2000 – 2001 Monitoring Report

on

Riparian Improvement Project Effectiveness

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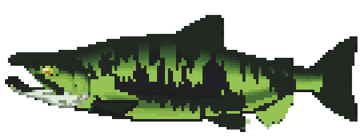

South Coast/Lower Rogue Watersheds

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Summary

Riparian conifers planted along 64.1 miles of stream from 1996 to 2001 had an average stocking/survival of 40%. If three failed sites from the first year of planting are excluded (6.6 miles), the average stocking/survival increases to 52%. These three plantings failed due to 1) abandonment after the November 1996 flood, 2) planting in a cobble/gravel terrace, and 3) planting in an an area subject to flooding by New River. Plantings typically either did well, with 80-100% survival, or did not do well, with 0-20% or 20-40% survival. Stocking/survival and growth estimates were obtained for 42% of the 64.1 miles of riparian improvements.

Factors that influenced growth and survival were evaluated by how frequently the factor was cited as the cause of failure. Blackberry and/or gorse competition was noted on 25% of the sites. It is suspected that some of the mortality in blackberry is due to vole activity (cited directly on only 5% of sites). Livestock browsing and/or trampling was noted at 20% of the sites. Droughty soils (trees planted on abandoned gravel bars, rip rap and other sandy soils) were noted on 15% of the sites. Other documented factors include: dessication by wind (12.5%) browsing damage by deer (especially on western red cedar - 12.5%), wind damage (10%), shading by alder (10%), poor selection of species (7.5%), beaver damage (7.5%), and damage from maintenance of competing vegetation (7.5%). Moisture competition from grass was only specifically cited on 5% of the sites, but was likely an important factor at the sites where droughty soils and dessication by wind were noted. Grass competition also occurred on sites where survival was high, but these sites generally had loamy soils and were further inland. Other factors listed on two or less sites included mountain beaver ("boomer") damage, low root-shoot ratios on sitka spruce nursery stock, and damage to protective fencing during the November 1996 flood.

Evidence of summer temperature reductions in two small streams is included as an attached report (Appendix A). To design and evaluate future riparian improvements, it would be useful to understand the relative contributions of increased surface and goundwater flow, decreased channel width, and increased shade on temperature reductions.

An adaptive management section recommends further investigation into interacting factors influencing survival and growth. Intensive plot monitoring should not replace the current extensive monitoring approach, including interviews and photo points. Photo point documentation and usage needs improvement. Expanded monitoring of changes in riparian functions is also recommended.

Introduction

Riparian improvements were implemented with the general objectives of restoring riparian vegetation and controlling livestock access to streams. Over time, riparian vegetation functions are expected to improve. These functions include shading, filtering and depositing sediment and wood, stabilizing stream banks, dissipating energy, infiltration and floodplain recharge, trapping and supplying nutrients, providing cover and harboring terrestrial insects, among others (NCASI, 2000, Pritchard, 1998). Riparian improvement activities include fencing, planting conifers and hardwoods, off-stream watering systems, and animal passage facilities.

Monitoring can address a wide range of questions about the effectiveness of riparian improvements. At the watershed scale, improvements may be judged as effective if they were strategically located in areas with greatest potential for increasing a critical or limiting riparian function. Riparian conifer planting is based on the premise that it is possible to "jump-start" the successional pathway. Research in unmanaged riparian areas along the central western Oregon Coast documented natural regeneration in only 18% of the plots, and most were Sitka spruce growing on logs (Nierenberg and Hibbs, 2000). If riparian areas were fenced to exclude livestock and left to develop, would the resulting vegetation function as an "effective" project? If we manage to establish conifers as the dominant overstory species, will the composition and diversity of the understory species be acceptable or desirable? More site-specific questions could focus on the cost-effectiveness of particular site-preparation treatments.

As riparian restoration activities begin to improve riparian functions, monitoring the status of these functions will increase in priority. This report documents improved riparian function, as measured by water temperature, for two small streams (Appendix A). However, most of the monitoring effort to date has been focused on conifer survival and growth as indicators of effectiveness.

What percentage of the conifers survived, and of the trees that survived, how is their vigor (as estimated by the annual growth rate)? Where survival is low, how much mortality resulted from moisture stress, competition for light, or animal damage? How do our choices of species, planting sites, planting and/or site preparation techniques, tree protection, maintenance schedules, and fencing types influence survival? How are site preparation and maintenance needs related?

> Riparian forests have many "troublesome" characteristics that make riparian silviculture difficult. Coastal riparian forests are disturbance prone…Succession trends are not necessarily toward conifers in a human-altered disturbance regime, and are poorly understood…Observation of current practices indicate that managers are…underestimating the amount of recurring maintenance that will be necessary to secure large conifers in coastal riparian forests (Emmingham, 1999)

This report identifies the type and geographic distribution of local "troublesome" characteristics. The relative influence of these factors on survival and growth of riparian conifers is discussed. At the current level of monitoring effort, these factors may be addressed only qualitatively. It may be helpful to recognize that survival rates for naturally developing stands are unpredictable
and

influenced by disturbance from flooding, wind, bank erosion, wildlife, wildfire, and naturally competing vegetation such as hardwoods and brush species. The "human-altered disturbance regime" is set within managed forest, pasture, golf courses, parks, and cranberry bogs. Even the act of caring for the plantings, by watering and treating competing vegetation, can produce unanticipated disturbances.

Riparian improvements began in 1995 under the Hire the Fisherman program with Oregon Department of Agriculture and grants from the State Watershed Health program and Oregon Department of Environmental Quality. Fencing in 1995 was followed by planting early in 1996. The earliest plantings are now six years old.

Methods

Ideally, all riparian plantings would be monitored, or a randomized process would be used to select projects for monitoring. In reality, funds for monitoring were limited so that all sources of information were used. Primary sources were from Tree Planting Record Forms (Appendix B), interviews from tree planting crews that were replanting some sites, and maintenance crews that watered and treated competing vegetation. Interviews with crew members, coordinators, and landowners about specific projects are available in the watershed council office and have been summarized for this report.

Sites that received maintenance were in some cases the more difficult sites, and in other cases they were replanted or maintained based on landowner request. Sites from the 1999 monitoring report were revisited. The monitoring program manager attempted to balance the monitoring of sites expected to be in good condition, with those expected to be in poor condition. Plantings from the earliest years and plantings along shorter reaches were less likely to be monitored.

"Condition Rating" classes from the 1999 monitoring report were replaced by separate stocking/survival and growth classes. Stocking/survival was grouped into classes of 0-20%, 20-40%, 40-60%, 60-80% or 80-100%. The mid-point of the class was used to calculate a lengthweighted average survival that was summarized by watershed and for all plantings. Each side of the stream is counted separately to estimate the length. The total length of planted riparian zone was calculated from the project database (Table 1).

The estimated stocking/survival is a cumulative rating, because nearly half of the monitored plantings were replanted in later years. Replanting intensity varied from infilling a few trees to complete failure of the first planting. Thus, the stocking/survival rating is really an estimate of the percentage of the original planting sites now occupied by trees. See discussion section for more about tree spacing and stocking percentages. The number of plantings completed to achieve the current stocking/survival classes are given in Table 2.

Growth classes were divided into slow (<1 ft/year), medium (1-2 ft/year), and fast (2-4 ft/year). Differences in growth by species are noted in Table 2. Many of the sites with species in the slow growth class were planted in recent years, and growth rates are expected to accelerate as the tree root systems mature.

Reporting for the Hire the Fishermen program (1996-1998) included total numbers of trees planted, length of riparian fencing completed, and map locations. Trees planted by species were reported beginning in 1999. For this report, all old tree orders were reviewed to compile a record of the species and seedling sizes planted in the early years of the program (Appendix C). Currently relational databases for projects, grants, and landowners are updated after each planting season with Annual Tree Planting Record Forms (Appendix B). Projects are listed by watershed, landowner, grant funding, year of project, number of trees and willows planted, and length along the stream. Database output is used to summarize the length of riparian planting and fencing projects, and the amount of monitoring completed by watershed.

Additional forms were developed in 2002 to record tree heights by species for different stream segments with photo points and GPS locations (see Appendix B). New forms were also introduced for recording plot data on plantings where measuring each tree would be too timeconsuming. A few sample project locations and monitoring results have been mapped on digital orthophotos using ArcView GIS.

New photo points were established on a number of the monitoring sites. In the future, additional photos could be taken at photo points established during the 1996 Hire the Fishermen program projects. A riparian survey in the summer of 1997 consisted of plots on Floras, Willow, Euchre, Pea and Cedar Creek, and included many photographs that could be retaken. Results from this older survey are included as Appendix D.

Results and Discussion

Riparian conifers planted along 64.1 miles of stream from 1996 to 2001 had an average stocking/survival of 40% (Table 1). Assuming that some failures from the first year of planting should be excluded (6.6 miles), the average stocking/survival increases to 52%. These three plantings failed from: 1) abandonment after the November 1996 flood, 2) planting in a cobble/gravel terrace, and 3) planting in an area subject to flooding by New River. Stocking/survival is related to site conditions, maintenance history, and year of planting. Watershed averages are influenced by all of these factors, and do not reflect site conditions as well as other means of summarizing the results. Where few miles were planted or a low percentage of the plantings were monitored, the results can be strongly biased.

Stocking/survival and growth estimates were obtained for 42% of the 64.1 miles of riparian improvements. Stocking/survival and Growth classes for each project site are tabulated with an "Explanation" column citing any site influences on tree survival and growth (Table 2). Plantings typically either did well in the 80-100% stocking/survival class, or did poorly in the 0-20% or 20-40% class. This distribution is distinctly bimodal, with none of the sites in the 40-60% stocking/survival class.

Tree planting crews report that they typically planted four feet apart where the soil, wind, and expected maintenance conditions were good. In windy areas, they might plant even closer. Stocking/survival classes are based on the number of planting sites occupied, or the count of trees remaining compared to trees planted. Based on a planting with four-foot spacing, if

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Table 1: Riparian Planting Stocking/ Survival by Watershed

Watershed	Miles Planted	Trees	Willows	Percent Checked	Length-Weighted Avg Survival
New River	5.2	19306	1750	57	49 88*
Floras Creek	14.7	46486	12610	32	49
Sixes River	9.5	11525	3125	37	23 90**
Elk River	15.9	27200	4500	44	39
Port Orford WS	0.4	1040	0	14	30
Euchre Creek	7.1	11282	10355	17	53
Lower Rogue	4.1	7520	1555	26	85
Hunter Creek	0.5	214	1000	3	20
Pistol River	1.2	1790	bioeng	91	48
Chetco River	4.3	9012	5300	99	33 74***
Winchuck River	1.2	950	0	87	10
Total:	64.1	136325	40195	42	40
Total with Exclusions listed below:					52

* Excludes a 1996 planting that had virtually no survival due to flooding along New River
** Excludes a 1996 planting that was abandoned after the November 1996 flood
*** Excludes a 1996-97 planting on a cobble/gravel bar with no survival

Stocking/ Survival Class	Growth Class	
		Stocking/Survival class includes # of plantings if more than one.
80-100%	Fast	Fast growth is 2-4 ft/year (F)
60-80%	Medium	Medium growth is 1-2 ft/year (M)
40-60%	Slow	Slow growth is 0-1 ft/year (S)
20-40%		
0-20%		

Table 2

Abbreviations: KMX=knobcone/Monterey pine hybrid, SS=sitka spruce, SP=shore pine, DF=Dougla-fir, WRC=western redcedar, US=upstream, DS=downstream, LF=lineal foot

