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Sustainable Management Practices of Under Story "Brush" Species in Southern Coastal Oregon

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Abstract
The coastal forests of Oregon are among the most biologically productive regions in the world. This high level of forest productivity enabled a large timber industry to grow in the region, and supply the area with its economic and cultural base. The economy experienced a crisis during the 1980s when the logging industry began closing down mills and laying people off. One factor which contributed to the loss of jobs was the loss of old growth trees due to decades of harvesting. As loggers tried to harvest the remaining old growth trees, environmentalist organized and successfully slowed down, or halted their efforts. While the attitudes of the past may have been one of either jobs or the environments, today there are many who are trying to find a balance and integrate the two through a sustainable forest management philosophy known as eco-forestry. Two challenges to this practice are how to sustainably suppress competitive under story "brush" species, and how to manage riparian zones. This capstone addresses both of these issues. The past and present uses of brush species including, the floral and nursery industry, as food for agricultural animals, medicinal and aboriginal uses are reviewed. A survey for economic brush species in riparian zones under different forestry management practices is discussed.

The findings indicate that the eco-forested site had a higher number of economic brush species then sites under different management practices, including preserved sites. The logging site which had trees harvested in its riparian zone had a different assemblage of species then either other logging or preserved sites. There was no correlation between the ground coverage of one brush species to another, but a decrease in the ground coverage of Rubus species may lead to an increase in overall biodiversity. Stream bank instability was found to be greatest in sites of industrial logging. The eco-forested sites conversely had the most stable stream banks of any site. How to manage riparian zones for economic brush species and the need for a program which certifies small, independent, sustainable, no-climax based, forestry practices are discussed.

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SUSTAINABLE MANAGEMENT PRACTICES OF UNDER STORY "BRUSH" SPECIES IN SOUTHERN COASTAL OREGON

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ABSTRACT

The coastal forests of Oregon are among the most biologically productive regions in the world. This high level of forest productivity enabled a large timber industry to grow in the region, and supply the area with its economic and cultural base. The economy experienced a crisis during the 1980s when the logging industry began closing down mills and laying people off. One factor which contributed to the loss of jobs was the loss of old growth trees due to decades of harvesting. As loggers tried to harvest the remaining old growth trees, environmentalist organized and successfully slowed down, or halted their efforts. While the attitudes of the past may have been one of either jobs or the environments, today there are many who are trying to find a balance and integrate the two through a sustainable forest management philosophy known as eco-forestry. Two challenges to this practice are how to sustainably suppress competitive under story "brush" species, and how to manage riparian zones. This capstone addresses both of these issues. The past and present uses of brush species including, the floral and nursery industry, as food for agricultural animals, medicinal and aboriginal uses are reviewed. A survey for economic brush species in riparian zones under different forestry management practices is discussed.

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instability was found to be greatest in sites of industrial logging. The eco-forested sites conversely had the most stable stream banks of any site. How to manage riparian zones for economic brush species and the need for a program which certifies small, independent, sustainable, no-climax based, forestry practices are discussed.

INTRODUCTION

The coastal forests of Oregon are among the most biologically productive regions in the world (Spies et al. 2002). Though ecologically important the biological integrity of this area is constantly in debate. Much of this debate centers on the extractive timber industry, which supplies the area with much of its economic and cultural base. After decades of timber harvesting, much of the old growth forest is gone. This has led to environmental policy aimed at protecting the remaining old growth forest, including policy specific to forested riparian zones. Many local residents, environmentalist, scientists, and outdoorsmen, however, worry that current forestry practices are not strict enough to protect the biological sustainability of the forest. Many argue that having an extractive industry as a base is also economically problematic, for it can lead to unstable cycles of boom and bust. Many further argue that economic stability and ecological integrity does not have to be mutually exclusive.

The purpose of this paper is to analyze how local residents are trying to create, or maintain, the ecological integrity of the forest, while still trying to support themselves economically from forest products, particularly under story or "brush" species. This study first gives an overview of economic and environmental issues in the region. These include an ethno-botanical history of common plants found in riparian zones; and the importance of riparian zones to stream ecology. I also address issues of forest certification. I further report on the harvesting of native plants for the nursery industry, the floral greens industry, and animal browsing as a form of brush control. I present findings from transect surveying of economic, under story, plant species along 1st order

streams in the region. The paper ends with a discussion of management options for small independent foresters, and the impact of such management practices on riparian ecosystems.

STUDY AREA

Geography

This project researched the Cape Blanco area of Oregon's south coastal range (Fig. 1). The Cape Blanco area includes southern Coos and northern Curry counties. It extends from Port Orford northward to Bandon State park, and extends inward to the headwaters of the South Fork of Coquille River adjacent to the Wild Rough Wilderness. Elevations in the area rarely exceed 2,500 feet. The terrain is rough and dissected by numerous streams and rivers. The maritime climate is moderate with mild, dry, summers. Winters are cool and wet, with wind gusts that can reach 100mph. Annual precipitation along the coast averages 60-80 inches but can exceed 100 inches in some inland areas (Oregon Biodiversity Project 1998).

This region has a high bio-diversity value for both aquatic and terrestrial species. Habitats of high biological priority include native sand dune systems, estuaries, headlands, and old growth conifer forests. The area provides habitat for more then 25 species classified as either vulnerable, imperiled, or critically imperiled, including fish, amphibians, birds, reptiles, and plants (Oregon Natural Heritage Information Center 2004, Oregon Biodiversity Project 1998). It also contains core areas for Coho salmon (*Oncorhynchus kisutch* ssp.), fall Chinook (*Oncorhynchus tshawytscha*), and winter steelhead (*Oncorhynchus Mykiss* ssp.). Rare vegetation communities include Port Orford cedar (*Hamaecyparis lawsoniana*) forests and "pygmy shore pine (*Pinus contorta*)" forests (Oregon Biodiversity Project 1998).

Figure 2 Location of the North fork of Hubbard Creek

Forest Ecology

Although most of the region's old growth forest has been eliminated by over a century of timber harvesting and a number of large fires, the distributions of major forest vegetation types has not changed significantly over the past century (Oregon Biodiversity Project 1998). Two major forest types dominate the costal range Sitka Spruce (*Pecea Sitchensis*) and Western Hemlock (*Tsuga Heterophylla*) forests. Sitka spruce forests still dominate the coastal forests. These typically occur in a narrow zone that is only a few miles wide, except in some area where it also extends up river valleys. These forests are considered to occur in the mildest climate of the Pacific Northwest forest types. These

forests receive between 75-120 inches of precipitation a year, frequent fogs in the summer, and mild temperatures year-round.

Mature Sitka spruce forests are often co-dominated by western hemlock, and western red cedar (*Thuja plicata*). Douglas-fir (*Pseudotsuga menziesii*) and true firs (*Abies* spp.) are found as secondary species (Agee 1993). Port Orford-cedar (*Chamaecyparis lawsoniana*) is a unique common co-dominate species of secondary forests in this area. Red alder (*Alnus rubra*) is also often dominate in disturbed areas. Inland from the Sitka spruce belt is the Western Hemlock zone; this is the most extensive vegetation zone in western Oregon. This area has a mild, maritime climate, with greater extremes of both moisture and temperature then the adjacent Sitka spruce forests. These forests are quiet varied in vegetative composition but have western hemlock as their common late successional dominate species. Since the time of European settlement, Douglas-fir has been dominant in the Western Hemlock zone due to a long history of fire disturbance (Agee 1993). Douglas-fir plantations and second growth forests currently dominate the Western Hemlock zone (Oregon Biodiversity Project 1998). Red alder, big leaf maple (Acer marophyllum), and Douglas fir co-dominate more then 20 percent of the eco-region. They are particularly common in areas of disturbance, such as past sites of timber harvesting.

Although the distribution of vegetation types has not changed dramatically over the past century, the loss of old growth forests has had a profound impact on biological diversity. Old growth forests currently account for 6 percent of the total landscape in Oregon's coastal range (Oregon Biodiversity Project 1998). Most of this old growth forest is found on federal land. It is also highly fragmented in terms of both habitat value

and management. The current management plan for this federal land places most of the remaining old-growth forest off limits to logging. A significant portion of the remaining coastal federal land is intended to return to late successional forest. Three fourths of the region's coastal forests, however, are either owned by the state or by private owners. Most private forestlands are currently managed on relatively short timber rotations. This hinders development of late successional forest habitats over large portions of the eco-region.

Forest Productivity

The above ground net primary productivity of Oregon's coastal forests is higher then most forests of the world, including many tropical forests (Spies. et al. 2002). The Hemlock-spruce forests of the Oregon coast can produce 15 metric tones of aboveground biomass per hectare per year (Gholz 1982). All of this productivity is not only found in tree biomass. In some stands production by shrubs, herbs, and mosses can be as much as 17 percent of the total net aboveground productivity (Long 1982).

The most common indicator of potential productivity used in forest management is the forester's measure: site index or site quality, which is defined as the total height of a tree at either 50 or 100 years (Spies 2002). On this basis the Coast Range is quiet productive. Much of the coast range is categorized as site quality II or higher for Douglas fir (more then 170 feet at 100 years). Oregon and Washington's coastal forests contain 7 percent of the forestland in the United States but 21 percent of the nation's highest productive lands. These forests are capable of producing 120+ cubic feet of timber, per

acre, per year, of Mean Annual Increment (MAI). The coastal forests of the Cape Blanco area have an average MAI potential of 100 cubic feet, per acre, per year (Spies 2002).

