the City’s trees. The lack of staff was so acute that in the summer of 2023, most of the work of the landscape crew was reduced to mowing and picking up trash.

Lack of staff results in the inability to control weeds in the landscaped edges. Over time, many landscape beds have been abandoned altogether and become overgrown with ivy, non-native blackberry, and bindweed. On some of these edges, the only maintenance is annual mowing with string trimmers, but

that isn't done until after the weeds have finished growing and gone to seed. Then, the mowing scatters the seeds into the adjoining forest.

Limitations of Volunteer Labor

Lack of funding was one of the reasons that Everett, along with other cities in the Puget Lowlands, joined Forterra's Green Cities Program[25], which used a volunteer work party model of forest restoration. At least in Forest Park, that program worked well for clearing large areas of invasive plants, but failed to generate a community of skilled forest stewards who could maintain cleared areas with selective hand weeding. In the language of the Bradley Method, the Forterra model in Forest Park resulted in overclearing.

Another limitation of volunteer labor on public property is the inability to use herbicides for cut-stump treatments on shrubs like holly, laurel, broom, and European Hawthorn for which manual removal alone is usually ineffective.

Conflicting Priorities

Public parks are multiple use areas. Priorities are established by elected officials and park managers. In Forest Park I found that some of the uses and/or priorities are detrimental to forest restoration.

- Park landscape plans approved by management include landscape beds along forest edges in which "ornamental" non-native plants are installed. Some of these plants, like Vinca and Sweet Woodruff, are shade-tolerant and spread by rhizomes into the adjacent forest.
- Trails are popular with dog walkers who ignore leash laws and let their pets dig and run off trail. In Forest Park almost all of the smaller plants installed near trail edges have disappeared, and I believe it was mostly because of the trampling and digging by dogs.

[25] https://forterra.org/our-work/programs/green-city-partnerships/

- The growing awareness of the harm caused by ivy in our forests has probably gone too far when it results in overclearing and the creation of an unsustainable vicious circle of weeding.

38 Common Native Plants of the Puget Lowlands

Below are 38 native plants, their common names, Latin names, and possible explanations for their Latin names

Trees

Evergreen

- Douglas Fir (Pseudotsuga menziesii) -- false fir of Archibald Menzies
- Western Redcedar (Thuja plicata) -- folded cedar
- Western Hemlock (Tsuga heterophylla) -- mother tree with variable leaves

Deciduous

- Red Alder (Alnus rubra) -- red alder
- Bigleaf Maple (Acer macrophyllum) -- maple with large leaves
- Black Cottonwood (Populus trichocarpa) -- poplar with hairy fruit

Shrubs and Small Trees

Evergreen

- Salal (Gaultheria shallon) -- Jean François Gaultier + the chinook name for the plant as reported by Lewis and Clark
- Low Oregon Grape (Mahonia nervosa) -- nervous plant named in honor of Bernard McMahon, one of the stewards of the plant collections from the Lewis and Clark Expedition
- Tall Oregon Grape (Mahonia aquifolium) -- sharp-leaved plant

- Evergreen Huckleberry (Vaccinium ovatum) -- classical Latin plant with eggs

Deciduous

- Osoberry (Oemleria cerasiformis) -- Augustus Gottlieb Oemler + cherry-shaped
- Beaked Hazelnut (Corylus cornuta) -- Greek hazelnut with horned beak
- Red Huckleberry (Vaccinium parvifolium) -- classical Latin plant with small leaves
- Vine Maple (Acer circinatum) -- Maple with rounded leaves
- Red Elderberry (Sambuca racemosa) -- the wood of the Greek musical instrument with elongated inflorescences
- Salmonberry (Rubus spectabilis) -- specular red flowers and berries
- Thimbleberry (Rubus parviflorus) -- red with small flowers
- Snowberry (Symphoricarpos alba) -- clustered white fruits
- Ocean Spray (Holodiscus discolor) -- plant with different colored upper and lower leave and with an unlobed disc supporting the flowers
- Red Flowering Currant (Rubus sanguineum) -- red with blood red flowers
- Bald Hip (Rosa gymnocarpa) -- rose with bare fruit
- Nootka Rose (Rosa nutkana) -- rose from the Nootka Sound
- Trailing Blackberry (Rubus ursinus) -- red of the bear