Project ID	Stocking/ Survival Class	Growth Class	Explanation
NR-03	0-20%	-	1997 planting out in wind-exposed zone, see orthophoto showing planted area with low survival
NR-03	60%	S-M	Early planting, included lots of KMX hybrid for wind break
NR-03	80-100%-5	S-M	2001 SS & SP on south side, behind row of willows on north. Windblown SS and KMX, less survival closest to ocean
NR-13	80-100%		Grand fir breaking off in wind
NR-06		M	Redwoods out of natural range, doing well
NR-01			See photos of spruce, no other data
FL-01	80-100%-2	S-M	Few older DF survive, redwood fastest growing, but some tops blew out, high survival in spruce, good WRC
FL-01	60-80%-4	M	Higher sites wind stressed, older plantings grazed by cows when fence not working, now stocked except for gravel bars
FL-16	0-20%	S	Few survived under blackberry cover, now cleared, but shore pine in good shape
FL-20	60-80%	S	Sitka Spruce and shore pine w/ 100% survival, redwood and western red cedar died
FL-20	80-100%	S-M	Beaver ate willow and alder first, now killing western hemlock and shore pine, leaving sitka spruce (M)
FL-18	20-40%-4	S	Self-planted older stock, browse by deer, mtn beaver, goats and cows occ in fence; shaded riparian, redwood Med
FL-05	0-20%-3	S-M	Poor survival in blackberry and in areas w/ cobble/gravel, alder shade in US section, DF & WRC Med, 15 LF/tree in DS sect
SX-09	80-100%	S	Competition w/ grass & thistles, little rodent damage, spruce growth may be Medium
FL-04	80-100%-4	S-M	Good upriver site but variable survival & height due to blackberry, sheep browse, rip rap, shade, beaver & vole damage
SX-04	80-100%-2	S-M	1999 plantings in excellent condition, scalping and watering consistent, some spruce have Medium growth
SX-01	0-20%	-	Fence not maintained after 1996 flood, grazing through riparian
SX-03	80-100%	M-F	Fence maintained, close to ocean but soil is loamy, spruce and shore pine look good
ER-08	20-40%-5	S	Multiyear SS & DF survived blackberry mowing only among large SS & willow, WRC survived overbank, .13 mi silty/sandy
ER-07	20-40%	S	2000 SS w/ wind dessication, cows in riparian zone like shore pine, coming up through blackberry
ER-06	80-100%-4	S	Shore pine (S-M), wind dessication of other species, but growing, stocked, fence line maintained
ER-01	0-20%-3	S	Third year willow cuttings, sheep grazing continues; also sandy soil where rock vanes were installed
ER-14	60-80%	S	SS w/ 50% survival (01 stock), grass competition, cattle trampling 2x, some rodent damage, WRC good survival but browsed by deer
ER-05	0-20%	-	Lack of maintenance, blackberry competition
ER-02	20-40%-3	S	Deer browse on western redcedar, some sitka spruce surviving within blackberry/gorse, some redwood?
PO-09	20-40%	S	Western redcedar survival only 15% due to deer browse
EC-02	0-20%-2	-	Lack of maintenance allowed cattle to graze trees, ranch manager was not owner, change of management
EC-02	20-40%-2	S-M	Protected from grazing in riparian zone by blackberry; spruce (M), redwood (S), Doug-fir (S)
EC-07	80-100%	M	Good stocking on diverse mix of Douglas-fir (M), redwood (M), spruce (M), incense cedar (S), and willow

EC-06	80-100%	M	Good stocking of Douglas-fir and sitka spruce, free to grow
EC-09	20-40%	S-F	Patchy survival, mostly spruce (M) & redwood (M-F), few Douglas-fir (S-M)
LR-02	80-100%-3	S-M	Excellent spruce growth, some DF, RW, WRC, WH. Grass competition, but had maintenance. Inland site
LR-22	0-20%	-	Mowing killed trees at a park
HC-06	20%	-	Trees overgrown by blackberries even with some maintenance
PR-01	80-100%-2	S-M	SP (M-S) in wind, vigorous, shovel-planted, water/blackberry control; ponderosa(S), 1st planting was droughty, 65%-70% survival
PR-06	20-40%	M	Only 30% survival of spruce and fir due to lack of fence, horse access, survivors 3-6 ft tall
CH-01	0-20%	-	Extremely droughty gravel/cobble bar with silt deposits over top, mixed together at bioengineering site
CH-01	0-20%	-	Low on streambank so expected to get enough water without watering
CH-01	0%	-	Gravelly soil, hi flows damage fence, 15% willow survival from deer browse

survival was only 50% and well-distributed, the site could have 100% stocking at eight-foot spacing. This site would likely have been replanted. See additional discussion in the section on Moisture and Light.

Table 2 observations from each project site can be grouped into the following categories:

- Moisture: Competition from grass or other brush, Droughty soils (gravel bars, rip rap, sandy), Wind exposure, Poor root/shoot ratio on nursery stock
- Light: Shading from blackberry, gorse, alder
- Species Selection: not adapted to the site
- Physical Damage: Livestock, Deer, Voles, Beaver, Mountain beaver, Wind damage, Maintenance of Competing Vegetation, Flood damage to fence and/or plantings.

Blackberry competition was noted as a factor at 22.5% of the sites, with gorse competition listed at one additional site for a combined 25% from blackberry and gorse. Livestock browsing and/or trampling was noted at 20% of the sites. These included cows, sheep, and horses, usually involving fence maintenance problems. In extreme cases of fence neglect, electric fences were overgrown by blackberry, allowing livestock access. However, blackberry protected some trees from livestock on at least two sites. On 15% of the sites, droughty soils were listed as a cause of mortality. These plantings were primarily located on abandoned gravel bars, but also on rip rap and other sandy soils. Dessication by wind, and browsing damage by deer were the next most frequent factors, at 12.5% each.

Wind damage and shading by alder were identified at 10% of the sites each. Most frequently, coast redwood (many were planted in 1996) blew over or had their tops blown out after two separate windstorms during winter 2001-2002. On 7.5% of the sites, it was noted that species such as Douglas-fir, coast redwood, and western red cedar did not survive as well as shore pine and sitka spruce where they were planted in wind-exposed areas. Maintenance of competing vegetation in golf courses, parks, and blackberry patches contributed to mortality on 7.5% of the sites. Beaver damage was reported on 7.5% of the sites, however at one site it was noted that they do not bother sitka spruce.

Surprisingly, competition from grass was only specifically cited on 5% of the sites. Moisture competition from grass was likely an important factor at the sites where droughty soils (15%) and dessication by wind (12.5%) were noted. Survival was high on some sites despite the grass competition, generally at sites with loamy soils and wind protection (plate 1, bottom right). Vole damage by girdling was identified as contributing to mortality on only 5% of the sites.

Because voles are known to hide under blackberry or grass cover, it is suspected that some of the mortality associated with blackberry and grass is related to vole activity. Mountain beaver ("boomer") damage was noted on one site (2.5%). Poor survival on one site was attributed to low root-shoot ratios on sitka spruce nursery stock. One site failed as a result of damage to fencing during the November 1996 flood, followed by a lack of interest in having the fence repaired. Flooding of wetlands and low pastures caused mortality of planted conifers along a tributary to New River (plate 2)

Some treatments and site conditions were mentioned as reasons for the good performance of a planting. On 10% of the sites, mortality was expected to be higher due to dessication by wind or grass competition, but watering improved the results. Watering and weed-eating of grass during the summer probably improved results on many more sites where maintenance records were not kept. Blackberry maintenance by mowing or spraying by the landowner improved the results on at least 10% of the sites (these activities are also probably under-reported). Other treatments that were attributed to better results included scalping, shovel-planting, planting a hybrid knobcone- Monterey pine cross (KMX) on a windy site, and good soils near a windy site.

Moisture and Light

Coarse-textured soils are located adjacent to active channels as a natural consequence of channel migration leaving gravel in abandoned bars and terraces. In agricultural areas many channels have been straightened so that abandoned channel beds and point bars frequently occupy riparian areas. Gravel deposits have reduced survival for plantings at Cedar Fork on Euchre Creek and Willow Creek. Where abandoned and active point bars have been fenced, natural regeneration of willow and/or alder can capture fine sediment and organic matter, improving the soil for other species.

Among the undesirable consequences of channel migration are bank erosion and property loss. Many of the rivers in the county have old rip rap along their banks where they flow through river terraces. Planting is difficult at these sites and the thin soils often do not provide enough moisture. Channel straightening has been used to fix property boundaries and to reduce deposits of wood and sediment from flooding. Straightened channels tend to downcut and isolate the stream bed from the upper banks. Less frequent overbank flooding reduces the soil moisture until the channel rebuilds a floodplain. Riparian conifers have been planted along downcut channels in various stages of recovery, including Davis Creek, Morton Creek, North and South Langlois Creeks, lower Floras Creek, Pea Creek and Crook Creek.

Soils conditions are extremely variable throughout Curry County. In addition to river terraces, streams flow over marine terraces, abandoned dunes, and a wide range of bedrock types. Soil conditions are considered in the field when selecting species and planting sites, but no consistent descriptions are available for comparisons. For example, compaction may be the explanation for mortality at some sites, rather than a reported "hard pan" layer.

Seedlings experience noticeable wind burn on the north-northwest side of the trees in plantings on Floras and Langlois Creeks. Survival/stocking decreased toward the ocean along Langlois Creek (plate 2). Wind dessication reducing soil moisture is suspected as the reason why growth rates on shore pine on Crook Creek decrease with proximity to the ocean (plate 3). However, soil textures could also vary and have not been analyzed. Stocking/survival on a planting near the ocean on Sixes River is excellent (plate 4). It would be useful to map the survival/stocking classes to overlay with soils and proximity to the ocean. Site-specific soil conditions may be somewhat different than the mapped NRCS soils.

Competition for moisture and light can influence survival, vigor, and increased height growth at the expense of diameter and root growth. Adequate root growth is needed to develop the windfirmness required for survival in coastal areas. Adjacent vegetation (which also competes for moisture and/or light) helps to protect tree seedlings from the wind. Moisture availability and the presence of competing vegetation are key factors to be considered in selecting appropriate species, site preparation, and tree spacing (see tree spacing discussion below). Moisture availability will vary with soil texture, aspect, cover, wind exposure, and vertical and horizontal proximity to the floodplain. Watering basins and/or mulch as well as scalping may help to retain adequate moisture.

The response of grass and blackberry to livestock exclosure is dramatic (plates 5 and 6), and competition with conifers is a detrimental effect. It is also evident that grasses, herbs and shrubs can provide one of the key riparian functions of filtering surface water runoff from pastures within a few months.

Summer maintenance of plantings by grants through the Watershed Councils have varied in intensity over time. Crews typically used weed-eaters to remove grass and competing weeds and watered during one-three summers following planting. Blackberry canes have been removed with various hand and power tools.

1995 Vegetation release on 2.0 miles along Euchre and 0.5 mile along Winchuck
1996 Youth group and Hire the Fishermen watered and released trees on plantings on Floras, Willow, Euchre/Cedar, and Chetco.
1997 Youth Conservation Corps three-person crew plus leader, weeding among other jobs
1998 Dedicated Youth Conservation Corps three-person crew plus leader, mostly weeding
1999 Dedicated 1-person weed crew (Wardle)
2000 Dedicated 1-person weed crew, minimal watering (Wardle)
2001 Dedicated 1.5-person weed and water (Mahoney and Lee)
2002 Dedicated 3-person weed and water crew (Lang, McKenzie, Meeks)

Many landowners also watered and maintained competing vegetation, but records are incomplete and anecdotal. The intensity of maintenance effort among landowners varies considerably. The landowner's ability and motivation to care for the trees is easier to evaluate in hindsight. Activities include irrigating trees (plate 7, bottom right), releasing trees from blackberries, spraying competing vegetation, and staking seedlings. See also the discussion under Physical damage.