This high rate of tree growth in coastal forests means that large trees, which are important components of forest and stream habitat, can grow faster than in any other region in the Pacific Northwest. Trees in the coastal range can reach 170 feet, the height at which many characteristics of old growth forest habitat begin to develop, in 70-100 years (Spies 2002). In comparison, the same tree in the Cascades may take over 200 years to reach the same height. Similarly large diameter trees (24 inches and up) can grow in as little as 50 years on the coast. The same species would take over 100 years to reach the same diameter in the Cascades.

Climate plays a major role in the high productivity of the region because tree growth is to a large degree determined by the constraints on growth set by climatic extremes, such as freezing temperatures and drought (Spies 2002). Freezing temperatures, drought, and high vapor pressure deficits cause the plants stomata to close, which reduces the plant's ability to photosynthesize and fix carbon in its tissues. Climatic constraints on the plants ability to photosynthesize are lower in the coast range then in other areas of Oregon. For example in some areas of the north coast, soil drought, freezing temperature, and vapor pressure deficit reduce the annual capture of Photosynthetic Active Radiation (PAR) by 8 percent of its maximum potential (Runyon et al. 1994). However where colder winters and seasonal drought limit the time that plants can photosynthesize, PAR is reduced by 13 to 42 percent in the western Cascades, and in the eastern Cascades PAR can be reduced by more then 69 percent.

Socio-Economic History

Environmental issues

Because of this high biological productivity and historic abundance of old growth forest, the timber industry grew in the region. From the 1930's onward this area became the nation's largest producer of softwood timber and softwood products (Prudham 2005). As a consequence timber became central in its economic development and cultural identity. By the mid 1960's 45% of Oregon manufacturing workers were wood product employees, and comprised 15% of the states total workforce. Most of the timber that supplied this workforce was from the regions federal lands.

The laws governing the extraction of timber from federal forests changed in early 1990's. The change in policy started in the early 1980's when organic farmers in areas close to the National forests in Oregon began getting sick (Egan 1990). Residents for years had been drinking out of the streams believing them to the cleanest in the world. Suddenly the residents were complaining of headaches, blackouts, and coughing spells. Seasonal forest workers also were developing cancer. Doctors blamed these conditions on exposure to the herbicide 2, 4, D. This herbicide had been recently introduced by the USDA Forest Service as a fast efficient way to destroy unwanted brush. This pesticide was also landing on berry bushes, poisoning berry pickers, and trickling into the streams used by organic farmers. When residents asked the government why they were spraying defoliant, and why was the brush unwanted, the government explained that it was important to defoliate because brush competed for nutrients and slowed the growth of trees planted for commercial harvesting. This only led to further questions about the Forest Service' management practices. Why were the USDA Forest Service managing

public forests with cancer causing chemicals, building costly roads, and planting monoculture tree stands for private industry? Demonstrations quickly sprung up around timber sales and quickly progressed to tree sitting, tree spiking, and other forms of direct action throughout the sate.

During the 1980's environmental activism in the Cape Blanco area was not as radical as in other parts of the state. Instead of spiking trees, many activists joined the Kalmiopsis Audubon Society and used the resources and clout of the organization to promote change. Through letter writing and political pressure they were able to place injunctions against many timber sales from the Siskiyou National Forest. These protected forests then came under attack in 1989 when Section 318 of the 1990 Interior Appropriations Act (locally nicked named the "rider from hell") overturned these injunctions (Environmental review 1996). One of the stipulations of this rider was that it required each National forest and Bureau of Land Management district to appoint a citizens' timber sale review panel to make recommendations about which sales should go forward (Durbin 1996). The Kalmiopsis Audubon Society was appointed as the citizen's review panel for the area and took on the task of deciding which areas of the Siskiyou would be protected.

Environmentalist gained a considerable advantage in the battle to save old growth on June 23 1990 when the U.S. Fish and Wildlife Service added the Northern Spotted Owl (*Strix occidentalis caurina*) to the federal list of threatened species. The owl's listing set off a chain of legal events which blocked logging and timber sales from federal land which housed the spotted owl. In 1992 the Marbled Murrelet (*Brachyramphus marmoratus*) also came under the Endangered Species Act (U.S Fish and Wildlife

Service 1992). This bird was known to inhabit areas in Coos and Curry counties. Environmentalists in the area began a monitoring program to document the habitat of the Marbled Murrelet. Using the same legal procedures that environmentalist in other areas were using to protect the spotted owl's habitat, they were now able to stop logging to protect more forest for the Marbled Murrelet.

Keeping his word on his campaign promise to deal with the old growth issue President Clinton presided over the 1993 Northwest Forest Conference in Portland Oregon (Prudham 2005). This controversial summit produced a plan aimed at protecting old growth and late successional forest. This plan called for the reduction in annual timber sale quantities on federal land within Oregon, Washington, and California by roughly 75% of the levels of the 1980's.

These changes in political policy reflected a change in popular attitude toward old growth forests, and loggers. Under the old forestry paradigm old growth forests were seen as an untapped and wasted asset. Now such forests were seen as priceless resources that should be maintained in a pristine state. Environmentalist and scientist sited such forests as important sites for biodiversity. This attitude was further persuaded by urban Westerners whose use of the forest was primarily for leisure rather than for supporting a livelihood.

Clear cutting is still practiced in the area today. This clear cutting may be an unintended consequence of forest policy aimed at protecting old growth forests. In the past timber harvested from federal lands tended to be of a larger diameter then timber taken from nonfederal land (Beuter 2004). Large old growth trees on federal land are now unavailable for timber harvesting. The mills which one processed these large logs have

closed. Nonfederal owners have found that their large timber has been devalued by the lack of markets. The incentive to grow large timber is falling driving nonfederal owners towards short rotation plantations in order to preserve the value of their land.

Though industrial logging is still practiced in the Cape Blanco, area a growing number of people in the area are experimenting with eco-forestry as an alternative to industrial forestry. Eco-forestry is a philosophy in which the ecology of the forest has an intrinsic value. Products are harvested from the forest in such a way that they either maintain or improve the forest's ecological integrity. The Kalmiopsis Audubon Society is still active in the area with over 200 members. In recent years the formation of the Elk River Land Trust has protected even more forested areas in the Siskiyou forest and has started issuing conservation easements to people in the Cape Blanco area. The area is also home to a number of organic farms including a very popular, organically certified, pick your own, blueberry plantation.

Economic Issues

Besides a change in environmental attitudes, the 1980s also brought a change in economic stability. The 1980s saw a rash of mill closures, a severe recession in the forest products industry, large sales of Canadian lumber from British Columbia, and an expanding lumber trade in the southeastern U.S. (Robbins 1988). All of these factors brought about economic hardships for the communities in the Cape Blanco area. Empty storefronts, office buildings, and auto dealerships became regular features of the landscape. In 1985 Champion International closed its lumber mill in Gold Beach. The

termination of Champion's operation caused Curry County's unemployment rate to rise to more then 20 percent.

Though the area was experiencing severe economic hardship, loggers received little sympathy from the global community. The change in attitude towards old growth forests had brought a change in attitudes towards loggers. Loggers and logging communities were no longer seen with the Paul Bunion-lumberjack romanticism of the past. Instead they were perceived with many new and unfavorable views (Satterfield 1996). One view portrays loggers as stupid and pathological beings that cut down forests for the sheer enjoyment of it this implied that loggers are people who are deserving of their own plight. Another view sees loggers as pawns of large business timber companies.

The major voice in reporting this exploitation, however, comes from the environmentalist and not from the members of such communities. Because of the stigma associated with being a logger and being pro-timber, members of such communities did not, and still do not, have the same opportunity to express their views to the larger world community (Satterfield 1996). At the same time, environmentalist portraying loggers as pawns is problematic. It implies that environmentalists are insightful and understand the logger's situation better then the loggers do themselves. It also implies that loggers and mill workers are incapable of actions or opinions of their own. It further denies that local grass roots, pro-timber, movements have their own set of values that are human and not industry based.

Pro-timber communities also feel exploited by big industry. During the 1980s the Weyerhaeuser Company in Coos Bay began exporting the logs harvested in the surrounding area to Japan for processing; this led to fewer jobs in area manufacturing

plants (Robbins 1988). The number of independent loggers has also declined rapidly since the 1980s. Those that remain feel that the intense competition from industry plays one independent against another. In many cases, contractors are only able to get work by undercutting the bid of a competitor. Grassroots, pro-timber groups which represent these independent loggers and small timber-dependant business are often wrongly criticized by environmentalists as being spokespeople for big timber industry. This assumption makes it harder for their group to gain sympathy from the global community (Satterfield 2002).

The estimated per capita income of the Cape Blanco area is currently $17,842 (U.S. Census Bureau 2000). An estimated 13.6 % of individuals live below the poverty line. Agriculture, tourism, forest products, fishing, and horticultural nursery stock currently provide the area with its economic base (Curry County 2007).