Ferns

- Western Sword Fern (Polystichum munitum) -- poly, many; stichos, rows, referring to the regular row of sori on the underside of the fronds; munitum: armed, with teeth
- Lady Fern (Athyrium filix-femina) -- Genus name comes from Greek athyros meaning doorless in reference to the slowly opening hinged indusia (spore covers). Specific epithet comes from Latin filix meaning fern and femina meaning woman as confirmed by the common name of lady fern.
- Licorice Fern (Polypodium glycyrrhiza) -- many high sweet roots

- Deer Fern (Struthiopteris spicant) -- fern with spikes (erect fertile fronds) formerly in the genus Blechnum

Forbs

- Large Leaved Avens (Geum macrophyllum) -- From Latin gaeum, a plant described by Pliny the Elder, with large leaves
- Fragrant Fringecup (Tellima grandiflora) -- The etymological root of the binomial name Tellima is said to be an anagram of Mitella, from which the genus was separated. Mitella is from the Greek diminutive miter, little-miter, referring to the seed pod shape. Grandiflora is derived from the Latin grandis large and flora flower.
- Youth on Age (Tolmiea menzessii) -- The genus was named after the Scottish-Canadian botanist William Fraser Tolmie, while the species name refers to Archibald Menzies, the Scottish naturalist for the Vancouver Expedition (1791–1795).
- Pacific Bleeding Heart (Dicentra formosa) -- Dicentra is Greek for double spurred, and formosa comes from the Latin word formosus meaning beautiful.
- Western Trillium (Trillium ovatum) -- three egg-shaped petals
- Candy Flower (Claytonia sibirica) -- Linnaeus named the genus Claytonia in honor of John Clayton and Siberia
- Western Starflower (Lysimachia latifolia) – The genus is named in honor of Lysimachus, a king of ancient Sicily, who is said to have calmed a mad ox by feeding it a member of the genus + wide leaves
- Foamflower (Tiarella trifoliata) -- tiara with three leaves
- False Lily of the Valley (Miainthemum dilatum) -- The genus name, from the Greek maios (May) and anthemon (flower), refers to time of flowering + extended
- False Solomons Seal (Maianthemum racemosum) – The genus name, from the Greek maios (May) and anthemon (flower), refers to time of flowering + clustered
- Western Sweet-Cicely (Osmorhiza occidentalis) -- Aromatic root of the west

Three Seasons of the Forest Stewards Work Year

In my mind, I divide the forest restoration work year into three seasons, the wet season, growing season, and dry season.

The Wet Season

I think the wet season is the best time to remove the highest priority weeds, the evergreen perennials, the non-native trees, the non-native blackberries, and broom. The ground is moist and it's easier to get the roots out. With most of the leaves gone from the shrubs, it is easier to spot the evergreen weeds.

It feels good to get out in the woods during the wet season. Temperatures in the forties and fifties are optimum for outdoor manual labor. I can work under the canopy of the forest in light rain or drizzle and not even realize its coming down. After a day or two with significant rainfall, the understory remains wet even when the rain has stopped, but if I choose to work despite the sogginess, I know that I have a warm house, dry clothes, and a hot tea at home.

The Growing Season - Controlling Weeds that Spread by Seed

During the growing season, I focus on trying to keep up with the weeds that spread by seed. These plants grow rapidly during the first part of the growing season, then flower and go to seed towards the end of the growing season and into the dry season. Each annual invasive can produce hundreds of seeds, so if I put off starting to remove them it can become harder and harder to eventually bring them under control.

The Dry Season

The amount of rainfall gradually diminishes as the growing season progresses, tapering off into the dry season which can begin as early as June and last well into October. The dry season may be the nicest time to be outdoors, but I don't think it is the best time to weed the forest. After the rains have diminished the soil dries up, and it becomes much harder to remove weeds without leaving the roots in the ground. There are still some jobs to do in the dry season including:

- watering plants,
- continuing to maintain weed breaks,
- making trail improvements in wet areas,
- marking rescue plants to transplant during the wet season, and
- maintaining compost heaps.

Other Resources

Resources – Books

Bradley, Joan, *Bringing Back the Bush – The Bradley Method of Bush Regeneration*, Reed New Holland Publishers, Australia, 2002.

Haskell, David George, *The Forest Unseen: A Years Watch in Nature*, Viking, 2012, A biologist reveals the secret world hidden in a single square meter of forest.

Maser, Chris, *Forest Primeval: The Natural History of an Ancient Forest*, Oregon State University Press, 2001, The author describes the birth and growth of a Pacific Northwest forest over a period of 1,000 years.