Blackberry does not appear to kill trees as readily as grass competition. In some areas blackberry has provided protection from livestock grazing when the fence was not maintained (plate 8). Blackberry appears to reduce vigor, resulting in elongated (etiolated) trees. In cases where trees have not survived the blackberry competition, it is not clear whether they have been shaded out, physically damaged by the canes, or chewed by voles that thrive under cover (plate 9). Forested sites typically had an alder overstory that shaded the seedlings and reduced vigor. Where the riparian alder were adjacent to pasture, the seedlings had more light (plate 7, top left and plate 10, top and bottom right).

Survival and growth rates were measured in response to different planting and site preparation techniques (Follansbee, DEQ Riparian Establishment and Maintenance Trials, Appendix E). Plots were established at two sites, one for shore pipe and one for sitka spruce. The experimental design was to include variations in weeding and watering, but it was determined that all sites needed maintenance to survive the first summer. Rainfall averages indicate that the moisture conditions were probably typical, and that the reported survival rates were similar to those experienced over the last six years. The control plantings had 50% survival on the Floras shore pine and 75% survival on the Rogue sitka spruce (Appendix E). Because only one species was planted at each site, it in unclear how much the site conditions influenced the results.

All treatments improved the survival rate, with the watering basins working better on the Floras site, and the weed mats working better on the Rogue site. Conifer growth was 1.7 to 3.4 times faster than the control, depending on the treatment.

Although different planting and site preparation techniques will increase survival and growth, will they be cost effective? To address this question, a "breakeven" analysis technique was developed. The spreadsheet (Table 3) allows the user to vary the costs for different planting and site preparation techniques. With results from plots like the DEQ Riparian Establishment and Maintenance Trials described above, for each technique the user selects an expected percentage survival, years of watering and scalping required, and stocking threshold for replanting. Values may be selected to represent conditions on good loamy soil/ protected sites and compared with values on rocky/gravelly exposed sites.

Assumptions programmed into the Breakeven Analysis:
- Planting and replanting use the same techniques
- Percent survival of new plantings is constant from year to year (user–specified)
- Mortality results from lack of moisture or competition (livestock grazing or wildlife browsing would affect all techniques equally)
- Mobilzation assumes driving and tree pickup time of 1 hour per crew member per day
- Cost for transport from nursery to coolers not included (fixed cost, higher for fewer trees)
- Water is applied 5 times from June-September (averaging every 3 weeks)
- Scalping takes 1.5 min. per tree, done twice per year in pasture
- Blackberry maintenance needs are not included in costs

Assumptions for the run plotted in figure 2:
- Planting costs for each technique based on interviews (Follansbee, Ashdown, & Swanson)
- Replanting not required after 85% of site is stocked
- Increased vigor due to shovel planting or scalping reduces years of watering & maintenance
- Scalping at time of planting reduces scalping need to once per year in the first year

To compare the cost-effectiveness of each technique, select an expected survival percentage, determine the cost of the technique, and compare the improved survival using another technique for the same cost. For example, on the graph for loamy soils, if we expect 50% survival from hoedad planting, it will cost $7.00/established tree. At the same cost, the shovel planting methods must achieve 87% survival, or they will be more expensive. The slope break in the graphs occurs due to the increased expense of replanting when survival is <85%.

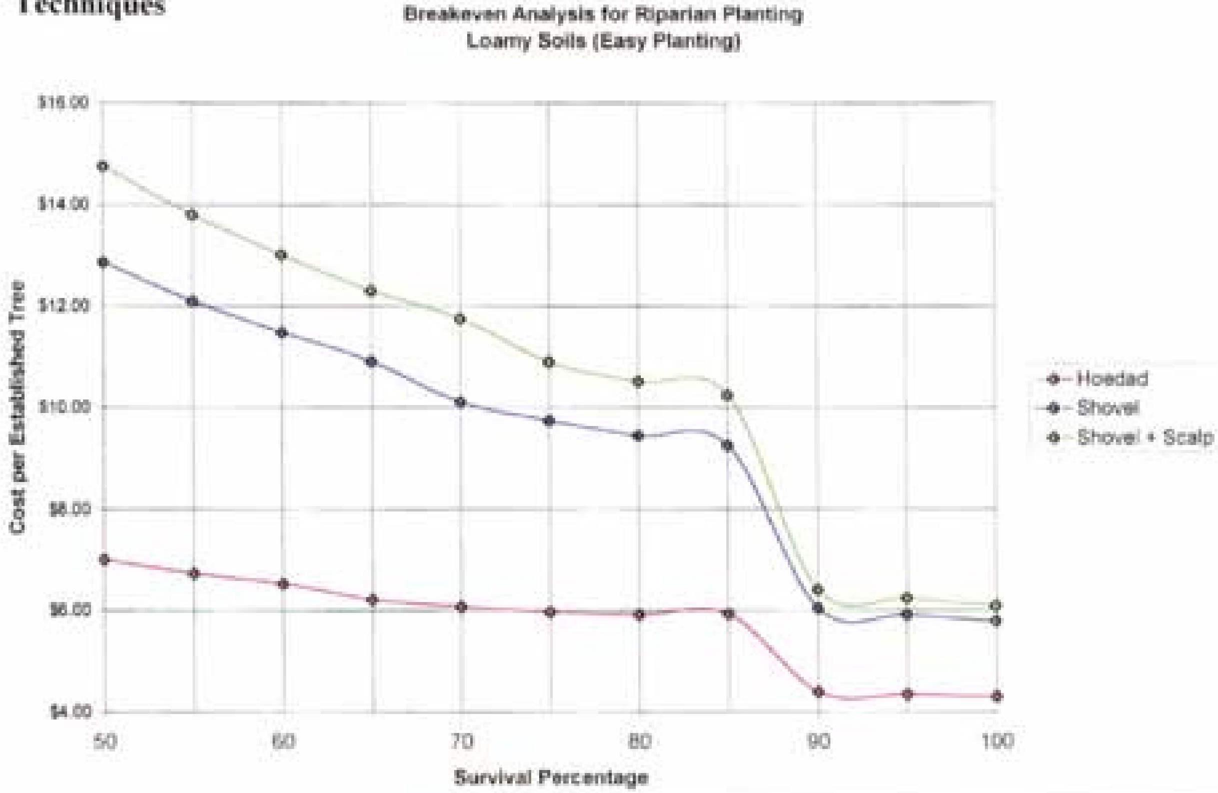
Table 3: Breakeven Analysis for Planting and Site Prep Techniques

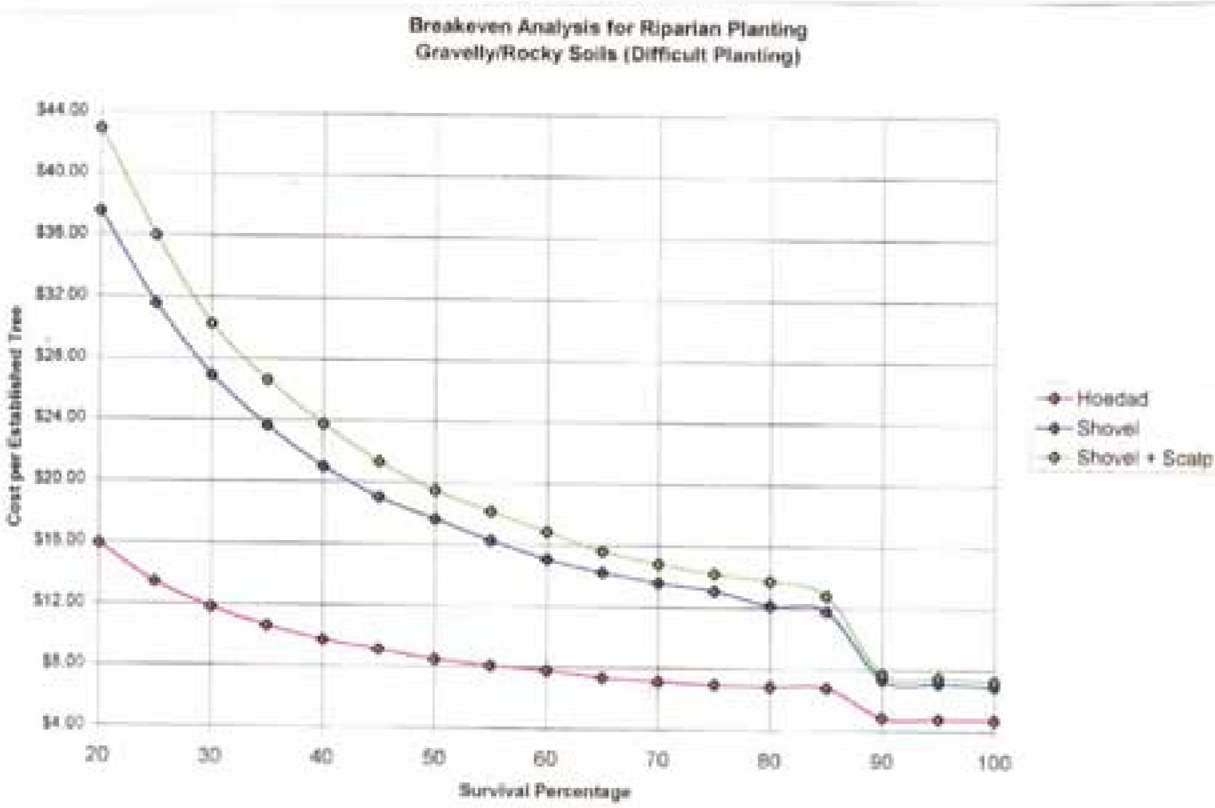
Cost per tree:	$0.40	(based on large sitka spruce & shore pine)	
No replanting when stocking is >	85%		
Number of trees to be planted	500	(affects mobilization costs)	

Loamy Planting Site/ Easy Access	Hoedad	Shovel	Shovel & Scalp
Planting Rate, minutes/tree	1	5	6.5
Survival per Year	75%	85%	95%
Planting Cost/ Established Tree	$1.08	$2.71	$3.04
Replanting Cost/Established Tree	$1.40	$3.06	$0.00
Years of Watering	2.0	1.5	1.0
Watering Rate, Trees/Hour	60	60	60
Watering Cost/Tree	$1.83	$1.38	$0.92
Years of Veg Maintenance (Scalping)	3.0	2.0	1.5
Veg Maint Cost/Tree	$1.65	$1.10	$0.83
Total Cost/Established Tree	**$5.97**	**$8.25**	**$4.78**

Gravelly or Rocky Planting Site/ Difficult Access			
Planting Rate, minutes/tree	2	8	9.5
Survival per Year	90%	50%	60%
Planting Cost/ Established Tree	$1.36	$6.93	$6.74
Replanting Cost/Established Tree	$0.00	$7.20	$6.90
Years of Watering	3.0	2.0	2.0
Watering Rate, Trees/Hour	60	60	60
Watering Cost/Tree	$2.75	$1.83	$1.83
Years of Veg Maintenance (Scalping)	3.0	2.0	1.5
Veg Maint Cost/Tree	$1.65	$1.10	$0.83
Total Cost/Established Tree	**$5.76**	**$17.07**	**$16.30**

Figure 2: Cost per Established Tree vs. Survival for different Planting Techniques





Species Selection

In the early years of the tree-planting program, several different nurseries were used to obtain a diverse mix of species (Appendix C). The relative numbers of each species purchased was at least partially determined by availability (figure 1). Hardwood purchases have been limited due to their greater cost per tree. As tree planters gained experience, they became more selective in their choice of species to be planted in more difficult sites. In 2001, Bruce Follansbee compiled a species selection and plant propagation document for watershed council use (Appendix F).