Though the fight over old growth forest has been one of jobs and culture versus the ecosystem, there is an eco-centric movement that feels that ecological integrity and economic stability do not have to be mutually exclusive. Proponents feel that the current paradigm where economics dictate land and resource use is wrong. Instead economics should be a subsystem of a healthy biophysical system (Drengson and Taylor 1997). Such an economic view is, however, controversial. Scholars of community development agree that the ecological sustainability of the forest and the sustainability of the human community are related. Many argue however that sustainable forest ecology does not automatically lead to economic stable communities, and that many other factors must also be addressed (Beckley and Reimer 1999).

One factor which is argued as preventing economic sustainability in timber-dependant communities is the lack of entrepreneurship within such communities

(Beckley and Reimer 1999). Timber dependant communities often lack economic diversification in the local economy. Members of such communities often must purchase goods and services outside the local economy even though such commodities could be produced locally. Other products which could be manufactured locally for export is also often absent as a result of the timber company's dominant economic force.

Certification

One strategy for promoting sustainable forestry is to create a market for sustainable forest products. For such a market to exist there needs to be proof that its wood products are produced using sustainable practices for such wood products. Certification provides this proof to consumers who wish to purchase such items.

The certification of sustainable wood products in the Pacific Northwest has its origins in the sustainable timber movement of Northern California (Maser and Smith 2001). During the late 1980's many residents in Mendocino County California were becoming critical of Louisiana Pacific's logging practices. Many of these people were loggers and had come from families that had been working in the timber industry for generations. They had been brought up in a logging culture where the biggest best trees were harvested while the younger ones were left to grow. Harvesting practices had recently changed and now loggers were told to "cut any tree that cast a shadow" (Maser and Smith 2001).

Mendocino residents were not only watching their landscape change from forests to clear cut "scorched earth" sites, but timber companies were also closing the local saw mills (Maser and Smith 2001). Timber companies blamed these closures on

environmentalists who were preventing them from logging. It was soon found out that the company had sent the saw mill's equipment to Mexico to open a resaw and drying plant there. This infuriated the loggers who along with labor leaders, and environmentalists, held a press conference criticizing Louisiana Pacific's forestry and labor practices.

Though many people were fired following this press conference, it created a spark in the community which led to re-thinking how forestry should be implemented in the community (Maser and Smith 2001). In 1990 the County of Mendocino formed a forest advisory committee to analyze the county's forest resources and provide for long-term management of the county's forests. As this committee began researching options such as local value-added milling, and restoration forestry they came into contact with other Pacific North Westerners who were also exploring alternatives industrial forestry. Through this network, some members of this advisory committee along with their collaborators formed the Institute for Sustainable Forestry (ISF).

The ISF began in 1990 meeting with community members in both Mendocino and Humboldt counties to address issues such as silvicultural and logging practices, stream protection, worker safety and employment (Maser and Smith 2001). Community members included forest activists, foresters, loggers, woodworkers, business people, and academicians. From these meetings criteria for forest sustainability were made along with a certification program for local timber. Realizing that local certification didn't have much of an impact in selling their wood on the global market ISF joined the Rainforest Alliance's Canada-United States Association of the SmartWood Network in 1995. This enabled ISF to be a SmartWood certifier and allowed them to certify wood anywhere in

Canada or the United States. SmartWood is also accredited by the internationally known Forest Stewardship Council (FSC) and therefore receives FSC certification.

As a response to FSC certification, in 1995 the industry's American Forests and Paper Association (AF&PA) started its own sustainable certification program called the Sustainable Forestry Initiative (SFI) (Sedjo 2004). The SFI came under considerable criticism from environmental groups which lead to a number of reports comparing SFI and FSC certification. Most reports sided with FSC being the more ecologically and socially responsible choice. Such criticism forced SFI to improve their standards, and become a separate entity whose board members include members from the timber industry and environmental groups. Currently both SFI and FSC wood is recommended by some sustainable forestry advocates including the forestry guild. Most wood producers, who seek certification, also become certified in both in order to reduce consumer confusion. Many environmental groups including Greenpeace and the Sierra Club still do not trust SFI even though SFI is making an attempt to change their image (SFI 2007, Alliance for Credible Forest Certification 2007). For differences in SFI and FSC see Table 1.

Table 1.FOREST MANAGEMENT CERTIFICATION SYSTEMS
ENVIRONMENTAL MANAGEMENT SYSTEMS STANDARD
(Canadian Environmental Network. 2006)

	Sustainable Forestry Initiative (SFI)	**Forest Stewardship Council (FSC)**
History and Description of the Initiative	AFPA's SFI has developed principles and guidelines related to various aspects of forest management on the basis of which companies develop their own policies and implantation plans. Developed in 1995, SFI essentially raises the floor of minimum standards of forest management and aims to improve the image of US forest products industry. As SFI is a condition for membership in AFPA, the organization has lost 10-15% of its membership from companies which did not wish to participate.	Set up in 1993 to promote good forest management and with goal of rewarding those producers with exceptional social and environmental performance. FSC accredits certifiers who provide on the ground certification of sustainable forestry practices. Since inception has broadened goal to focus on vast areas of forest in Europe and North America. Membership dominated by environmental NGOs (ENGOs) and social NGOs, with few industry members
Supporters	US industry, Magazine Publishers of America and other customers.	Environmental organizations, certified companies, indigenous groups
Communication Orientation or Marketing Strategy	SFI set up in part to head off federal and state regulations. Industry wants to improve image in eyes of public, government, and customers	FSC systems were originally designed to communicate sustainability message to retail consumers, but current goals much broader. Used by some companies to communicate sustainability commitment to regulators
Verification Mechanism	No third party evaluation required. An advisory group of independent experts will assist in preparation of annual report	FCS accredits independent, third party certifiers (for-profit or non-for-profit). Companies request that these certifiers carry out the certification process.
Major Advantages	Raises the goalpost for poor performers in US industry. Has helped bring sustainability to the forefront in US Includes vast amounts of US forestland.	FSC system has wide environmental support. On the ground verification. Standard setting process includes many stakeholders.
Major Critiques	SFM guidelines too broad and allow companies to set their own policies and programs with very loose minimal standards. Does not require public disclosure of results. Relies heavily on existing government regulations. Environmental community believes that SFI does not go far enough. Some in industry believe that system must be modified from within to address credibility concerns.	Industry unhappy with FSC as a whole because of dominance of NGOs; doesn't feel as if it was included fully in their development. Therefore does not have credibility with industry. Accounts for a very small percentage of forestland. Critics claim the organization is not properly structured, with only five certifiers around the world. Many believe that social criteria smack of "social engineering" inappropriate for companies

.

Riparian Ecology

Riparian zones are areas of direct interaction between terrestrial and aquatic ecosystems (Gregory et al. 1991). They are not easily delineated and encompass a mosaic of landforms, communities, and environments within the larger landscape. The 3 dimensional boundaries of riparian zones extend horizontally outward to where flooding is limited, and upwards vertically into the streamside canopy. Riparian zones are important ecological areas which filter contaminants, buffer landscapes against erosion, maintain the health of the aquatic zone, and are important for promoting biodiversity.

Riparian zones are closely connected with adjacent streams and often have a high rate of disturbance caused by flooding. In these areas soil properties and topographies can vary widely, and perennially wet to well drained soils can be found over a short distance. Climates in riparian zones also vary over a short distance due to fluctuations in topography, light, and canopy cover. Collectively all of these factors allow a large number of species to coexist in a small area (Gregory et al. 1991, Naiman et al. 2000).

There is debate as to whether or not riparian zones are more bio-diverse then upland areas (Sabo et al. 2005). Recently a meta-analysis on data from 47 papers that explicitly enumerated species richness in both riparian and upland areas, or turnover in species between these two areas, was conducted. All 7 continents were reported in this study. Their finding was that riparian habitats do not house higher numbers of species, they do support significantly different species altogether. Riparian habitats therefore increase the species richness in regions where they occur. This also suggests that riparian zones are different ecosystems then upland zones. Being a different ecosystem implies that that other forest products may be found in these areas. It also implies that they need

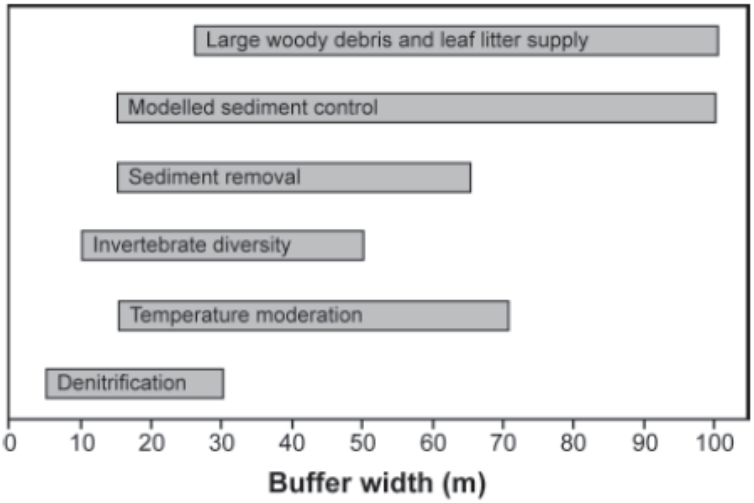
to be managed differently then upland areas. This could be an asset in forestry or homesteading systems that are looking to diversify their forestry products within a sustainable forestry scheme. This is particularly useful in areas where riparian zones are left intact or mostly intact following industrial logging.