Mathews, Daniel, *Cascade-Olympic Natural History, A Trailside Reference*, Second Edition, Raven Editions, Portland Oregon, 1999, The author presents an

informed and fascinating look at many of the common species of Pacific Northwest flora and fauna.

Simard, Suzanne, *Finding the Mother Tree: Discovering the Wisdom of the Forest*, Alfred A. Knopf, 2021, Professor Simard tells her story -- a life and career centered on unlocking the mysteries of the forest and its trees.

Tallamy, Douglas W., *Natures Best Hope*, Timber Press, Portland, Oregon, 2020. An entomologist makes a case for installing native plants in our yards.

Wohlleben, Peter, *The Hidden Life of Trees: What They Feel, How They Communicate – Discoveries from a Secret World*, Greystone Books, 2016, The story of a forester in Germany who gradually discovers things about the forest and the trees around him that he never imagined could be true.

Plant Identification

Jacobson, Arthur Lee, *Wild Plants of Greater Seattle*, 2008 - 2nd ed., The first and only field guide to feature reliable accounts and finely detailed drawings of over 500 Seattle-area plants, in everyday, non-technical language.

Pojar, Jim & MacKinnon, Andy (compilers and editors), *Plants of the Pacific Northwest Coast*, B.C. Ministry of Forests and Lone Pine Publishing, Vancouver, B.C., 2004. This is the plant identification book that is used by many forest stewards in the Pacific Northwest.

Taylor, Ronald J., *Northwest Weeds*, Mountain Press Publishing Company, Missoula, Montana, 1990. A good reference for identifying common invasive plants, especially annuals and biennials.

Invasive Plant Control

Chace, Teri Dunn, *How to Eradicate Invasive Plants*, Timber Press, Portland, Oregon, 2013.

Kaufman, Sylvan, and Kaufman, Wallace, *Invasive Plants, Guide to Identification and the Impacts and Control of Common North American Species*. 3rd edition. Stackpole Books, Mechanicsburg, PA 2023.

Lexa, Rebecca, *Common Invasive Plants of North America: Identification and Control*, 2022.

Gardening with Natives

Currin, Kristin and Merritt, Andrew, *The Pacific Northwest Native Plant Primer: 225 Plants for an Earth-Friendly Garden Paperback*, Timber Press, 2023.

Kruckeberg, Arthur, *Gardening with Native Plants of the Pacific Northwest*, first published in 1982, and updated in 1996 and 2019.

Leigh, Michael, *Grow Your Own Native Landscape*, WSU Extension, 2013. May be hard to find a copy of this, but it has details on how to propagate most of the native plants in the Pacific Northwest. However, the Green Cities Native Plant Propagation Field Guide, Forterra, 2015, is largely based on the guide by Michael Leigh.

Restoration of Other Ecosystems

Crosby, Cindy, *The Tallgrass Prairie; An Introduction*, Northwestern University Press, 2017.

Putz, Frances, *Finding Home in the Sandy Lands of the South: A Naturalists Journey in Florida*, 2014 by Cypress Highlands Press of Florida. A fascinating and at times humorous book about the authors experiences restoring a patch of Florida woodland.

Strickler, Dale, *The Complete Guide to Restoring Your Soil*, Storey Publishing, LLC, 2021.

Resources on the Web

Invasive Plants

Organizations

King County Noxious Weeds – "The noxious weed control program works throughout King County to prevent and reduce the economic, environmental, and

social impacts of noxious weeds in King County, Washington. Our focus is to provide education and technical assistance to landowners and public agencies to help everyone find the best control options for noxious weeds on each site and to reduce the overall impact of noxious weeds throughout the county." See Also King Counties Noxious Weed Blog.

Washington State Noxious Weed Control Board – "The Noxious Weed Control Board advises the Washington State Department of Agriculture (WSDA) about noxious weed control in Washington State. The Board maintains the state's official list of noxious weeds that landowners may be required to control. This list is established in the Washington Administrative Code, or WAC 16-750. The listing process, the schedule for adding a plant to the Noxious Weed list, is in WAC 16-750-022."

Oregon Noxious Weed Profiles—"The noxious weed policy and classification system includes Oregon's official noxious weed priority list as designated by the Oregon State Weed Board (OSWB)."

CABI Invasives Blog, Articles from around the globe on the battle against invasives from the Center for Agricultural Bioscience International.

Articles / Documents

The Bradley Method – "The Bradleys were intuitive pioneers in the techniques that have since been shown to produce superior ecological outcomes in Australian bushland restoration. Simply put, if you remove the weeds, the bush comes back by itself."