The early emphasis on Douglas-fir has decreased over time in favor of more sitka spruce and shore pine. An increase in Douglas-fir planted in 1999 resulted from a larger proportion of riparian areas along small forested type streams that year. These changes are consistent with recent studies of upland Douglas-fir abundance on unlogged headwater streams in the Oregon Coast Range and Sitka spruce zone (Shatford and Hibbs, 2002). In the Coast Range, 44% of the trees on small first-order streams and 8% on third-order streams were Douglas-fir. The abundance on all streams in the Sitka spruce zone was less than 2%. Spruce appear to be less palatable for grazing cows than some other species.

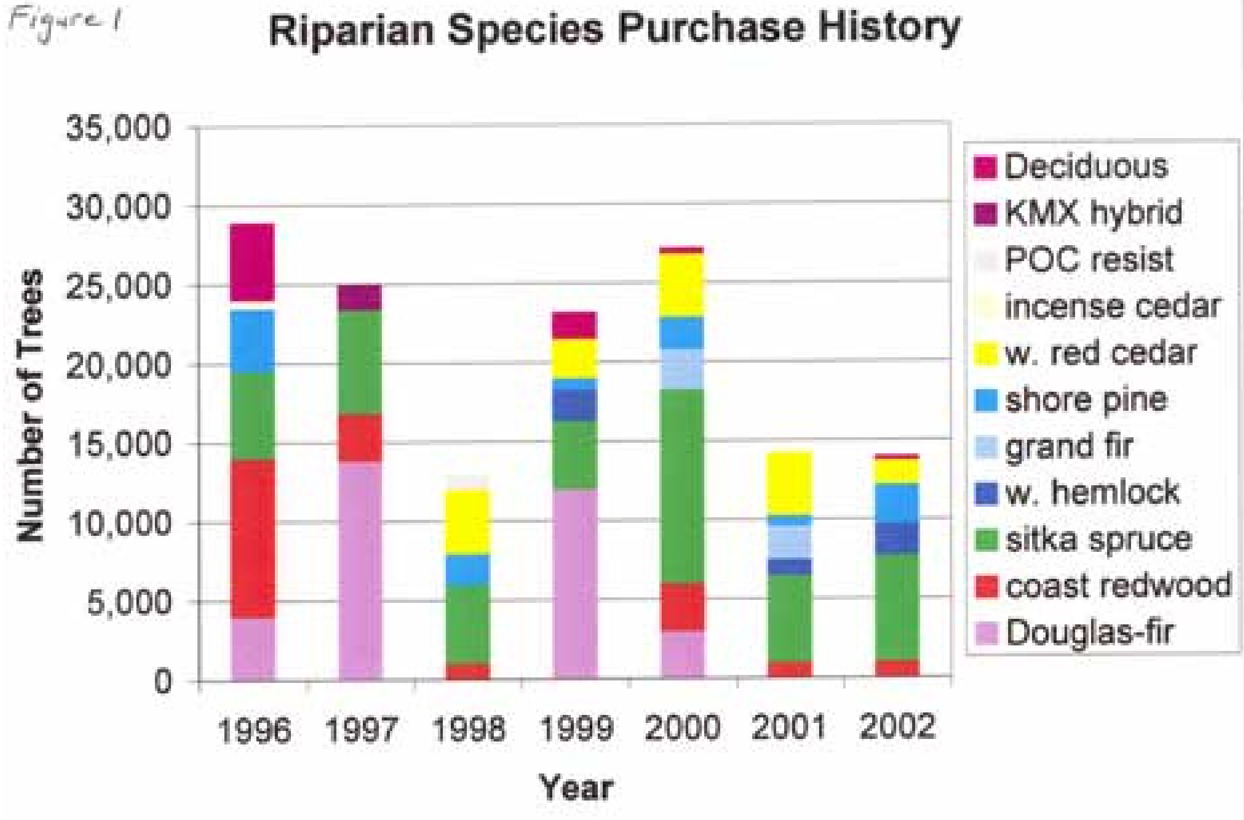
Coast redwoods were planted outside of their natural range, north of Chetco River to New River tributaries by landowner request. Where relatively protected from wind exposure, redwoods are growing vigorously, and are among the tallest of the early plantings (plate 7, bottom left). It is recognized that their long-term survival may be limited by extreme events of frost, drought or wind, or that their susceptibility to disease may be greater outside of their natural range. Already, it appears that redwoods may be somewhat more susceptible to wind damage than other seedlings, especially when planted in pasture with no understory shrub cover to help stabilize their roots. Considering the former range of coast redwood within the Pacific Northwest, these trees are rather close to their natural range.

In 1996, 500 incense cedar seedlings were planted in riparian areas (outside of their normal habitat in this region), but the exact locations are unknown. Where observed in Cedar Creek (plate 11, top left), they are slow-growing but healthy. One landowner purchased 50 ponderosa pine to plant within 0.5 mile of the coast. The 25% that survived are growing well.

Species vary in their rate of root development and growth. For example, sitka spruce has been observed to lag behind other trees in the first few years, but growth accelerates after the root system develops (plates 12 and 13). Spruce is not doing as well as we'd hoped in the "blow zone" at the downstream end of Floras, Elk, and Pistol Rivers. Hay bales were placed at one site to provide wind protection, but the spruce tips got brown when they grew above the barrier. More willows are being planted to provide cover for the spruce.

Non-native species planted in the first two years include 1500 knobcone-monterey pine cross (KMX) and 2000 super-poplar (Appendix C). The KMX were planted to establish wind breaks to protect future plantings and are well-adapted for that purpose. Many of the super-poplar trees were killed by beaver, although a few tall individuals remain in some areas.

Figure 1



Riparian Species Purchase History
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Number of Trees
1996
1997
1998
1999
2000
2001
2002
Year
Deciduous
KMX hybrid
POC resist
incense cedar
w. red cedar
shore pine
grand fir
w. hemlock
sitka spruce
coast redwood
Douglas-fir

Clearing for pasturelands has eliminated nearly all of the native black cottonwood from riparian stands in the county. As cuttings become available from three propagation beds established by Bruce Follansbee, black cottonwood plantings will increase in the future. Protocols and direction for propagation of black cottonwood are included as Appendix G.

Willow cuttings were purchased for 1996, but willows have since been propagated from species near the planting site. Many of the past willow plantings were associated with bioengineering projects (covered in a separate monitoring report). Photo points for monitoring these types of plantings are be preferable to accounting for individual cuttings. Willows can fully occupy a site after livestock exclusion without planting (Appendix A, Crook Creek and plate 3, bottom left).

Physical Damage

To quantify the extent of physical damage and effect on survival and growth, riparian plots would need to be established and visited at least annually for long-term results. Agents of physical damage range from floods and wind to trampling and browsing by livestock. Although conifers can survive and grow directly on the banks of stream channels, bank erosion, battering, and burial are more likely closer to the channel (plate 14). Site potential conifers measured across Curry County for a riparian shade assessment averaged 16 to 20 feet from the edge of the active stream channel, with closer distances for species such as cedar and hemlock. Alder and other hardwood species typically occupied the area closer to the channel. Where riparian areas had existing hardwoods, conifers were often planted behind them to mimic the more natural distribution (plate 1 and plate 7, top left). Where channels flow through open pasture, conifers have been planted to within five feet of the stream bank.

Recorded instances of livestock damage range from total free access (fence neglected), to a single incident of a young animal penetrating an otherwise well-maintained fence. Unfortunately, trampling or browsing the tops of seedlings can reduce the growth rate for a number of years, or kill already stressed trees. Freshly planted seedlings can be pulled out of the ground by browsing animals.

Electric fence requires maintenance of vegetation and debris along the fence line. Although many electric fences have been installed and are working well, landowners also report problems leading to animals within the riparian zone. Continued vigilance and maintenance of electric fence or woven wire is required to exclude lambs and small sheep from the riparian area. Larger animals can maintain vegetation along the fence line where the bottom electric wire is raised (plate 15, bottom left).

Unless the stream channel is incised, annual flooding causes accumulation of debris in the fencing, and periodic damage to the structure. The November 1996 flood eroded fences and riparian plantings including 10% of 5.3 miles on Euchre and 21% of 6.6 miles on Floras. Most of these fences were repaired in 1997. At least one landowner with electric fencing recommends "break-away" weak links to allow parts of the fence to fail without pulling on the posts.

High water during summer closures of the mouths of estuaries has shorted out electric fencing. Electric fence boxes had to be replaced in one instance each of vandalism and destruction by lightning. On the positive side, once animals are trained to an electric fence, they generally will not attempt to cross it for a period of time when it needs maintenance.

Chronic bank erosion makes fence maintenance an ongoing problem for landowners (plate 15, bottom right). Negotiations over wider setbacks can be difficult with landowners that already are volunteering to forego the use of part of their land. To decrease mortality from livestock browsing and reduce fencing costs where soil, vegetation, and channel conditions indicate that the fenced riparian setback is likely to be eroded, additional discussion will be needed. Narrower setbacks could be traded along inside bends and wider setbacks along the outside bend and downstream to anticipate channel migration. Although funds are generally unavailable for bank stabilization, providing structures that incorporate wood, planting willows and installing rock vanes and weirs are preferable to rip rap bank protection (plate 16). Sloping of banks to reduce erosion also creates a mineral soil planting site that is easier to revegetate (plate 17, top and bottom right), unless the exposed soils are droughty.

Livestock typically have access to streams and riparian areas at water gaps, where off-channel watering systems have not been installed. Cross-channel fencing and other water gap control structures require maintenance and repair after flooding. When adjacent properties are not fenced, livestock travel along the stream channel unless the responsible landowner controls the boundary with a cross-channel fence.

Browsing by deer and elk have also been cited as a cause of physical damage, stress, and reduced survival for particular tree species. It is unknown whether the presence of riparian fences might affect the intensity of wildlife browse. Tree protectors (Protex Progrow) were used in some years, and although spruce and Douglas-fir did well in tree protectors, KMX trees were damaged. Elk and cows can knock off vexar tubes. Selective browsing by deer on western red cedar was noted in most of the cases of browsing damage, and has been documented in the literature (Schreiner, et. al., 1996). Elk are known to graze on western red cedar, especially nursery stock with a higher nitrogen content (communication with Bruce Follansbee, citing research from Tillamook Bay Project).

Many unprotected hybrid poplar (and more recently black cottonwood) were attractive to beaver. At least one landowner protected his trees from beaver with individual wire fences. Beaver appear to have damaged more trees in low gradient areas where vegetation and large wood are sparse.

Awareness of tree mortality from voles has increased in the last couple of years. It is apparent that where cover is present under tall grass, dense weeds, blackberry, or weed mats, voles are able to chew the bark and kill seedlings. However, vole damage has also been observed in more open areas (communication with Matt Swanson). Plastic shields suggested for protection were not implemented due to concerns about wind, and the potential for warm air moving up the tubes if they were not in direct contact with the ground. Tinfoil has been suggested as a deterrent (communication with Chris Massingill). An ecosystem approach to this problem would dictate that we encourage owls, reportedly the primary predators on voles.

Where competing vegetation is controlled by mechanical methods, such as mowing or weed eating, trees are often killed. Along one reach with severe blackberry competition, a landowner planned to mow between the young trees, but instead killed the trees because they were so overgrown. Some type of brightly-colored marking is needed where mechanical methods are likely to be used. Tree survival was low in parks, campgrounds, and golf courses (plate 11, top right, and plate 18). One landowner mentioned that it was easier to find and water the trees that he had staked.