A well managed riparian zone protects the aquatic zone from sediment, it provides a steady flow of nutrients and water into the aquatic system, and regulates the water temperature through shading (Allan 2004). Mismanaged harvesting in riparian zones, however, can lead to erosion caused by channel flow water drainage, causing sedimentation to enter streams. This sedimentation leads to an increase in the turbidity and causes scouring of rocks and logs which impair the substrate suitability for the production of periphyton. A decrease in periphyton can lead to a decrease in insect consumers and bottom up disruptions in the food web. Sediment also fills in interstitial habitats, which harms crevice living invertebrates and gravel spawning fishes. This filling also leads to depth heterogeneity of the stream which leads to a decrease the amount of pool species. Sedimentation also suffocates fish and aquatic invertebrates by coating gills and other respiratory surfaces.

Opening the forest canopy over streams causes an increase in light, water temperature, penetration, and plant growth (Allan 2004). It also leads to a reduction in leaf detritus, an important component in the aquatic food web, and wood, which is important for aquatic habitats. An open canopy decreases bank stability by facilitating channel flow erosion, and reducing sediment and contaminant trapping. This changes the character and quality of dissolved organic materials that reaches the stream.

In order to protect both streams and their adjacent riparian zone from the harmful effects of upland logging and agriculture practices a riparian buffer is maintained between the stream and the site of harvesting. People who use upland sites for harvesting often want narrow riparian buffers for they want the buffered land for economic use (Broadmeadow and Nisbet 2004). Buffers that are too narrow, however, provide inadequate protection to both the stream and the riparian zone. The needed width of riparian buffers is therefore under debate. In a literature review of best management practices Broadmeadow and Nisbet (2004) found that there was a wide range of buffer widths needed to perform specific buffer functions (fig. 2). Their conclusions were that the width of the buffer should reflect the natural dimensions of the aquatic and riparian zones. Though it's not possible to specify a definitive minimum buffer width, buffers in the range of 5-30m wide have been found to provide at least 50-75% effectiveness at preserving functions associated with undisturbed forest streams.

Fig 2. The range of riparian woodland buffer widths reported in the literature by Broadmeadow and Nisbet (2004) as being required for the adequate performance of several specific buffer functions.



In September 1994 major revisions to Oregon's forest practice rules involving riparian areas took effect (Adams 1996). The new rules are based on the size and use of the stream, and are put into three major size classes, and three major use categories (Table 2). These rules focus on retaining vegetation and avoiding ground disturbance to protect water quality and fish habitat. Though rules vary by geographic region all streams, except small Type N, streams must retain the following vegetation: all under story vegetation within 10 feet of the high water level, all trees within 20 feet of the high water level, and all trees leaning over the channel.

Table 2.Width of riparian management areas based on classification of forest stream type and size. (Adams 1996)

Stream Size	Fish Use (F)	Domestic Use (D)	Neither F nor D (N)
Large	100 feet	70 feet	70 feet
Medium	70 feet	50 feet	50 feet
Small	50 feet	20 feet	Varies

Ethno-botanical History

People who are interested in the sustainable management of natural resources often turn to aboriginal people's management practices and customs for clues on how such resources may be managed today. Below are management practices and uses of some riparian under story plants that have recorded ethno-botanical uses by native peoples of the coastal Northwest. I also include modern day know uses of these plants.

Native Americans would selectively harvest living fronds from larger Sword Fern (*Polystichum Munitum*) plants (Turner and Peacock 2005). Fronds were then used to line steaming pits, baskets, storage boxes, and berry drying racks (Turner 1998). The fronds were also used to cover the floors of summer houses and dance halls. Fronds were

sometimes woven into crude mats for bedding. Native children would also play an endurance game with the fronds. In this game, children would try to pull off the most pinnae, in a single breath. It was believed that this was part of a young man's training to teach him to hold his breath for a long period. This skill was useful for diving down to the base of the bull kelp to cut strips off of the ocean floor. Currently the fronds are used in floral arrangements.

Rhizomes from large plants were also eaten as food during periods of low food resources (Turner 1995). Rhizomes were usually dug up in the spring before new leaves sprouted. They were either cooked on an open fire or steamed in pits, then peeled and eaten, usually with either grease or dried salmon eggs.

Medicinally this plant was used by native peoples. The roots were eaten as a cure for diarrhea (Turner 1995). An infusion of the fronds has been used as a wash to treat sores and boils (Plants for a future 2007). Young shoots have been eaten as a treatment for womb cancer, sore throats, and tonsillitis. The leaves have been chewed to facilitate childbirth. Sporangia have been crushed to make a poultice to treat burns, sores, and boils. An infusion of the rhizome has also been used as a treatment for dandruff.

Berries were, and continue to be, very important to the culture of the Pacific Northwest. Thought there are many varieties of plant genera that produce berries the focus of my research is on Blue huckleberry (*Vaccinium membranaceum*, Red huckleberry (*Vaccinium parvifolium*), Salmonberry (*Rubus spectabilis*), Thimbleberry (*Rubus parviflorus*), and Salal (*Gaultheria shallon*). With the exception of wild strawberry (*Fragaria* spp.), the management of berry crops by native peoples was similar for each species (Turner and Peacock 2005). The fruit picking was non-impacting to the

plant. A diverse number of berry species were managed simultaneously, and alternative species of berries were used depending on the productivity of that year's crop. Berries plants were pruned or coppiced periodically to stimulate new growth. Plants were known to be transplanted, and berry patches were also known to be fertilized.

Periodical prescribed burning of patches of *Vaccinium* species was done by native peoples to increase their productivity (Lepofsky et al 2005). Such proscribes burns would happen in the fall at the end of the berry season, roughly every third year. Patches that were infested with pests would be burned more frequently. Proscribed burns increases productivity by several mechanisms. It discourages the invasion of other species, particularly conifers and heathers, which compete with *Vaccinium* for light and nutrients. Periodic fires discourage pests which inhabit fruit and other vegetative parts. Fires return nutrients to the soil that was held up in woody tissues. Fires also keep woody re-growth to a minimum, which allows the shrub to put more energy into fruit production

Blue and red huckleberries were, and continue to be, a very popular fruits among native peoples (Turner 1995). The berries were gathered from mid summer to fall and eaten either fresh, dried in cakes, or cooked with salmon spawn. Huckleberries are popular berries among non-native peoples as well and are eaten raw, in pies and pastries, and are also made into jams and jellies. Such jams are very popular items sold at souvenir shops, and road side farmer's markets.

The berries of blue huckleberry of were mashed by native peoples to make a purple dye for basket materials (Turner 1998). The straight green stems and twigs of red huckleberry have been used to make brooms (Plants for a future 2007). Currently huckleberries are used in floral arrangements.

Native peoples used an infusion of stems and roots of blue huckleberry to treat rheumatism, arthritis, and heart troubles, while a decoction of bark from red huckleberry was used to treat colds (Plants for a future 2007). In contemporary herbal medicine tea from the leaves of huckleberries are used for treating alkaline PH cystitis, and to help modify blood sugar levels in Type 1 diabetes (Moore 1993). The tea is also used for its antiseptic, astringent and carminative properties (Plants for a future 2007).

Both the young sprouts and berries of Salmonberry and Thimbleberry were eaten in large quintiles by native peoples (Turner 1995). The sprouts of both plant species were harvested in spring, peeled, and eaten raw. Salmonberry sprouts were also steamed, and dipped in either grease or dried salmon spawn. Sprouts are still eaten today but are now sprinkled with sugar. Both the gold and ruby forms of the salmonberry were pick and eaten raw. Salmonberries were never dried for they were too watery. Thimbleberries conversely were dried into a special berry cake. Such cakes were made by laying out sticks of roasted clams on a board. These were then covered by a layer of fresh thimbleberries, followed by another layer of strung clams and so on. A plank was then laid on top of this pile and staked with stones compressing the pile into a compacted, flat, loaf. This loaf was then sun dried for later use. Though a superior drying berry, thimbleberry was not often eaten fresh, and was considered inferior to other berry species. Today non-native species of cultivated *Rubus* (that have also subsequently left cultivation) are considered to be of superior flavor to native species. Though jams made from native *Rubus* species are often sold in roadside farms stands, they are treated more as a novelty item for tourist consumers.

Native peoples used the young, straight, woody, shoots of salmonberry as spears in throwing games and as arrow shafts (Turner 1998). They were also used to keep sheets of cedar-bark roofing flat by driving the shoots crosswise at intervals through the inner layers of the bark. Short hollowed pieces of salmonberry stems were used as valves between harpoon heads and shafts, and as sockets between the hook and handle of a gaff. Hollowed out stems were used to add water to covered steaming pits, and as pipe stems.

The leaves of Thimbleberry were used by native peoples to line steaming pits (Turner 1998). The leaves were also laid in berry picking baskets to separate different types of berries within the basket. Leaves were also used to wrap cooked elderberries for storage. The bark was boiled to make soap, and the berries were used to make a stain for tanned robes, arrow quivers, and wood.

The leaves and roots of salmonberry are astringent, while the root bark is analgesic, astringent, disinfectant and stomachic (Plants for a future 2007). A poultice of the chewed leaves was used by native peoples as a dressing for burns. A decoction of the root bark was used to treat stomach complaints and to lesson the pains of labor. A powder of the bark was dusted on burns and sores, while a poultice of the bark was applied to wounds, and aching teeth.