Controlling Himalayan Blackberry (Rubus armeniacus [R. discolor, R. procerus]) in the Pacific Northwest from a multi-agency collaboration in 2002.

Human activity facilitates invasive plants colonization in Mediterranean ecosystems, January 12, 2024, University of Barcelona, "Some invasive plants can form persistent banks of seeds that remain under the soil for years, and this makes their eradication practically impossible. Over time, this invisible population

of large quantities of living, buried plants -- in seed form -- will reoccupy ecosystems and displace the typical flora of the natural environment."

Plant nurseries are exacerbating the climate-driven spread of 80% of invasive species, December 5, 2023, University of Massachusetts Amherst, "Researchers have provided detailed maps of how 144 common invasive plants species will react to 2° Celsius of climate change in the eastern U.S., as well as the role that garden centers currently play in seeding future invasions."

Tackling unintended consequences of invasive species removal – timing may be everything, BES Blog, November 1, 2023, "late removals in autumn were less susceptible to secondary invasion than early summer removals."

Urban Forest Restoration

Organizations

Green Cities: Good Health – "Metro nature - including trees, parks, gardens, and natural areas - enhance quality of life in cities and towns. The experience of nature improves human health and well-being in many ways. Nearly 40 years of scientific studies tell us how."

King County Conservation District – "At King Conservation District, were all about better ground. Better ground means taking important stewardship actions at home and in our communities to create healthy soil and water, to provide healthy food, and to conserve land, water, forests, wildlife, and related natural resources. And you don't have to go at it alone. You have a partner, your local conservation district."

Natural Areas Conservancy – "The Natural Areas Conservancy's Forests in Cities program was created in 2019 to promote and advance healthy forested natural areas in cities across America through science, management, partnerships, and communications."

Trees for Seattle – "Thousands of volunteer hours have gone into removing invasive species from parks through the Green Seattle Partnership, however until

the worst invaders are eliminated on residential property, the seed source will continue to infest parks."

WSU Extension Forestry, Puget Sound Region – "We are a locally-based Washington State University faculty and staff dedicated to providing objective, research-based education and resources for owners of forested and wooded property in the Puget Sound Region. We offer a variety of forestry classes, publications, and online resources."

Urban and Community Forestry, Washington State Department of Natural Resources.

Articles / Documents

The Story of My Backyard Woodland, Martha LaFollette Miller, 2020 – "When I moved from North Carolina . . . I had no idea at that time that my woods would come to occupy such an important place in my life, eventually becoming a full-fledged forest restoration project."

Native Plants

Organizations

Burke Herbarium Image Collection – Comprehensive collection of plants found in the Pacific Northwest. Helps in determining which species are native and which are non-native.

iNaturalist –" Contribute to Science by sharing photos of the plants in your backyard. Every observation can contribute to biodiversity science, from the rarest butterfly to the most common backyard weed. We share your findings with scientific data repositories like the Global Biodiversity Information Facility to help scientists find and use your data. All you have to do is observe."

Jepson eFlora, University of California, Berkeley. The only online source I've found with detailed botanical keys to identify plants.

Native Plants PNW – "An encyclopedia of the cultural and natural history of native plants of the Pacific northwest."

Washington Native Plant Society -- Mission Statement: “To promote the appreciation and conservation of Washingtons native plants and their habitats through study, education, and advocacy.”

Fire Effects Information System (FEIS) Database – “The Fire Effects Information System is an online collection of reviews of the scientific literature about fire effects on plants and animals and about fire regimes of plant communities in the United States.” NOTE: The information on native plants is extensive, going well beyond simply the effects of fire, and well worth checking out.

Native Plant Network – “Our goal is to provide technical and practical information on the growing and planting of North American (Canada, US, and Mexico) native plants for restoration, conservation, reforestation, landscaping, roadsides, and so on.”

Gardening with Natives

Real Gardens Grow Natives, Eileen M. Stark, “When we garden with natives were doing crucial conservation work, and doing ourselves a favor as well, because native plants are low maintenance, often drought tolerant, and easily compete with the beauty of exotic plants.”

Designing with Native Plants, Curtis Adams, “Designing with native plants is not that different from designing with any other plant palette. You still use basic design concepts, using the shapes, colors, and textures of plants to create rhythm and flow in the landscape. What is different is that your selection of plants is more focused on native species, ideally ones that are regionally or locally native.”