Physical damage can also result from competing vegetation such as blackberry causing breakage from canes hitting the trees in the wind. Conversely, with no cover from the wind, seedlings appear to be more susceptible to wind damage. At several sites where only grass was anchoring the soil, windstorms in winter 2002 blew over 6-12 foot trees, primarily coast redwood.

Tree Spacing and Stand Density

The desired stand density varies with species, function, and age of the stand. Annual losses of trees to disturbance can naturally thin an overly dense stand. Spacing for underplanting of senescent alder stands should account for conifer seedlings that will be damaged by falling branches and stems. Conversely, where trees have been planted close together, survival is high and disturbance is low, the resulting stand appears to have been overplanted in hindsight. Better predictions of expected mortality due to moisture stress and competition would improve this situation, but would require considerable investment in design and monitoring of plots.

Stocking of hardwoods and conifers in riparian stands developed under natural disturbances can provide some guidelines for target stocking levels at successive age classes. Access for landowners or crews to mow or treat competing vegetation is an important consideration in choosing tree spacing (communication with Jennifer Wright, ODF Forester).

Adaptive Management - Observations from Previous Reports on Tree Planting:
In 1996, the trees were planted late, and trees remained in the cooler for too long. The first year crew was inexperienced in planting techniques, resulting in some J-rooted seedlings. In some areas, crews planted on gravel bars or on rip rap where the soil holds too little moisture to support the trees without irrigation. In 1997, planting occurred earlier and the crew had more experience. Spruce and shorepine are best adapted to coastal conditions, but few have been available. Streambank erosion is a threat along some properties and many of these are sites of rock vane structures designed to trap sediment and narrow the channel. In 1999, spruce plugs were ordered for outplanting and delivery for the next winter.

Adaptive Management

There is a need to distinguish among the multiple causes of poor survival more quantitatively, with a focus on the types of sites that typically have had more problems. Mortality appears to be strongly related to differences in soils and wind stress. Mapping the survival/stocking classes would allow these results to be correlated with soil texture and proximity to the ocean. These maps would help to evaluate past survival and growth and to plan future riparian plantings. Problem sites can then be evaluated on a cost-benefit basis to determine how much more expensive planting or maintenance is worthwhile. Experimental plots that quantify expected survival and years of maintenance required will provide data for breakeven cost analysis.

The historic emphasis on planting conifers should be revisited. Where more pioneering shrub species can protect conifers from moisture stress, consider delaying conifer planting until cover is available. The desired riparian vegetation community may be better understood by examining the historic vegetation reconstruction from Government Land Office Surveys (received by the South Coast and Lower Rogue watershed councils in November, 2002).

Some questions to design into experimental plots:

- Effect of reducing grass competition (by scalping, weed mats, ongoing maintenance or other means) at sites with different moisture stress and moisture availability; vary proximity to ocean, soil types, and species
  - hold planting techniques constant for this set of plots
  - consider using a soil moisture retention model (Atzet) to predict and interpret the results
- Extent of physical damage from livestock access versus mortality from moisture stress
  - requires frequent visits to plots
- Extent of physical damage from voles using different vole control techniques
- Blackberry control techniques
  - document with photo points

Address riparian setback and fence maintenance issues by evaluating the probability of bank erosion and discussing fence maintenance responsibilities with landowners.

Future riparian monitoring can help to address some of the questions raised in this report. However, funding would need to increase several times over the current level of investment.

- Control costs by balancing extensive monitoring (field observations on many plantings) and intensive monitoring (plots designed to answer particular questions)
- Visit experimental plots at least annually, causes of damage or mortality are still evident.
- Expand monitoring of riparian functions as an outcome of the fencing and planting program.
- Upgrade systematic use of matching photo points with careful documentation, maintain storage system to allow rapid retrieval of photos a nd descriptions, and commit to locate photos prior to going to the field. Visit photo point locations at the same time of year for vegetation comparisons.

Acknowledgements

Riparian monitoring was funded by grants from the U.S. Fish and Wildlife Service and Oregon Watershed Enhancement Board.. This report would not be possible without the assistance, cooperation, and patience of landowners, watershed council coordinators, Curry Soil and Water Conservation District Directors, Oregon Youth Conservation Corps (OYCC) crews, and past maintenance and planting crews. Technical assistance was provided by Derek Godwin, Oregon State University Watershed Extension Agent. Matt Swanson, Watershed Council Monitoring Program Manager, Mike Maguire, Watershed Assessment Specialist, and Ralph Scott, OYCC leader provided additional monitoring data. Sincerest thanks go to Chris Massingill for increasing our focus and expectations for riparian conditions and monitoring. Harry Hoogesteger encouraged and supported this project when it was needed most. This report is dedicated to Cecil Ashdown, whose commitment to riparian improvement is what makes the program, and who patiently and graciously answered five years of questions.

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Plate 1

Edson Creek, LR-02, 03/05/02, view to the NNE of plot #1

Edson Creek, LR-02, 03/05/02, view to east of plot #2

Edson Creek, LR-02, 03/05/02, view to NNW of conifers behind diverse hardwood stand downstream

Edson Creek, LR-02, 06/28/00, view of plot #2 from upstream to

Plate 2

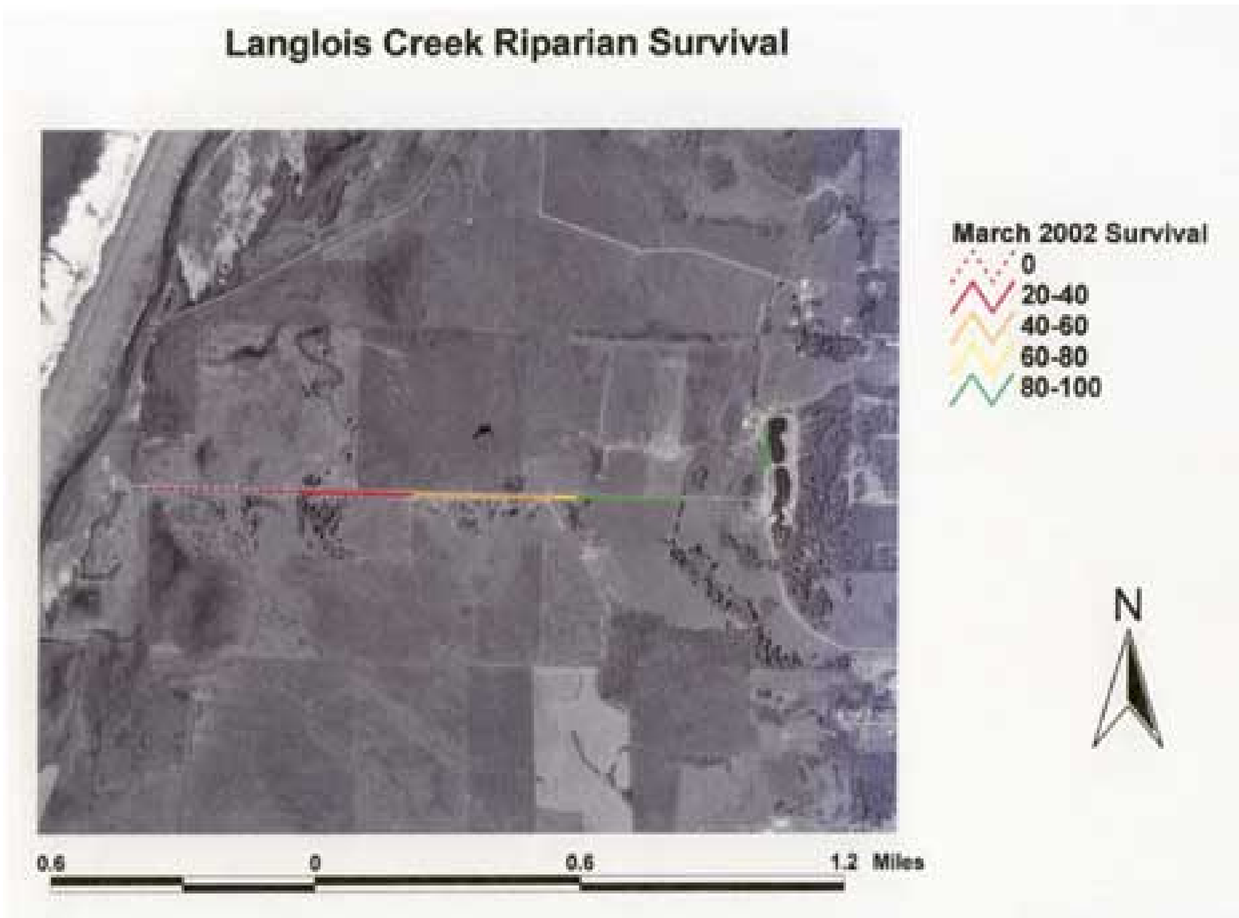

Langlois Creek Riparian Survival
March 2002 Survival
0
20-40
40-60
60-80
80-100
N
0.6
0
0.6
1.2 Miles

Plate 3

Crook Creek, view from fence corner, toward house, 12/28/01

Crook Creek, view from fence corner toward barn, 12/28/01

Willow along Crook Creek, thistles in shore pine, 12/28/01

Crook Creek view toward ocean from mid-reach, 12/28/01

Plate 4

SX-03, 02/08/02, view DS from NE corner of pasture

SX-03, 02/08/02, view DS from NE corner of pasture

SX-03, 02/08/02, view DS from near NE corner of pasture

SX-03, 02/08/02, view north from mid-pasture

Plate 5

South Langlois Creek, view to west, 03/15/00

South Langlois Creek, view to west, 12/15/00

South Langlois Creek, view to east, 03/15/00

South Langlois Creek, view to east, 12/15/00

Plate 6

North Langlois Creek, 02/19/99

North Langlois Creek, 12/15/00

North Langlois Creek, 02/19/99

North Langlois Creek, 12/15/00

Plate 7

Cedar Ck (EC-06), 01/04/02, Doug-fir & Sitka spruce Cedar Ck (EC-09), 01/04/02, surviving conifer on under alder upstream reach


Cedar Ck (ED-07),01/04/02, 15-20' redwood & Cedar Ck (EC-07), 01/04/02, irrigated redwood, 20-25' willow approx 18'

Plate 8


Euchre Mainstem Riparian Stocking
Riparian Monitoring Sections
Densely Stocked < 8 LF/tree
Mod Stocked 8-16 LF/tree
Sparsely Stocked 16-24 LF/tree
No conifers present
N
0.1 0 0.1 0.2 Miles

Plate 9

Willow Creek, FL-05, 02/22/02, Douglas-fir growing along fence line above slope newly cleared of blackberries

As above, newly cleared area replanted

Plate 10

Willow Creek, FL-05, view along fence where Willow Creek, FL-05, coast redwood next to alder, blackberries
were cleared recently, 02/02/99 canopy opening to the south, 02/22/02

Willow Ck, similar view with blackberries cleared again, 02/22/02 Douglas-fir growing well on open slope above terrace, 02/22/02

Plate 11

Cedar Ck (EC-07), 01/04/02, 3-5' incense cedar

Cedar Ck (EC-09), 01/04/02, view DS, 7' Doug-fir along fairway

Cedar Ck (EC-07), 01/04/02, irrigated Douglas-fir

Plate 12

Tributary to Fourmile Creek, 12/15/00

Tributary to Fourmile Creek, 12/15/00

Tributary to Fourmile Creek, 03/15/00

Plate 13


Early growth of spruce trees slow until root systems develop


Accelerated growth after root development, same view as left


Early growth of spruce trees slow until root systems develop


Accelerated growth after root development, same view as left

Plate 14

Willow Creek, FL-05, 02/02/99, matches with one of the

Willow Creek, FL-05, 02/22/02, coast redwood two photos on page, uncertain which one