The leaves of thimbleberry are antiemetic, stringent, blood tonic and stomachic (Plants for a future 2007). In contemporary herbal medicine and infusion of the leaves are used to treat stomach complaints, diarrhea, dysentery, anemia, the spitting up of blood, vomiting, and to relieve complications associated with menstruation. A poultice of dried leaves was used by native peoples to treat wounds and burns, while fresh leaves were crushed and rubbed onto pimples and blackheads. A poultice of the leaf ash was used to

treat swelling. Young shoots are alterative and antiscorbutic and the roots are appetizer, astringent, stomachic and tonic. An infusion of these parts was used by thin people to help them gain weight, and to treat stomach disorders, diarrhea, and dysentery. A decoction of the roots was also used to treat pimples and blackheads.

Salal berries were, and still are, the most plentiful and widely used fruit by coastal native peoples (Turner 1995). Berries were picked in late summer and either eaten fresh or dried into cakes for winter. During feasts berry clusters were dipped in grease. Berries were then eaten one at a time, and the remaining stem was thrown into the fire. For winter storage berries were mashed and either boiled in boxes, or dried in the sun to produce a thick "jam". This jam was then poured into rectangular cedar frames on Skunk Cabbage (*Lysichiton americanum*) leaves, and dried on a rack over an alder-wood fire. These cakes were rolled and stored in a cedar boxes in a warm area of the house. Such cakes were highly prized and only eaten at special family meals or by chiefs at feasts. To eat dried cakes were soaked overnight in water, kneaded until broken into small pieces, and then mixed with grease. These cakes were eaten with special black spoons made from a mountain goat horn so as not to show the berry stain. Berries were also used to sweeten other foods and to thicken salmon eggs. Though still widely eaten by native peoples, many non-native people dislike the berry's grainy texture. Salal jam is however a popular item along roadside farmers markets and stands.

Native people placed Salal branches in their steaming pits over and under the root crops being steamed (Turner 1998). A purple stain was also made from the berries. Today Salal foliage is used in the floral industry. Salal leaves are astringent and anti-inflammatory (Moor 1993). In contemporary herbal medicine a tea of the leaves are used

for treating diarrhea, accompanied by heat, cramps, and moderate fever. The tea is also used to help scratchy, irritated coughs from allergies. It's given to young children to relieve colic, gas pains, and to adults for gastritis, and bladder infections. Topically the tea is applied to scrapes, abrasions, burns and insect bites. Salal berries are incredibly high in flavonoids and are used in contemporary nutritional therapy for strengthening capillaries in chronic skin and mucus membrane fragility.

Red Elderberry (*Sambucus racemosa*) root cuttings were also transplanted by native peoples (Turner and Peacock 2005). Red elderberry stems are easy to hollow out and many native peoples used them as whistles, drinking straws, blowguns and pipe stems (Turner 1998). The stems, roots and foliage are however poisonous and using them for such items is not recommended, especially when fresh. The pith was used to fasten flint onto arrow shafts, and segments of the stem were also fixed onto arrows used to stun birds and squirrels. A piece of the stem was also used as a base for a feathered shuttlecock employed in a game. Hollowed out pieces of stem with seagull feathers were used as Lingcod lures. Leaves have also been used to repel insects (Plants for a Future 2007)

Though commonly believed by non-natives that the fruit is poisonous the fruit was widely used by native peoples (Turner 1995). It is recommended however that the seeds be removed, and the fruits cooked before eaten to remove any toxicity (Plants for a Future 2007). Gatherers pulled down the higher berry clusters with long, hooked poles, and broke off the cluster stems at the base to keep the cluster intact (Turner 1995). These stems were then removed before cooking. Elderberries were either steamed overnight in pits lined with Skunk Cabbage leaves that were bent up to hold the juice, or were boiled

in tall cedar boxes using red hot stones. They then laded the hot berries into cedar frames set over Skunk Cabbage leaves and dried on a rack over a small fire for 24 hours. These cakes were then tied in bundles and stored in cedar boxes.

Red Elderberry cakes were eaten at noon for they were said to give stomach aches if eaten in the morning. Dried cakes were broken into dishes, soaked in water, and then rubbed against the side of the dish until they fell apart. Grease was poured over the berries and eaten with a spoon, swallowing the juice but spitting out the seeds and skins. Water was always drunk immediately afterwards to wash out the seeds. Today native peoples add sugar to cooked Red Elderberries and make them into jam, jelly and wine.

Red Elderberry was widely used medicinally by native peoples to treat a range of complaints, especially as an emetic and purgative to cleanse the system (Plants for a Future 2007). Though not often used in contemporary herbal medicine the leaves, stems, and roots are anodyne, carminative and vulnerary. A decoction is used in the treatment of traumatic injuries, fractures, rheumatoid arthralgia, gas pains, acute and chronic nephritis. The fruit is depurative and laxative. The leaves are diuretic, resolvent and sudorific. They are used externally to soothe abscesses and boils. Infusion of the root is used to treat stomach pains. The roots can also be rubbed on the skin to treat aching and tired muscles.

METHODS

Interviews and Observations

From mid August to late October 2006 I lived and worked on a homestead just outside of Port Orford in Curry County Oregon. The homestead was owned by one man who made his living from growing and then selling organic garlic, goat's milk, eggs, and lumber. His diet was supplemented by produce from his organic gardens and orchard, and berries and mushrooms that were foraged from the forest. He got meat, dairy, and eggs from raising goats, chickens, and from fishing in the Pacific Ocean, and local streams. He often took in volunteers to help maintain the homestead. Work was in exchange for room, board, and training in homesteading practices. I was one of two volunteers who stayed there at the time. It was understood that I would be conducting interviews and surveying plants while I was there.

The homestead was part of an informal network of eco-foresters in the region. During my visit I was introduced to two other eco-forestry operations through this network. One was a forested area owned by an intentional community in Coquille, Coos County Oregon. This community was comprised of approximately 15 individuals (including 2 children). The focus of this community was homesteading through permaculture practices; which included gardens, orchards, poultry, and forestry. The other eco-forestry operation was operated by a husband and wife team on Elk River in Curry County Oregon. Though they did harvest timber from their land, their main source of income came from running their own land management consulting company. Both homesteads mentioned above used this company as their consultants. Interviews at the homestead where I stayed where very informal and usually took place while working or

over meals. Interviews of the other eco-foresters where also informal and took place during work parties, or over communal meals. Questions focused on: (1) the difference in their forestry management practices to industrial practices, (2) reasons for choosing such practices, (3) challenges to such practices, (4) best management practices for riparian zones, and (5) uses and management of under story species.

A small native plant nursery in Port Orford was also interviewed. Most of the work is done by himself and his partner, but he often hires locals for bigger jobs on a temporary basis. He harvests plants, or takes seeds or cuttings from the forest, then propagates them to sell to nurseries in Portland, Eugene, and Lorane OR. He often does what is called a "clear-cut rescue" that is harvesting plants from an area that is scheduled for clear cutting. This interview was done over the phone. The questions were: (1) likes and dislikes of his profession, (2) reason for choosing such a profession, (3) what plants were harvested and where, and(4) uses of such plants.

I also visited the office of the Curry watersheds Council, an NGO focused on measuring the effectiveness, safety, health, and other factors in watershed stewardship in Curry County. I interviewed the Monitoring coordinator, Riparian specialist, and Farm planner about riparian issues and management practices. All three of these people were interviewed at once, during one informal visit.

Riparian Plant Surveying

The focus of this survey is on under story plant species that had been harvested economically in the area for the floral industry. These plants included: Sword fern (*Polystichum munitum*), blue huckleberry (*Vaccinium membranaceum*), cedar (*Cedrus*

spp.), salal (*Gaultheria shallon*), brambles (*Rubus* spp.), Oregon myrtle (*Umbellularea californica*), and red huckleberry (*Vaccinium parvifolium)*. When surveying for cedar only trees which were small enough to harvest boughs, or were seedlings were counted. Oyster mushrooms (*Pleurotus ostreatus*) were also surveyed since they are an economically important foraged mushroom in the area. In addition foxglove (*Digitalis purpurea*), and Maidenhair fern (*Adiantum* spp.) were also surveyed because of their potential economic value in the nursery industry. Red elderberry (*Sambucus* spp.) was also sampled though it has no current economic value.

Transects surveying of under story vegetation was done at five riparian sites of the North fork of Hubbard Creek in Port Orford Oregon. Each site was along 100m of a riparian zone, at one of three 1st order stream branches. Transects began at the edge of the stream bed and went 30m perpendicular to stream flow (Table 3). All transects were done on western slopes to decrease any variation in amount and intensity of day light between sites. Slopes averaged 60 degrees or higher. After an initial sampling at 5m intervals it was found that average plant coverage fore each species did not change on 10m. The intervals were then changed to every 10m. Each interval was place according to the length of the stream bed regardless of the frequency or degree of it curves. Plants which fell on the transect, above the transect, or within 1m of the transect were recorded. Plants and mushrooms were recorded in terms of the BRAUN-BLANQUET cover abundance scale (Mueller-Dombois and Ellenberg 2002). This scale is based primarily on present cover of each surveyed species, and total species cover may exceed 100%.