Washington Native Plant Society, Gardening with Natives, “Many native plants are attractive as ornamentals and adapt easily to garden conditions in the Pacific Northwest.”

Articles / Documents

The story of Coastal Douglas-fir forests: All about fungi. “There is a mysterious world of diversity within the world of fungi; in the widely

understudied CDF zone this mystery runs deeper than in many other regions of BC." Raincoast Conservation Foundation, November 20, 2023.

The Forest in the City, Emma Bjornsrud, 2020 -- Researchers are looking for answers to the mysterious die-off of sword ferns in Seattle's Seward Park.

Forest Restoration Methods and Case Studies

Articles / Documents

Do tree-planting campaigns follow best practices for successful forest restoration?, January 29, 2024, University of California - Santa Cruz, "New research reviewed publicly available information for 99 different organizations that coordinate large-scale tree-planting programs around the globe to see if these organizations seemed to be applying best practices for successful reforestation."

Forest Regeneration under Scotch Broom Control, Phase I Progress. Technical Report submitted to Joint Base Lewis-McChord and The Nature Conservancy, "In another related study in March 2009, we planted Douglas fir seedlings along the edges of the same clearcuts described above, and we found higher survival along those edges than in the center of the clearcuts."

Cost of planting, protecting trees to fight climate change could jump, North Carolina State University, Science Daily, 2020 – "Planting trees and preventing deforestation are considered key climate change mitigation strategies, but a new analysis finds the cost of preserving and planting trees to hit certain global emissions reductions targets could accelerate quickly."

Dramatic long-term restoration of an oak woodland due to multiple, sustained management treatments, Karen Glennemeier, Stephen Packard, Greg Spyreas, 2020 – "We measured 34 years of plant community change in a degraded oak woodland undergoing ecological management. Management included regular prescribed fire, control of white-tailed deer populations, repeated sowing of a diverse seed mix, and removal of invasive plants. We tracked change with several conservation metrics."

Elizabeth Waddington, How to Restore Native Forests on a Small Scale, Reforestation needs to happen globally—and that starts in your own backyard. April 12, 2022.

Plans to plant billions of trees threatened by massive undersupply of seedlings, "US efforts to fight climate change with tree planting at risk from lack of stock and species diversity, new research shows." July 31, 2023, University of Vermont.

Secondary forests more sensitive to drought than primary forests, July 31, 2023, Lund University, "The dry summer of 2018 hit Swedish forests hard -- and hardest affected were the managed secondary forests."

Grow a 100-Year-Old Forest in Your Backyard in Just 10 Years, Derek Markham, Updated September 09, 2020, " Rather than the typical suburban lawn, a far better option is to mimic the way that forests grow in nature, with plenty of diversity and an abundance of soil fertility, with multiple layers of plants that serve to nurture and protect each other. Thats the approach that Shubhendu Sharma takes with his mini-forests, which allows him to create ultra-dense, biodiverse mini-forests of native species in urban areas that end up being maintenance-free and self-sustaining."

Could Akira Miyawaki's 50-Year-Old Innovation Help Promote Biodiversity and Reduce The Risk Of Climate Change?, Kamala Thiagarajan, June 11, 2020 – "It can take hundreds of years for a forest to rejuvenate on its own, but we don't have that kind of time. Here, were looking at a methodology that converts a barren patch of land into a thriving forest in a span of three years."

https://www.americanforests.org/af-news/policy-platform-to-revive-national-forests/ "New platform charts ambitious, bipartisan course to revive, restore America's national forests. ecologically appropriate, climate-informed reforestation, management will protect clean water, create jobs, address climate crisis."

Brazil scientists map forest regrowth keeping Amazon from collapse: Study Shanna Hanbury, 2020, Mongabay Series – "A Brazil-wide map of secondary

forests over the past 33 years can help regrow Amazon rainforest, stop fires, and curb carbon emissions."

Restoring forests and landscapes: the key to a sustainable future, The Global Partnership on Forest and Landscape Restoration, 2018 – "Showcasing the success of large-scale restoration of landscapes burdened by natural or man-made disasters. The unprecedented study chronicles the results of long-term and large-scale research and outlines several case studies in forest and landscape restoration. The report bears a positive message, presenting a variety of time-proven opportunities to bring infertile land back to life."

Asher, Claire, New Tree Tech: Data-driven reforestation methods match trees to habitats, Mongabay 11 July 2023.