FL-05, coast redwood bent over and damaged from high flow, silt deposited at base

Plate 15

Floras Creek, 12/00, view upstream

Premature cone development on young Douglas-fir

Floras Creek, 02/99

Floras Creek, 04/97

Plate16

Floras Creek, 04/97, view downstream

Floras Creek, 12/15/00, note rock vanes for bank stabilization, view downstream

Plate 17

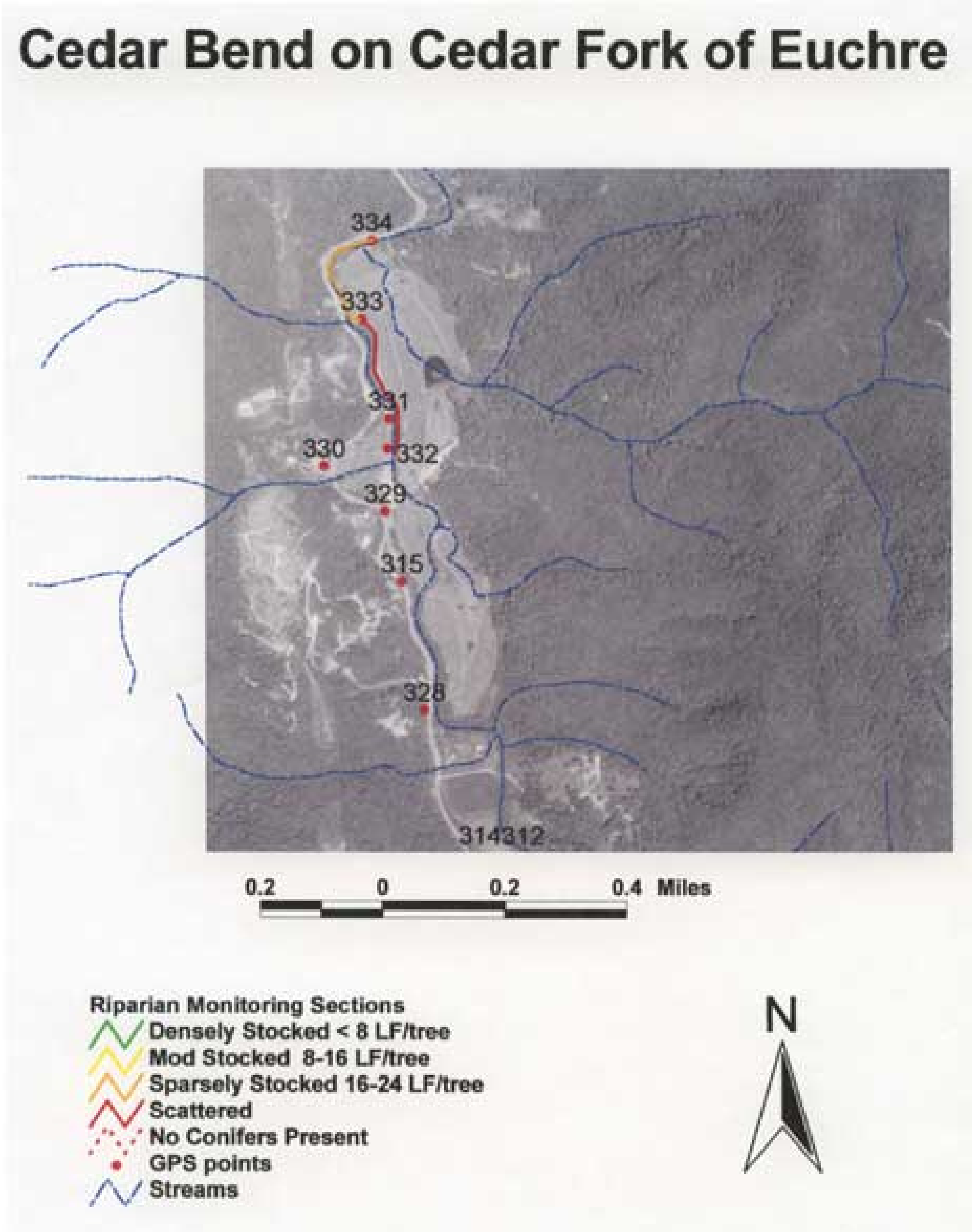
FL-04, summer '96 after fence construction, note gate nr river

FL-04, October '98 after bioeng project, view downstream

FL-04, 01/28/02, STA 7.16-10.96 east end, same gate as above

FL-04, 01/28/02, STA 5.75-7.16, view similar to above

Plate 18


Cedar Bend on Cedar Fork of Euchre
334
333
331
330
332
329
315
328
314312
0.2
0
0.2
0.4 Miles
Riparian Monitoring Sections
Densely Stocked < 8 LF/tree
Mod Stocked 8-16 LF/tree
Sparsely Stocked 16-24 LF/tree
Scattered
No Conifers Present
GPS points
Streams
N

Summer Stream Water Temperature Reduction in Response to Riparian Improvement Projects

by Cindy Ricks Myers

Introduction

Since 1995, the South Coast and Lower Rogue Watershed Councils have been monitoring summer water temperatures on streams in Curry County. In addition to monitoring riparian projects, sites were selected to obtain baseline conditions, evaluate trends, provide data for input to the DEQ's Heatsource model, and inform landowners and other interested citizens. In this report, we present results from riparian improvement projects on two small agricultural streams. Our experiences illustrate some of the difficulties encountered in implementing an experimental design.

Methods

Standard protocols are currently used for locating continuous recording thermometers and performing accuracy checks and audits as described in the Stream Temperature Protocol chapter of the Water Quality Monitoring GuideBook (1999). A Quality Assurance Project Plan provides direction for procedures. Thermometers are placed at sites with well-mixed streamflow, away from any groundwater or tributary sources. In Pea and Crook Creeks, water depth was insufficient to achieve the optimum placement in 18" of water, so thermometers were located in the shade. During the summers of 1995-1998, thermometers with only 2K of storage were used and programmed to record hourly.

Accuracy of the continuous recording thermometer data from Pea Creek in 1995 and 1996 cannot be verified due to a lack of field audits and office accuracy checks. 1996 field audits were performed during deployment, but before the start time of the thermometer's delayed launch instructions. In 1997, audits were recorded, but the software was programmed to overwrite previous data, so temperatures were only retrieved for the first deployment (prior to August 3rd).

<u>Pea Creek (tributary to Euchre Creek)</u>

Pea Creek is located two miles from the coast, with a drainage area of one square mile, and typical bankfull width of 8-11 feet. The channel was straightened in the past and has a northsouth orientation. The treated reach is approximately 1/4 mile long. This reach was fenced in 1994. In 1995 riparian plantings along Pea Creek and mainstem Euchre included 1000 willows and in 1996, a mixture of approximately 500 spruce, Douglas-fir, redwood, western red cedar, bigleaf maple, vine maple, Oregon ash, black cottonwood, cascara, chokecherry, pacific dogwood, and redtwig dogwood. An off-channel watering system was developed from a spring on the hillslope above. Use of this system was later discontinued, and in any case was not likely to have influenced streamflow in Pea Creek (figure 1). Several log steps were also installed in the straightened channel, to help dissipate energy and create pools.

In 1995, thermometers were placed above and below the Pea Creek project reach, below the county road culvert and near the mouth of the stream. In 1996, the monitoring layout followed

Figure 1

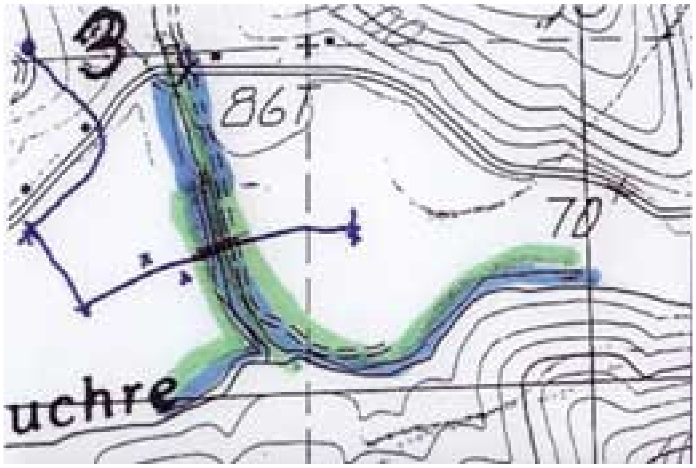


Figure 1: Pea and Euchre Creek project
Hire the Fishermen program.
Bottom photo: view to south along Pea Creek

Map Legend

Blue	**Fence (10,000 feet)**
Green	**Conifer & hardwood plant**
Purple	**Off-stream water system**

View to south along Pea Creek

Close-up of plantings on bank, mainstem Euchre the experimental design advocated by Ron Minor, OSU Extension Agent, with a control reach 100 meters upstream of the culvert and the treatment reach 130 meters downstream of the culvert (figure 2). Due to a change in monitoring personnel, the original design was not followed in subsequent years, but a trend site was located near the mouth of Pea Creek.

Results from 1996 are shown on figure 3, with minimum and maximum temperatures for each day connected as a single line. Minimum temperatures at the upstream site are well below the ranges typically found on South Coast streams, and are interpreted as evidence that the thermometer was exposed to air temperatures.

Photo points illustrate growth in riparian vegetation from 1995 to 2001 (figure 4). Although shade has not yet been measured systematically, as of January 2001 an estimated 40% of the reach was covered, 40% exposed, and 20% mixed. Overhanging and nearstream willows provide most of the shade. Conifers shade the stream only during the earliest and latest parts of the day, even though many measured 8-12 feet in height as of 2001. The channel also appears to have narrowed, deepened, and increased in sinuosity as a result of willows building streambanks. Progressive changes in the average 7-day maximum value at the mouth of Pea Creek document a dramatic reduction from 70.1 F in 1995 to 60.0 F in 2001 (figure 5). Note that 1997 temperatures include only the first half of the summer, so that the 7-day maximum is at least as high as the reported value. Table 1 documents the progressive decline of diurnal temperatures from 16.3 to 7.4 degrees F.

Crook Creek (tributary to Pistol River)

Crook Creek is located 1/2 mile from the coast, with a drainage area of 2.2 square miles, and typical bankfull width of 16-22 feet. The treatment reach of 1770 feet was fenced in 1997. Approximately 750 trees were planted in 1997, including shore pine and a few ponderosa pine. The site was replanted in 1999 with shore pine. Three rock weirs were also installed along this reach, to help dissipate energy and create pools in the straightened channel.

Figure 6 illustrates locations of the temperature monitoring sites. The multi-year record began in 1998 at the downstream-most site under the cattle bridge. Control and experimental/treatment reaches were not established until 2001. The upstream control reach of 425 feet is in unfenced pasture and the downstream treatment reach of 385 feet is fenced and includes some pre-existing riparian vegetation (figure 7).

Pre- and post-project photographs are not available, but willow appears to be an important component of increased shade along Crook Creek. The channel also appears to have narrowed and deepened as a result of willows building streambanks. The landowner commented that he had noticed an increase in streamflow since the channel was fenced and planted. It has been determined that no irrigation occurred on the treated reach during this period, and none was observed along the reach upstream.