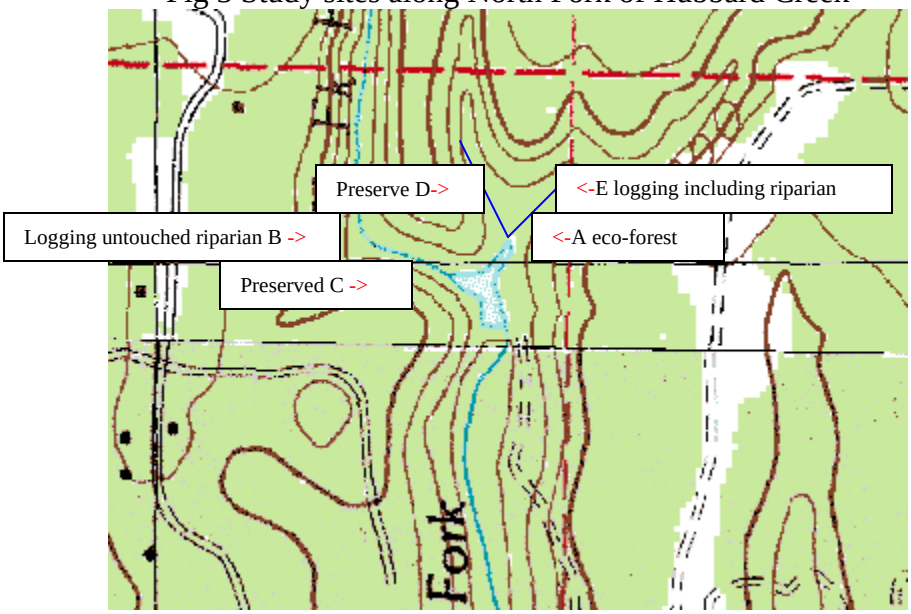
Table 3-Study sites along the North Fork of Hubbard Creek

Site	**Type**	**Number of Vegetation Transects**	**Number of Stream Bank Transects**	**Length of Study Area**
A	Eco-forested	20	20	100m
B	Logged riparian zone left intact	20	20	100m
C	Preserved	12	20	100m
D	Preserved	10	10	100m
E	Logged including riparian zone	10	10	100m

The length of these transects is based on Best Management Practices for riparian zones world wide, and suggests a 30m wide buffer (Broadmeadow and Nisbet 2004). Zones this wide should protect a stream from denitrification and sediment removal, and promote temperature moderation, sediment control, invertebrate diversity, and large woody debris supply. Intervolves of 10m was arbitrarily decided on so that transects would fall in some mathematical predetermined area and not from the on site discretion of the surveyor.

Stream bank stability was surveyed to infer the amount of erosion at each site. To do this I used the inventory method from the Idaho Department of Health and Welfare (1999). This method has 6 criteria: Bank Stability, Bank Condition, Vegetation cover, Channel shape, Channel bottom, Deposition. Each of these criteria has a ranking system where 0 is the healthiest and higher numbers (depending on criteria) is less healthy. The numbers from each of these ranking are then summed for a cumulative ranking. Stream banks with lower cumulative rankings are more stable then those with higher rankings.

Fig 3 Study sites along North Fork of Hubbard Creek



The ground cover percentage of individual species at each transect within a site was also compared using graphical analysis. If the abundance of two species had a consistent relationship, it suggests there may be an ecological relationship between the species. A consistent positive slope could suggest the species are not directly competing, and may suggest a communal interaction where the presence of one facilitates the presence of the other. In contrast if a consistent negative slope was present then it could suggest an antagonistic relationship where the presence of one out-competes the other. All species were tested. There was no consistent slope or pattern found among any of the species compared.

A similar comparison where ground cover percentages of individual species at each transect was compared with stream bank stability total. This comparison was done on the same liner graphing excel program. There was no consistent slope with regard to any of the species and stream bank stability total.

RESULTS

Sources of Potential Income

Native Plant Nursery

The owner of the native plant nursery stated that though he harvests some plants before an area is clear cut, most of his plants come from harvesting a few years after a clear cut. These are species harvested from an early point of forest succession. This shows that forests products can potentially be harvested from each point of succession including early succession. The bulk of his clientele are nurseries in Portland, Eugene, and Lorane OR that deal in landscaping. Most landscaping plants are those that do best in full sun, as opposed to shade loving plants harvested from the forest. Though he does harvest whole plants many of his best selling plants are propagated from seed.

He prefers this because plants propagated from seeds have a smaller mortality rate than harvested plants. He also told me that it wasn't worth it to sell rare plants. Rare plants take a lot of work to maintain and propagate and most people aren't willing to pay the premium for maintaining such plants; as I was told, "Most people don't want to spend a lot of time working on their lawn, so they want plants that don't take a lot of work." When I asked why he chose to propagate and sell native plants, I was told that he did so because it gave him an opportunity to learn about the ecology and phenology of native plants. Something that he thoroughly enjoyed. He felt such a job gave him a unique perspective of landscape, land use, and seasonal variation for he often thinks of such things from the perspective of plant communities. A table of native plants harvested and their harvesting conditions are listed in Table 4.

Table 4. Native wild plants harvested in the Cape Blanco area for horticultural nursery stock. Table compiled from interview of nursery owner. October 2006.

Harvesting plants prior to scheduled clear cutting (clear cut rescue).	Lilies (*Lilium* spp.) Trilliums (*trillium* spp.) Ferns (*Pteridophyta*) Orchids (*Orchidaceae* spp.) Oregon grape (*Mahonia aquifolium*)
Plants harvested a few years after a clear cut.	Rhododendrons (*Rhododendron* spp.) Currants (*Ribes* spp.) Huckleberries (*Vaccinium* spp.) Salal (*Gaultheria shallon*) Douglas iris (*Iris douglasiana*)
Plants which are propagated from seed and/or from which wild harvested seeds are sold.	Native brambles (*Rubus* spp.) Wax myrtle (*Myrica californica)* Huckleberries (*Vaccinium* spp.)

Brush Industry

Interviews indicated that harvesting brush, which is foliage from salal, huckleberry, sword fern, and various other plants used in the floral industry, is a common way to make or supplement a living in the area. I was told that harvesting such plants produces a quick, but not well-paid, income which is often paid in cash. When I asked around looking for brush pickers to interview the response I got was either "I don't know any" or "I don't associate with any." I asked if anybody had heard of brush pickers being hired to help control brush. I was told that brush pickers are selective and after brush which is aesthetically pleasing to the floral industry. For brush control you would need pickers who were less selective about the brush they removed.

Interviews with land owners indicate that they generally do not trust brush pickers and are fearful that pickers wouldn't have respect for their private property. I was told stories of brush pickers offering to give a cut of their sales to the landowner in exchange for allowing them to pick brush on their land, but then never paying. Other stories were of private roads being eroded due to the vehicles used by brush pickers. Brush pickers are often viewed by many of the locals as drug addicts or illegal aliens who are just out to make a quick buck. Some point out the violence among salal pickers in Washington as evidence of the outlaw mentality of brush pickers (Foster 1998). I did contact a brush buyer to see if I could interview them about the brush industry; unfortunately they refused.

Animals Used For Brush Control

A sustainable, non-chemical, way to control brush is to allow animals to browse on the brush. I interviewed one forester who has been experimenting with using animals for brush control for roughly 20 years. He started using animals because he was morally opposed to using chemical herbicides for environmental reasons. He also felt that animal browsing brought financial independence from herbicides. He had found that goats were his best option. He based this on the investment in resources need for animal care versus amount and type of brush eaten, and the amount of milk or meat the animal can provide. He preferred to use goats in general because he enjoyed their temperament and personalities better then other brush animals. Table 6 below compares the differences in brush animals.

He is currently using a heard of eight goats and plans on using goat herds of similar or slightly larger sizes for the foreseeable future. Before an area is browsed it must first be fenced off. In this case fencing was zigzag railing approx. 3 feet high with an electrically charged wire fixed on top and bottom railing, with a gate installed at one end. Goats are then brought into the area and browse all foliage within their reach. As the goats brows they leave woody parts behind, which include the stems and branches of shrubs ($\leq$ 1 inch diameter). These are then cut at the base and placed into piles. Plants in which the leaves are higher than the goats can browse are also cut, and placed into piles that the goats then brows from. These piles are arranged around young trees to act as mulch. Piles are also placed in areas to act as heat sinks and wind breaks for young trees, and future tree seedlings. Brush piles provide habitat for rodents, and owl boxes are placed on snags to encourage owls. Once brush is sufficiently browsed, goats are taken out of the area and tree seedlings are planted.

Goats are brought back in on small rotations to control new brush growth. Such rotations begin when the wax myrtle (*Myrica californica*) gets too high and brambles come back. Before the goats are brought back into the area to browse for brush, deer repellent is sprayed on the young tree seedling to protect them from goat browsing.