Ecosystem Science

Organizations

Mongabay: News and Information from Natures Frontline, Rainforests, Oceans, Animals, Environment, Business, Solutions, Articles.

ENSIA, Published at the University of Minnesota's Institute on the Environment, Ensia is a solutions-focused nonprofit media outlet reporting on our changing planet.

FunctionalEcologists.com is the official blog of Functional Ecology, a journal of the British Ecological Society. We explore the stories and the people behind the published research.

Journal of Ecology, The Blog, British Ecological Society.

OIKOS, Advancing ecology, Published By The Nordic Society Oikos.

Raincoast Conservation Foundation, Raincoast is a team of conservationists and scientists empowered by our research to protect the lands, waters, and wildlife of coastal British Columbia. We use rigorous, peer-reviewed science and community engagement to further our conservation objectives.

The Narwhal, The Narwhal is a Canadian investigative online magazine that focuses on environmental issues.

Articles / Documents

Forest can adapt to climate change, but not quickly enough, -- Science Daily – "While most forests in the U.S. have the potential to adapt to hotter, dryer conditions, they aren't changing quickly enough to avoid the impending stress." July 10, 2023, University of California - Santa Barbara.

How weather patterns will change in the future, September 25, 2023, Portland State University, "In a warming Pacific Northwest, summers are getting hotter and winters less cold, but the atmospheric patterns that influence the weather aren't necessarily expected to become stronger or more frequent by the end of the century, according to a new study."

Trees in wetter regions more sensitive to drought, December 13, 2023, University of California - Santa Barbara -- "Scientists just discovered that globally, trees growing in wetter regions are more sensitive to drought."

Trees struggle to breathe as climate warms, January 31, 2024, Penn State – "Trees are struggling to sequester heat-trapping carbon dioxide (CO2) in warmer, drier climates, meaning that they may no longer serve as a solution for offsetting humanity's carbon footprint as the planet continues to warm, according to a new study."

Western Cascades landscapes in Oregon historically burned more often than previously thought, September 28, 2023, Oregon State University – "Forests on the west slope of Oregon's Cascade Range experienced fire much more often between 1500 and 1895 than had been previously thought."

Climate change threatens global forest carbon sequestration, study finds, January 16, 2024, University of Florida – "Climate change is causing Western U.S. forests to be less effective carbon sinks, even as it boosts the productivity of forests in the Eastern U.S., according to new research."

Big old trees grow faster, making them vital carbon absorbers, The Conversation, Bill Laurance, David Lindenmayer, William Morris, 2014 – "Large, older trees have been found to grow faster and absorb carbon dioxide more rapidly than younger, smaller trees, despite the previous view that trees growth slowed as they developed."

How Non-Native Plants Are Contributing to a Global Insect Decline, Janet Marinelli, 2020 – "The impact of introduced plants on native biodiversity has emerged as a hot-button issue in ecology. But recent research provides new evidence that the displacement of native plant communities is a key cause of a collapse in insect populations and is affecting birds as well."

Justin Catanoso, What we need to protect and why: 20-year Amazon research hints at fate of tropics, Mongabay Series, 24 July 2023.

New IPBES report delivers wakeup call on the growing global threats of invasive species, September 4, 2023, BES Press Office – "Global efforts to halt biodiversity loss by 2030 could be jeopardized by rising cases of invasive species. A new report from IPBES reveals the overwhelmingly negative impacts biological invasions have on people and nature, but shines hope on a turning tide for better, more collaborative, management."

Most species are rare, but not very rare, September 4, 2023, German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig – "More than 100 years of observations in nature have revealed a universal pattern of species abundances: Most species are rare but not very rare, and only a few species are very common."

How climate warming could disrupt a deep-rooted relationship, September 21, 2023, Syracuse University – "Trees depend on fungi for their well-being. As climate change and global warming cause higher temperatures and amplified drought, little is known about how these important fungi will respond. To investigate this issue, a research team conducted a climate change experiment where they exposed boreal and temperate tree species to warming and drought treatments to better understand how fungi and their tree hosts respond to

environmental changes. Their findings revealed that the combined effects of warming and water stress will likely result in major disturbances of ectomycorrhizal networks and may harm forest resilience and function."

Kaber, Janek, Why unmanaged forests are crucial for understanding long-term forest dynamics, adminjournalofecologyorg, September 14, 2023. – "Analysis of tree inventory data with over 1 million tree measurements from more than 6000 forest inventory plots in 299 forest reserves in Europe from records going back as far as a century found that trees appear to find more shelter and support from their peers under low-temperature stress compared to drought conditions. Under drought conditions, competition was dominant and larger trees suppressed the growth of smaller trees."