The average 7-day maximum value at the cattle bridge on Crook Creek documents a progressive reduction from 73.9 F in 1998 to 69.3 F in 2001 (figure 8). Diurnal fluctuations are also

Figure 2

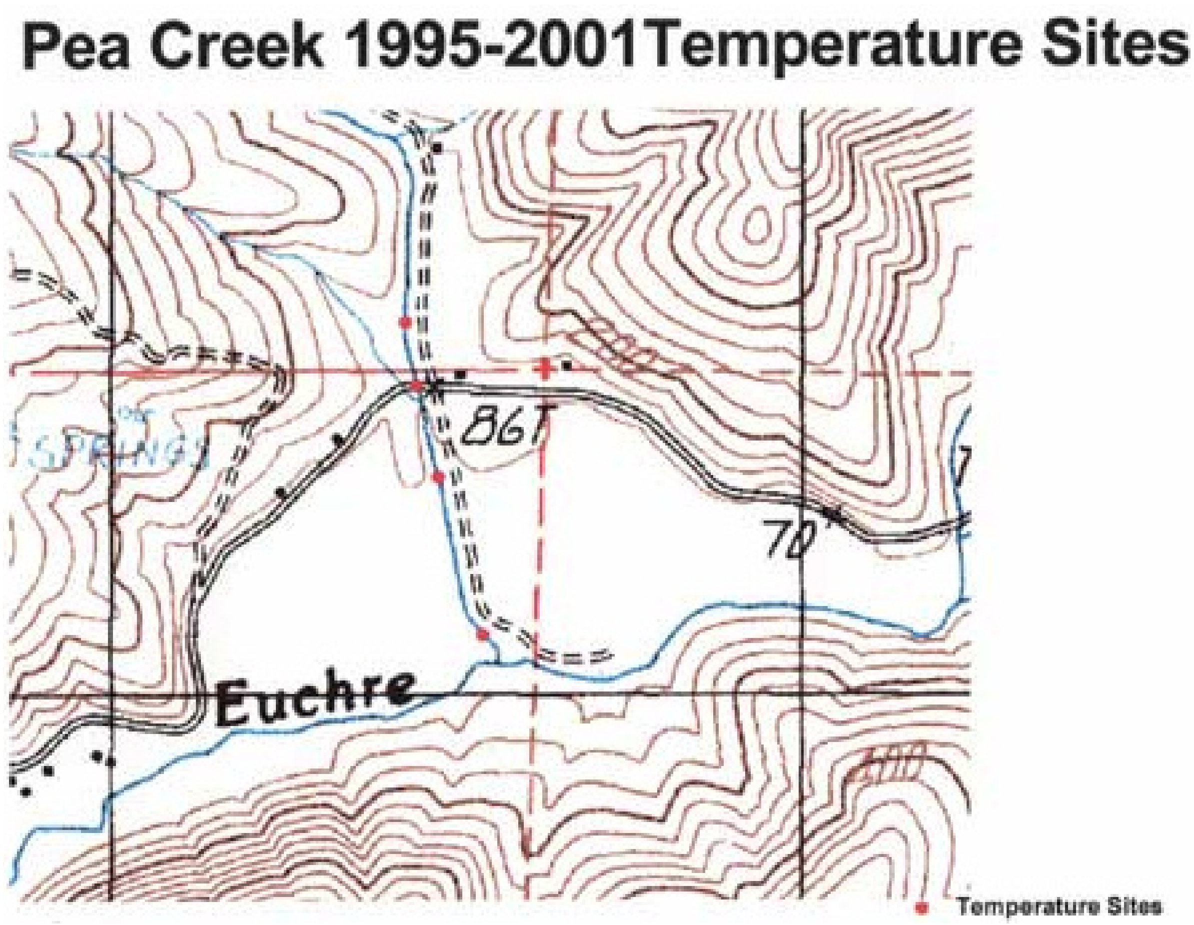

Pea Creek 1995-2001Temperature Sites
86T
70
Euchre
Temperature Sites

Figure 3

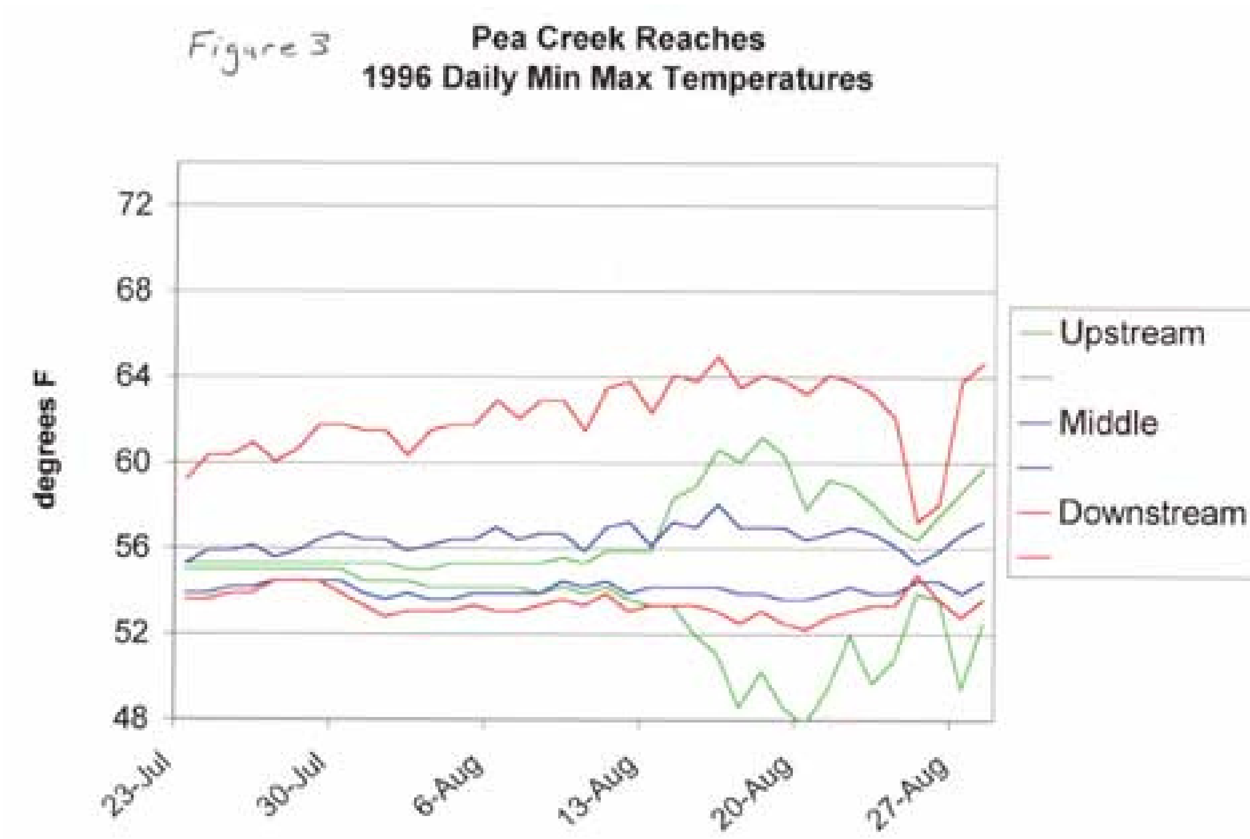


Figure 3
Pea Creek Reaches
1996 Daily Min Max Temperatures
72
68
64
60
56
52
48
degrees F
23-Jul
30-Jul
6-Aug
13-Aug
20-Aug
27-Aug
Upstream
Middle
Downstream

Figure 4

Pea Creek view to the north, summer '95

Pea Creek, view to south, 01/16/96

Pea Creek, view similar to above, 06/04/01, small gate middle of both photos

Pea Creek, similar view as above, 01/12/00, conifers in visible in distance visible on both, left-center

Figure 5

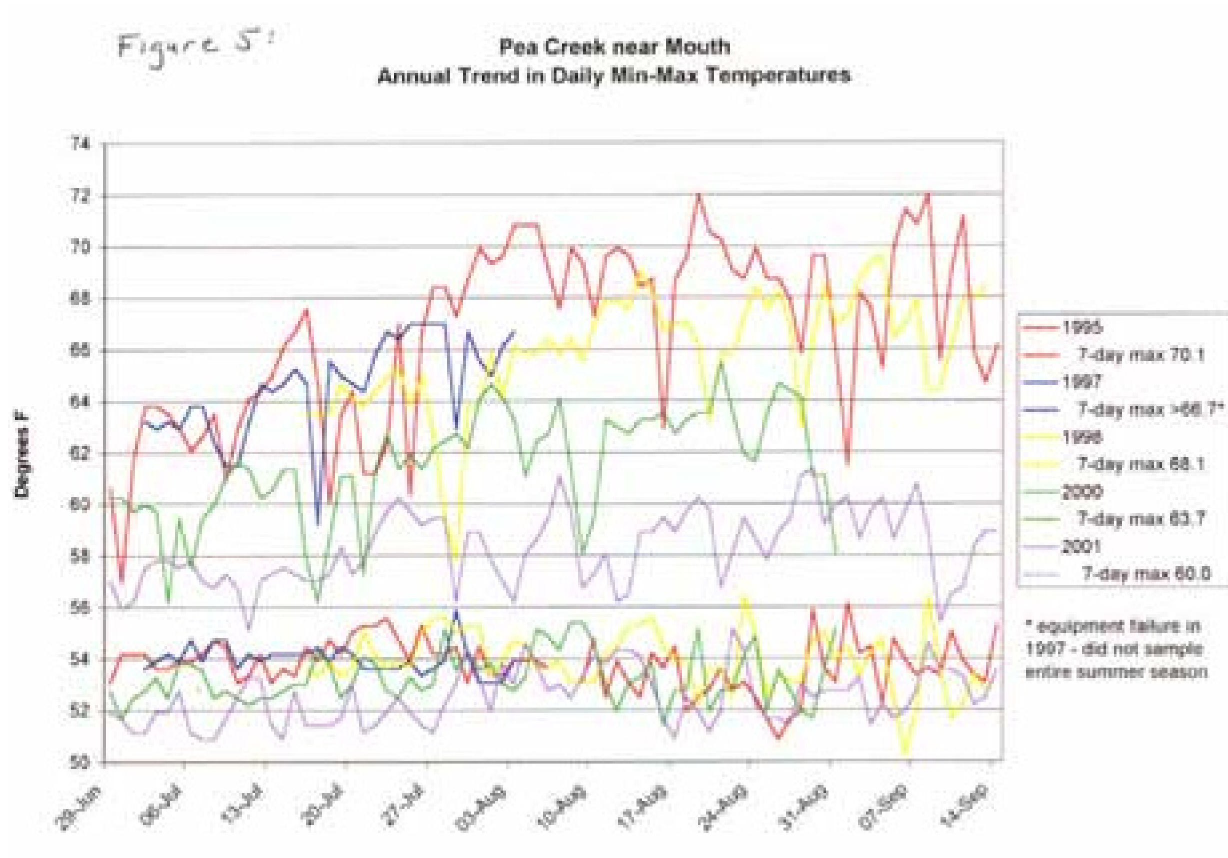


Figure 5:
Pea Creek near Mouth
Annual Trend in Daily Min-Max Temperatures
Degrees F
74
72
70
68
66
64
62
60
58
56
54
52
50
29-Jun
06-Jul
13-Jul
20-Jul
27-Jul
03-Aug
10-Aug
17-Aug
24-Aug
31-Aug
07-Sep
14-Sep
1995
7-day max 70.1
1997
7-day max >66.7*
1998
7-day max 68.1
2000
7-day max 63.7
2001
7-day max 60.0
* equipment failure in 1997 - did not sample entire summer season