Table 5.A Comparison of animals used for brush control, compiled from interview in Port Orford OR. October 2006

Animal	Resources needed	Byproducts	Overall advantages	Overall disadvantages
Cow	Water Hay grass Grain feed Shelter	Meat Milk	Great defoliators most large brush is eaten Manure is great fertilizer	Manure attracts large numbers of flies Grazers by nature, need hay and grass
Pig	Water Slop feed Shelter	Meat	Manure is great fertilizer Root eaters better for controlling salal, and for spreading Port Orford-cedar blight. (*Phytophthera lateralis)* 1 Rooting good for disturbing soil for planting	Manure attracts large numbers of flies Aggressive temperament Smelly Slop feeding is both water and labor intensive. Larger brush must be cut down and fed to animal Fencing is labor intensive
Goat	Water grain feed for milking and young goats Shelter	Meat Milk	Browsers by nature can live on brush alone. Manure is great fertilizer Manure is evenly spread through out the area. Little soil disturbance	Larger brush must be cut down and fed to animal Un-castrated male goats require labor intensive fencing.

1. The spreading of Port Orford cedar blight is used to select for resistant Port Orford cedars. This blight is a fungus which attacks the roots of these cedars. As pigs root they facilitate the spread of this fungus. Trees which are not resistant get infected and die quicker then if left to get infected by normal vectors. Seedlings which have a higher probability of carrying the resistant genes are planted in the infected area. Those that do not carry the gene die quickly. Those that do not die quickly are assumed to be resistant, and the stand itself can be assumed to be resistant.

Riparian Zones

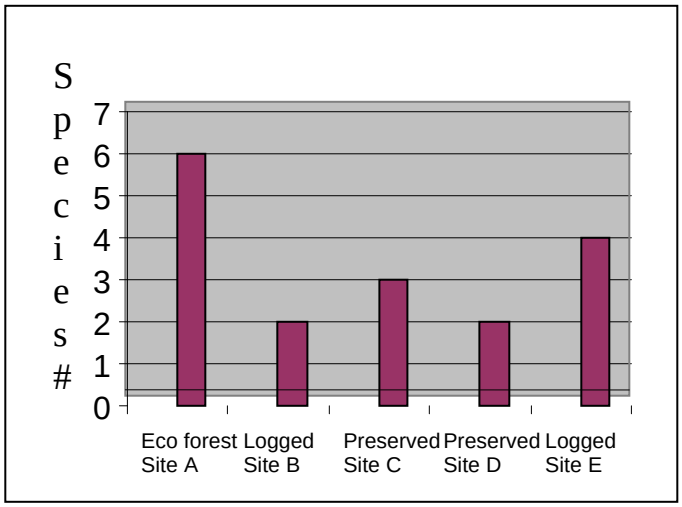
Plant Surveying

Table 6 shows the average ground cover of each surveyed species and the total ground cover for each site. The number of species whose average ground cover was higher then 5% and 1% is also noted. Figure 4 illustrates the number of species surveyed that has an average ground cover higher then 1% per site. The eco-forested site has the highest number at 6. The sites with the lowest number (2) are a preserved site and the logging site where the riparian zone was left.

Table 6.Ground cover as average percentage measured in fall 2007 along 1st order streams of North Fork of Hubbard Creek Port Oreford Oregon.

species cover average	Site A	Site B	Site C	Site D	Site E
	Eco-forest	Logged riparian	Preserve	Preserve	Logged no riparian
Sword fern	83.8	61.3	66.7	55.1	22.9
Blue huckleberry	33.5	0.0	0.0	0.3	47.6
Cedar	0.0	0.0	0.0	0.0	0.0
Salal	2.3	0.0	0.0	0.0	12.9
Brambles (*Rubus* spp)	35.3	71.3	55.2	57.5	1.3
Myrtle	1.0	0.0	0.0	0.0	0.0
Red huckleberry	1.0	0.0	1.1	0.0	0.0
Oyster mushrooms	0.0	0.0	0.0	0.0	0.0
Foxglove	0.0	0.3	0.0	0.0	0.0
Maidenhair fern	0.0	0.0	0.0	0.6	0.0
All economic species (excludes red elderberry)	156.8	132.8	123.0	113.5	84.7
# species $\geq$ 5%	3	2	2	2	3
# species $\geq$ 1%	6	2	3	2	4
Red elderberry	6.0	6.5	19.0	4.7	0

Figure 4. Ground Cover Greater then 1%



Riparian Vegetation Management

I asked both eco-foresters and staff of the Curry Watersheds Council what would be the best way to manage these stream banks for economic species. Independently both agreed that many banks were too steep (≥ 60 degrees) to consider harvesting plants from them. For erosion control they would be better left alone. One eco-forester felt that the streams could use more large woody debris and thought that such debris could be inoculated with oyster, turkey tail (*Trametes versicolor*) and phoenix (*Pleurotus pulmonarius*) mushrooms for harvesting.

When asked what would be the most effective way to maintain the ecological integrity of these riparian zones. The general consensus was to just let natural succession take its course, but monitor for invasive species. The owner of the eco-forested riparian site had put in sediment catches, large woody debris, and sand bags to improve the structure of his stream bank.

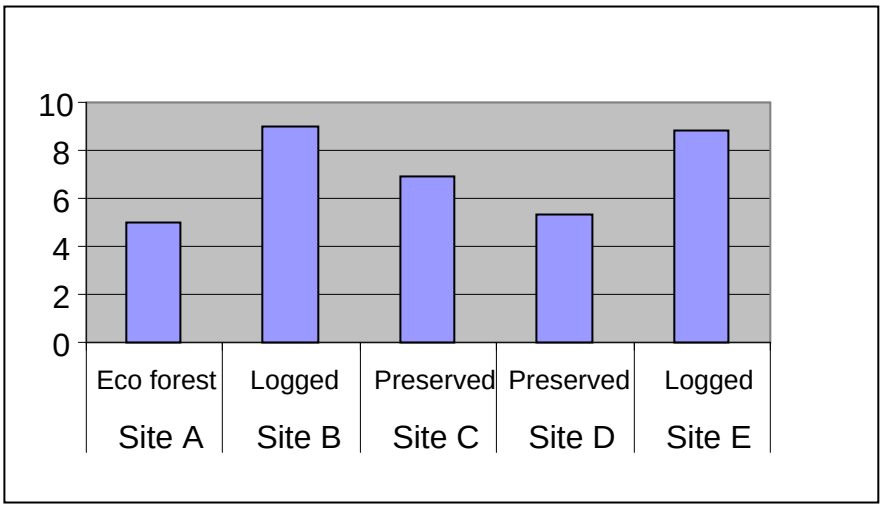
Stream Bank Surveys

Table 7 shows average for each criterion, and the average total, for stream bank stability from each site. Figure 5 illustrates that stream bank stability total at each site. The lower the number the more stable the stream bank. The eco-forested site is the most stable being only slightly more stable then a preserved site. The logging sites of B and E are the most unstable, with the more recently logged site being slightly more unstable.

Table 7. Stream bank stability Data
(Note that the lower the number more stable the criteria)

	Site A	Site B	Site C	Site D	Site E
	Eco-forest	Logged riparian	Preserved	Preserved	Logged no riparian
stability	0.8	1.80	0.90	0.70	0.70
condition	0.2	1.50	1.00	0.70	1.40
vegetation	0.7	2.80	2.50	1.70	2.80
shape	2	1.80	1.40	1.20	1.40
bottom	1.2	1.10	0.90	1.10	1.90
deposition	0.1	0.00	0.00	0.00	0.60
total	5	9.00	6.90	5.30	8.80

Figure 5. Stream Bank Stability Total
(Note the higher the number the less stable the stream bank)



Certification

In interviewing eco-foresters in the area one forester told me that he felt that as a national movement eco-forestry was losing ground. He stated that this was not due to ideological reasons but to economic ones. Eco-foresters state that sustainable forestry is more labor intensive and has stricter ecological management requirements than industrial forestry. They therefore believe wood harvested from such sites deserves a premium price. In order to sell wood at a premium it must be certified as sustainable harvested, and a price must be paid to a reliable certifier. Eco-foresters ideologically agree with paying for certification, but none that I talked to were currently certified. Each stated that they felt certification did not increase the amount of wood sold, and they never got their money's return from the cost of certification.

Certification also carries an ideological value as well. I was told by eco-foresters that they manage the forest in a sustainable manner for they feel a moral responsibility to do so. One eco-forester told me that becoming a certified eco-forester was an affirmation of views that he had long held. Certification creates a sense of unity and a feeling that one is part of a larger movement.

Eco-foresters feel they are in competition with an industry that can easily out-compete them in terms of price. This industry has created its own sustainable certification, through the Sustainable Forestry Initiative (SFI), which only exacerbates this competition. Eco-foresters believe SFI certification is just a rubber stamp for industry, and does not truly promote ecological sustainability. Instead Eco-foresters would rather certify as SmartWood through the non-profit Forest Stewardship Council (FSC) if they could afford to do so. Eco-foresters believe having two major sustainable wood certifiers creates confusion for people wanting to buy sustainable wood, and believe that many are unaware of the differences between the two.

DISCUSSION

Impact of management on Riparian Ecosystems

Biodiversity

The data suggests that the eco-forestry management program produced a riparian zone that is more biologically diverse then both preserved sites, and industrial logging sites (figs. 4 & 5). Logged site E does however have the second largest biodiversity then other sites, with the exception of eco-forested site A. In comparing the logged site E to the other sites it appears to have a different plant community in which blue huckleberry and sala are much more represented, and sword fern and brambles are less represented then in other sites (table 6). If we view all the sites as pieces of a puzzle, rather then as independent islands, site E adds a layer of diversity into the area as a whole. If promoting biodiversity is a factor in promoting biological sustainability then the harvesting of all trees in a riparian zone, of a portion of an area, could be an acceptable part of a management plan. It is important to note that surveying was only done for economic shrub and herbaceous specious and not all vegetative species. Though the study infers that the level of biodiversity in economic species reflects the level of diversity as a whole, further surveying should be done to include all vegetative species.