Soil microbes help plants cope with drought, but not how scientists thought, University of Illinois College of Agricultural, Consumer and Environmental Sciences, July 25, 2023 – "In a multi-generation experiment, researchers found microbes helped plants cope with drought, but not in response to plants cries for help. Instead, the environment itself selected for drought-tolerant microbes. And while those hardy microbes were doing their thing, they just happened to make plants more drought-tolerant, too."

Research offers a reason why diversity in plant species causes higher farming yield, solving a bit of a mystery, December 20, 2023, University of Kansas – "A study appearing in Nature Communications based on field and greenhouse experiments at the University of Kansas shows how a boost in agricultural yield comes from planting diverse crops rather than just one plant species: Soil pathogens harmful to plants have a harder time thriving."

Over half of western United States most abundant tree species in decline, Hunter Stanke, Andrew O. Finley, Grant M. Domke, Aaron S. Weed & David W. MacFarlane, Nature Communications, volume 12, Article number: 451 (2021).

Can palm oil be grown sustainably? Agroforestry research suggests it can, and without chemicals – "Miccolis told Mongabay that SAF Dendê research on the participating farms (some of which are just six kilometers from the conventional

oil palm operation at the heart of Mongabay's investigation) shows that agroforestry systems can produce high oil palm yields and food while also generating profits and environmental services, including mitigating the effects of climate change."

Carbon-capture tree plantations threaten tropical biodiversity for little gain, ecologists say, October 3, 2023, Cell Press – "The increasingly urgent climate crisis has led to a boom in commercial tree plantations in an attempt to offset excess carbon emissions. However, authors argue that these carbon-offset plantations might come with costs for biodiversity and other ecosystem functions. Instead, the authors say we should prioritize conserving and restoring intact ecosystems."

Scientists, philosophers identify natures missing evolutionary law, October 16, 2023, Carnegie Science Earth and Planets Laboratory – "A new article describes a missing law of nature, recognizing for the first time an important norm within the natural worlds workings. In essence, the new law states that complex natural systems evolve to states of greater patterning, diversity, and complexity. In other words, evolution is not limited to life on Earth, it also occurs in other massively complex systems, from planets and stars to atoms, minerals, and more."

Climate change damaging North Americas largest temperate rainforest, harming salmon – "New research found that a remote region of North America's largest temperate rainforest is experiencing changes to its ecosystem due to climate change."

In symbiosis: Plants control the genetics of microbes – "Researchers have discovered that plants may be able to control the genetics of their intimate root symbionts - the organism with which they live in symbiosis - thereby providing a better understanding of their growth. In addition to having a significant impact on all terrestrial ecosystems, their discovery may lead to improved eco-friendly agricultural applications."

Study challenges Ecology's Field of Dreams Hypothesis -- Restoring habitat requires much more than just the right plants – "A new study challenges the Field

of Dreams hypothesis in restoration ecology, which predicts that restoring plant biodiversity will lead to recovery of animal biodiversity. The study of restored tallgrass prairie found the effects of management strategies (specifically controlled burns and bison reintroduction) on animal communities were six times stronger on average than the effects of plant biodiversity."

Symbiotic relationship between California oaks and mutualist fungi as a buffer for climate change, An Bui, University of California - Santa Barbara, 2020 -- "Happy families are all alike; each unhappy family is unhappy in its own way. So goes the first line of Leo Tolstoy's *Anna Karenina.* Little did the Russian novelist know his famous opening line would one day be used to describe microbial communities, their health, and their relationships to their hosts."

Index reveals integrity issues for many of the world's forests, James Watson, University of Queensland, 2020 – "Only 40 per cent of forests are considered to have high ecological integrity, according to a new global measure, the Forest Landscape Integrity Index. The Index was created by 47 forest and conservation experts from across the world."

Evolving ecosystems can change more than previously thought, Randal S. Olson, 2013 – "Recent research suggests that ecosystems may not be as fixed as previously believed. Ecological communities may look like fixed points only because new species don't evolve on timescales that are easily observed in our lifetime."

Some Amazon rainforest regions more resistant to climate change than previously thought -- ScienceDaily – "A new observational study demonstrates that increasing air dryness does not reduce photosynthesis in certain very wet regions of the Amazon rainforest, contradicting Earth System Models that show the opposite."

Small urban greening projects can dramatically increase number of insect species in cities, British Ecological Society, August 22, 2023 – "Just three years into their project, University of Melbourne researchers managed to increase the number of insect species found in an urban area by seven times."

Biodiversity protects against invasions of non-native tree species, August 23, 2023, ETH Zurich – "Researchers combined human and ecological factors to analyze the global scale of non-native tree species invasions. Human activity in hotspots of global trade, such as maritime ports, is linked to an increased likelihood of non-native tree species invasions. However, a high diversity of native tree species can help to curb the intensity of such invasions."

An Investigation of the Mycorrhiza of Douglas-fir Seedlings, Gertrude Draper Pentland, 1959, University of British Columbia – See page 7 of this article for a list of likely mycorrhizae associated with Douglas Fir in the PNW.

How to Help Reverse Insect Decline, Florida Museum, Natalie van Hoose, January 11, 2021 – "Entomologist Akito Kawahara's message is straightforward: We can't live without insects. They're in trouble. And there something all of us can do to help."

Carbon storage in harvested wood products - Residential structures provide secure carbon storage through 2070 and beyond, August 11, 2022, USDA Forest Service - Southern Research Station – "Wood is infinitely useful. Critically important for our changing climate, trees store carbon. When trees are harvested for wood products like lumber, some of that carbon continues to be stored. Even after a wood product is discarded, it keeps storing carbon."

Interesting People

Bringing Forest Restoration to Life, How Mayra Flores is connecting people to help Brazil's Atlantic Forest, Lorin Hancock, 2021 – "Mayra Flores was an admirer of Copaíba—a well-regarded forest restoration organization in Brazil—long before she joined the team."

The Biological Flora of Tilia platyphyllos: a landmark account, Rhosanna Jenkins, 2020 – "At the age of 92, Professor C.D. (Donald) Pigott must be by far the most senior contributor to the Biological Flora of the British Isles – and one of the most distinguished."

The Social Life of Forests, Ferris Jabr, 2020 – "As a child, Suzanne Simard often roamed Canada's old-growth forests with her siblings, building forts from fallen branches, foraging mushrooms and huckleberries and occasionally eating handfuls of dirt (she liked the taste)."

Soil and Erosion

The forgotten environmental crisis: how 20th century settler writers foreshadowed the Anthropocene, Philip Steer, 2020 – "Erosion was first brought to the attention of the western world in the 19th century by the American diplomat and polymath George Perkins Marsh. In *Man and Nature: Or, Physical Geography as Modified by Human Action* (1869), he argued that much of the Old World of the Mediterranean had been transformed into desert by deforestation. He warned that European colonization threatened a similar fate for other parts of the world. These concerns came back with a vengeance in the 1930s, when the Dust Bowl in the United States began to raise alarm about the long-term security of global food supply."

Western Washington Forests

Legacy Forest Defense Coalition, "The Legacy Forest Defense Coalition is a registered 501(c)(3) nonprofit organization that is dedicated to serving a forum and resource for people who care about the conservation of mature and old growth forests on DNR managed land in Western Washington."

The Center for Responsible Forestry: Preserving Legacy Forests in WA for All, "The mission of CRF is to achieve the permanent protection of the last remaining legacy forests in Western Washington by working with impacted local communities and state policy makers. CRF also works in partnership with other conservation organizations to accelerate the adoption of state forest policy and practices grounded in forest ecology."

Volunteer Forest Restoration Opportunities

Earthcorps – "EarthCorps envisions a world where people and nature thrive together. At EarthCorps, we believe in the power of people to tackle the most

pressing challenges facing our planet. EarthCorps brings together passionate and hardworking young adults from the US and countries around the world, for a year-long leadership training program in Seattle, Washington."

Green Seattle Partnership – "The Green Seattle Partnership is a collaboration between the City of Seattle, Forterra, community groups and non-profits, businesses, schools, and thousands of volunteers working together to restore and actively maintain the City's forested parklands."

Snohomish County Healthy Forest Project "Through this program, the Healthy Forest Project will partner with local communities to recruit, train, and support volunteer stewards to lead forest restoration projects in priority parks."

Climate and Weather

Past Weather by Zip Code (NOAA) -- I've had a hard time finding a good source for monthly precipitation summaries for my area. This one is very slow and clumsy, but if you persevere you can make it work. Follow the instructions under the tab "How-To." After going through the how-to steps, it creates a file that you add to your cart. When you checkout it gives you an email where the file is sent after it is processed.

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