The data suggests that there is no correlation between ground coverage of one species to another. This would suggest that one could harvest, plant, or otherwise manage one species without affecting the ground coverage of other species. An exception may be found between the ground coverage of brambles and overall biodiversity. Eco-forested site A has a higher number of species then other sites surveyed (fig. 5). Part of the

management practices for this site was to routinely cut back the brambles with a machete in order to allow better access to manage the stream bank. Site E has the least ground coverage of brambles the any other site (table 6) and is also more bio-diverse then other sites with the exception of A. Though the data suggests a reduction of brambles may not have an effect on the presence or abundance of any particular species, a decrease in brambles does apparently lead to an increase in bio-diversity.

Stream Bank Stability

In comparing industrial logging sites to preserved sites the data indicates that industrial logging sites, regardless of whether or not the riparian zone is left produces a less stable bank then preserved sites. Though removing all trees in the riparian zone does open the canopy increasing light and the biodiversity of herbaceous economic species, it also promotes erosion and stream bank instability. Since stream bank stability is decreased, removing all trees does not improve the overall biological sustainability of the area. If removing all the trees from an area is to be considered, management practices must be implemented to decrease erosion and maintain stream bank stability. This is not only important for maintaining the ecological integrity of the immediate area, but also for areas downstream.

In comparing the stream bank stability of preserved site C to preserved site D, site C is less stable then site D (fig. 5). Site C is also downstream from logged site B (fig. 3). Erosion from site B is probably a contributing factor to the differences in stability between the two preserved sites. Adding silt traps in site C and adding large woody debris to sites B, C, and E should improve stream bank stability of these sites. The eco-

forested site A is downstream from logged site E, yet has the most stable banks of all the sites surveyed. The stability of the stream bank is probably due to the management practices of the site. These practices include: adding large woody debris to the stream, sandbagging areas of the stream bank, and installing sediment traps in the stream bed. Since these practices seem to improve stream bank stability they should be considered part of a sustainable forestry management plan.

There was also no correlation between stream bank stability and riparian ground coverage on any species. This suggests that one should manage the riparian vegetation and stream bank integrity independently of each other. Stream bank instability was, however, linked to areas that used clear cutting practices upland. Such areas were less stable regardless if the riparian zone was left or not. It is important to note that the areas clear cut were not only upland but also upslope ($\geq$ 60 degrees) from these riparian zones. This suggests that in order to reduce erosion and maintain the integrity of the stream clear cutting practices should not be done on areas $\geq$ 60 degrees upslope from riparian zones. The site where trees were harvested under an eco-forested management plan, however maintained its bank stability. Two key components to this management plan were to add large woody debris to the stream, and to selectively harvest trees. This suggests that if these two management practices are observed trees may be harvested without detriment to stream bank integrity, even in areas which have $\geq$ 60 degree slope.

Options for Eco-foresters/Homesteaders

This study indicated that Eco-foresters and Homesteaders in the region have options, but face challenges, when trying to manage their land sustainably. Options

include collecting species for the floral industry, and managing under story brush species and riparian areas using locally developed, sustainable, techniques. Challenges include developing eco-monitoring and certification programs for small independent foresters in the region.

Salal, huckleberries, and sword fern are the three most commonly found species that are used in the floral and nursery industries. Though less frequently found while surveying; cedar and Oregon myrtle similarly are used to make holiday wreaths. The vegetative parts of such plants can be routinely harvested for such industries. To be of importance to these industries plants must be managed so as to produce high quality foliage. The most common species surveyed: sward fern, various native brambles, and blue and red huckleberries are also commodities in the local nursery industry. Sword ferns are routinely transplanted and sold to nurseries. Huckleberries and brambles are also transplanted, have cuttings made from, and have seeds harvested for the nursery industry. Another market that could be explored is the herbal medicine market. Managing for this market would be similar to the brush industry market where plants are managed to produce high quality anatomical and/or physiological components. Native American spirituality and cultures are also of interest to many people throughout the region and country. Such plants therefore could potentially be sold or bartered to those who wish to pursue such a lifestyle.

One of the major problems in creating sustainable forests in the area is how to sustainably deal with under story brush species. Such species are problematic for they heavily compete with tree species decreasing their rate of growth. When I observed a site that was being cleared of brush by goat browsing; I was shown the rings of late

successional tree species approximately 3 inches in diameter. By counting the rings I concluded that they were roughly 40 years old. This stunting of growth was likely due to competition from the thick population of brush. In an area where forest productivity can allow trees to grow to 24 inches in diameter in 50 years, one can easily see how competition with brush species has a great impact on this productivity. Encouraging the browsing of pigs, goats and cows, as a form of brush control, does allow for a chemical alternative to herbicides and fertilizers. It has also created commodities for other markets such as dairy, and meat. This could also open up markets for other value added animal products such as cheese, soap, and leather goods.

In a region that relies heavily on forestry products it is worth examining which products may be available from riparian zones since they are areas that are not logged. If forestry products can be sustainably harvested from riparian zones it may add a layer of economic diversity in a potentially unstable extractive economy. Giving riparian zones an economic value could also help maintain their debated width from those who wish to include it in the harvested area. Agricultural animals are also not allowed to browse or graze in riparian zones. Giving an economic value to the brush in riparian zones could offset the loss of not being able to use these areas as grazing or browsing areas.

In order to create a market for eco-forested products, such products need to be certified as sustainable harvested. Eco-foresters in the area want and need access to affordable certification that sets them apart from industry. Current certification institutions do not address the financial needs of these small, independent, sustainable, wood producers. Even though the FSC has been able to give grants to small independent producers in the area to reduce the cost of certification, the cost is still in the thousands of

dollars, and still too expensive for the eco-foresters surveyed. Industry, however, can afford to be certified by both the SFI and FSC. Small independent foresters do not have a certification that sets them apart from industry. This is also bad for consumers who wish to buy from independent producers. A consumer who purchases FSC wood can not be sure if the wood that they are buying is from independent producers, or from large companies which may also promote industrial, non-sustainable forestry.

Current certification practices themselves also need to be reexamined. Certification is meant to assure the consumer that the timber product purchased is from a forest whose logging practices promotes sustainable forest ecology, and promotes social responsibility. The problem is there is no clear consensus on what defines biological or socioeconomic sustainability, especially given that there are regional variations for both. Certification (as it is currently practiced) may itself interfere with promoting ecological integrity (Sedjo 2004). Some argue that forests should not be seen as moving through a narrow set of given stages until they reaches a predicted climax stage, but rather forest succession should be view as independent set of stages. At each stage a set of variables characterize that stage. As each variable within that stage changes, it creates the possibility for the forest to move into a different stage. Therefore there is no one unique path for forest succession but multiple potential stages that may, or may not, reach climax (Botkin 1990). Certification procedures are criticized as being too tied to climax forestry ideology, which views forest ecology as a static state, and does not ensure ecological sustainability through its relevant potential ranges, but instead inhibits it (Sedjo 2004).

Finally, to monitor the progress of certification and sustainability of forestry practices, extensive surveying, and continual monitoring, of all plant species should be

done to document their representation and change in the region. Studies that determine the relationship between the presence of brambles and the overall bio-diversity of a site should also be conducted. The effects of introduced native economic species into the riparian zone should be conducted to test for their viability, and for their effects on the existing plant communities. Surveying and ethno-botanical analysis of edible mushrooms should also be done. The transect data suggests that eco-forestry practices promote biological sustainability in the area. Such practices therefore should be promoted to improve and maintain the areas biological integrity. Part of the area's eco-forestry management plan is to restore much of the forest to old growth status. As such forests progress to old growth it could reestablish a market for larger trees. This might create incentives for industrial sites in the area to progress and stay at old growth as well. This could provide an economic alternative to managing stands in short term rotations.

Conclusions

Timber communities are often criticized for lacking entrepreneurship (Beckley and Reimer 1999). I however, did not observe this in the Cape Blanco area. In fact I observed a culture in which people were actively engaged in experimenting with gaining self-sufficiency through using natural resources from their environment. I also observed a culture in which information, labor, and resources were readily shared or bartered. The culture also displayed moral responsibility to maintain the biological integrity of the area. All of these factors suggest that a sustainable approach to forestry, which utilizes a diverse number of forestry products, has a chance of succeeding in the area.

What hinders this success is the lack of access to a reliable and affordable certification process. With out such certification it is doubtful that such items could be sold in any significant quantities outside of the Cape Blanco area. Informal networking however is very prevalent and efficient in this area, and a sustainable forestry market may be economically sustainable on a micro level. Tourism and seasonal retirement communities are prevalent in the area, which provide some opportunity to sell products to consumers outside of the community. In my experience many residents in the area strive to be as self sufficient as possible. An economy which sells or barters a diverse number of locally produced commodities may be more suited to the goals and lifestyles of this community, than one that sells commodities to the larger world community. This study suggests therefore that ways in which the local economy can maintain itself on a micro level should be seriously explored.

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