Table 1

Table 1

Summary Data for Pea Creek, tributary to Euchre Creek

Site Name	Start Date	Stop Date	7-Day averages Date	Maximu	Minim	Δ T	Days > 64 F	Days > 70 F	Hours > 64 F	Hours > 70 F
Euchre: Pea Creek near mouth	06/24/96	09/23/96	08/03/96	70.1	53.8	16.3	66	12	384	30
Euchre: Pea Creek near mouth *	07/02/97	08/03/97	07/22/97	66.7	53.7	13.0	21	0	60	0
Euchre: Pea Creek near mouth	07/16/98	09/13/98	09/01/98	68.1	54.3	13.8	48	0	252	0
Euchre: Pea Creek near mouth	06/29/00	08/31/00	08/19/00	63.7	52.8	10.9	8	0	16	0
Euchre: Pea Creek near mouth	06/28/01	09/14/01	08/31/01	60.0	52.6	7.4	0	0	0	0

Figure 6

Figure 7

Crook Creek, 11/01/01, view upstream, control reach

Crook Creek, 11/01/01, view upstream, control reach

Crook Creek, 11/01/01, view downstream, experimental (fencing planting) reach reach;

Crook Creek, 12/28/01, view downstream, along experimental and shore pines and willows visible

Figure 8

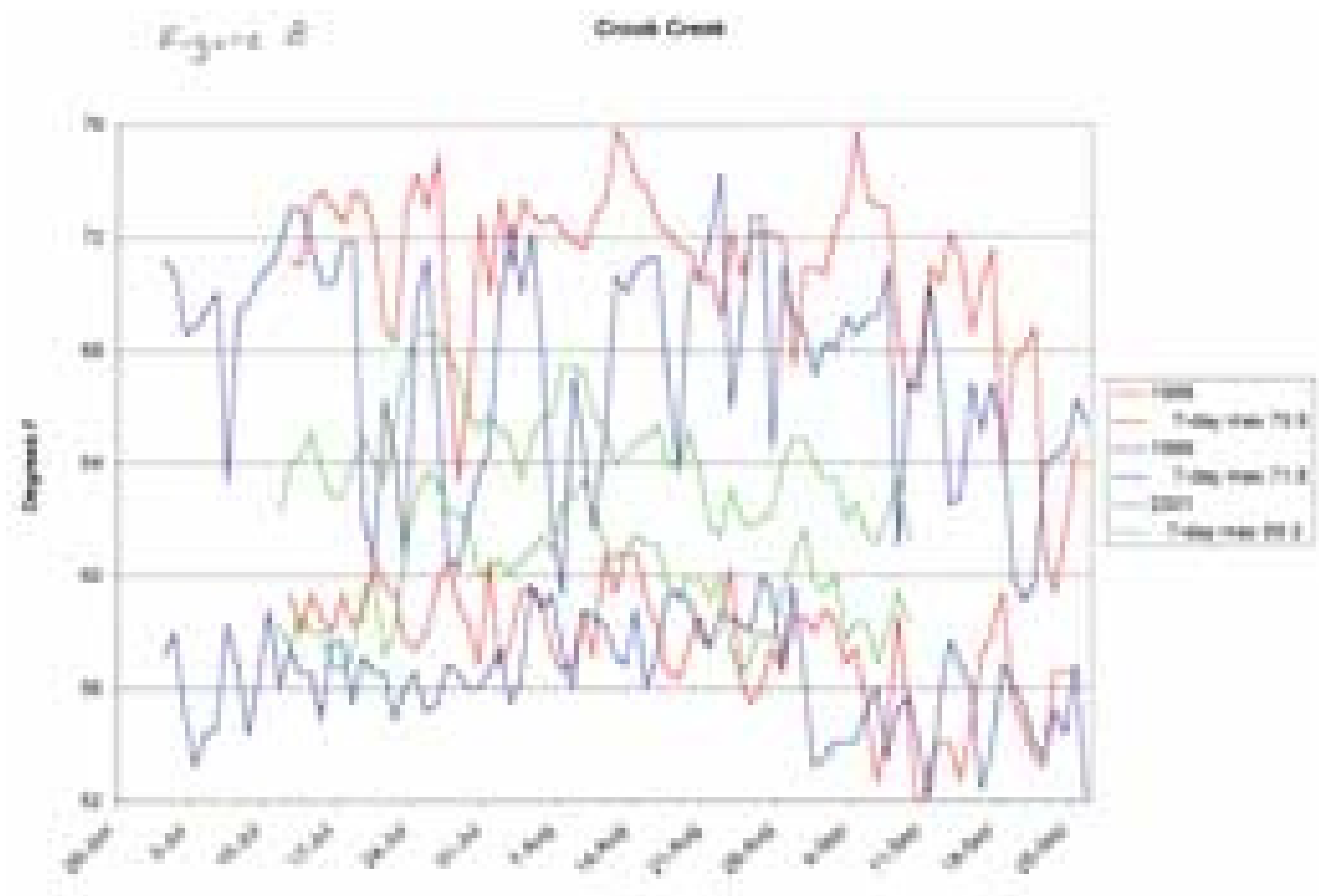


Table 2

Table 2: Summary Data for Crook Creek, tributary to Pistol River

Site Name	Start Date	Stop Date	7-Day averages Date	Maximum	Minimum	Δ T	Days > 64 F	Days > 70 F	Hours > 64 F	Hours > 70 F
Pistol: Crook Creek @cattle bridge	07/12/98	09/25/98	08/13/98	73.9	59.5	14.4	71	57	709	252
Pistol: Crook Creek @cattle bridge	06/30/99	09/26/09	07/15/99	71.8	56.6	15.1	70	32	569	115
Pistol: Crook Creek @cattle bridge	06/26/01	09/14/01	08/06/01	69.3	59.0	10.3	61	3	444	9

declining, from 14.4 to 10.3 degrees F (table 2). Figure 8 illustrates a warming of daily minimum temperatures. More insulation from the cooler night air temperatures could be provided by an increase in vegetation or water depth or both.

Results from 2001 are shown on figure 9, with minimum and maximum temperatures for each day connected as a single line. Prior to the mid-season audit on August 13th , the upstream site had been exposed to air temperatures and the thermometer at the middle site had been moved. Data after August 13th are valid, but no average 7-day maximum value was calculated. The diurnal variation shows heating in the control reach, and cooling in the treatment reach.

Discussion and Recommendations

The magnitude and trend of the temperature reductions on Pea Creek appear to be sufficient evidence that the riparian improvements are effective, even though the desired experimental design was not implemented. Multi-year data at a site are adequate to document temperature reductions on small streams that have a high diurnal fluctuation. Inter-annual variability was evaluated using Curry County temperature sites that have multiple years of data. 7-day maximum temperatures for 1998-2001 were compared with 1999, the coolest year as a result of an early August rainstorm (figure 10). Most sites vary between years by only one to three degrees (figure 11). Larger inter-annual temperature differences in figure 11 occur at sites within estuaries or influenced by subsurface flow.

On Crook Creek, heating within the exposed control reach was expected, but cooling in the treated, shaded reach was unexpected. If the increase in vegetation is allowing more efficient infiltration or more groundwater recharge of the floodplain, cooler subsurface water could be flowing into this reach. Groundwater of contrasting conductivity was not detected in measurements of the middle and downstream sites, which differed by only 1 uS. Water might also be cooled closer to the coast by moderate air temperatures and strong winds.

To design and evaluate future riparian improvements, it would be useful to understand the relative contributions of increased surface and goundwater flow, decreased channel width, and increased shade on temperature reductions. Measurements of streamflow, channel dimensions, conductivity, and shade are recommended. These data would have indicated whether the change in streamflow observed by the landowner was actually more flow, or just deeper due to the narrower channel. Shade must be sampled taken at frequent enough intervals to account for the high degree of variability in shade (patchy distribution).

Acknowledgements

We recognize the contributions of the many Curry County landowners whose cooperation has made it possible to measure water temperatures in many locations. Since 1995, the South Coast and Lower Rogue Watershed Councils have received funding from Oregon Watershed Enhancement Board and Department of Environmental Quality to support monitoring for the Oregon Salmon Plan.

Figure 9

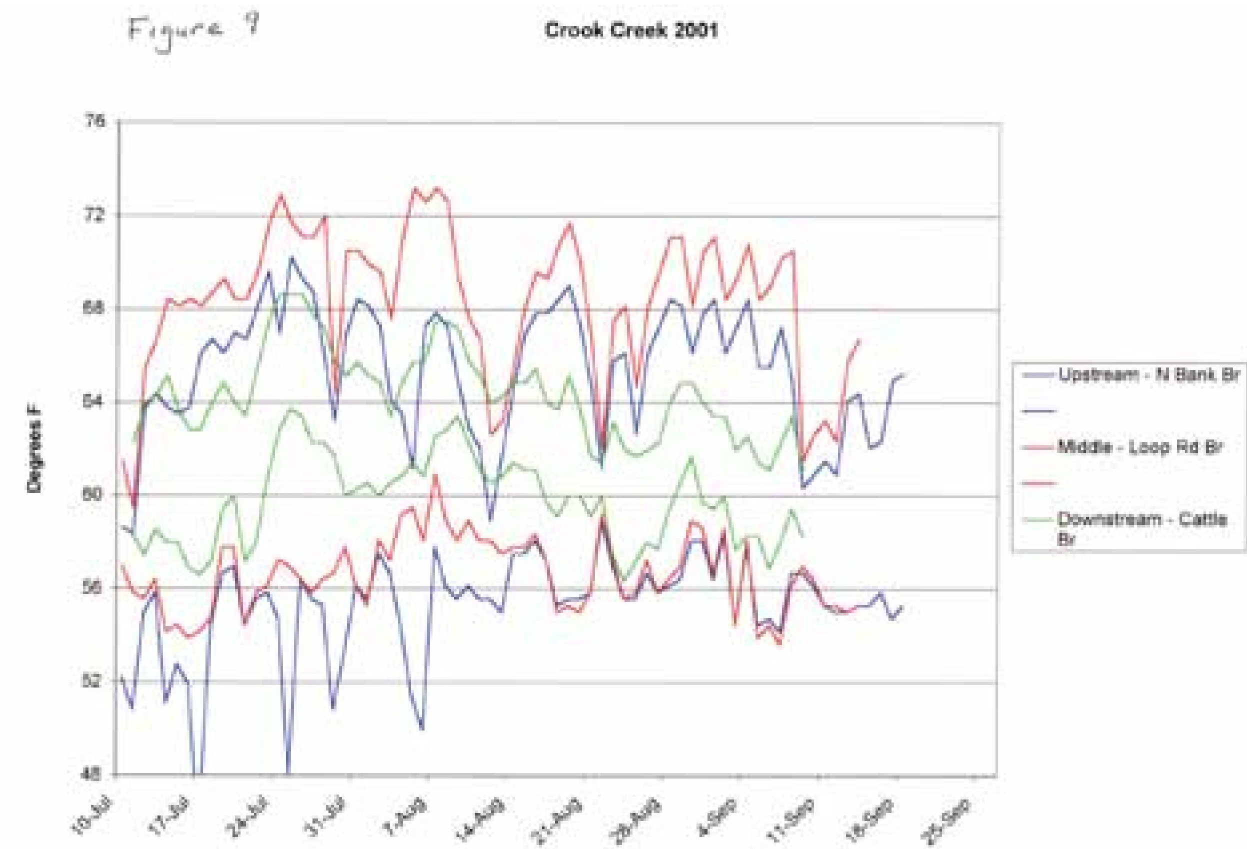


Figure 9
Crook Creek 2001
76
72
68
64
60
56
52
48
Degrees F
10-Jul
17-Jul
24-Jul
31-Jul
7-Aug
14-Aug
21-Aug
28-Aug
4-Sep
11-Sep
18-Sep
25-Sep
Upstream - N Bank Br
Middle - Loop Rd Br
Downstream - Cattle Br

Figure 10

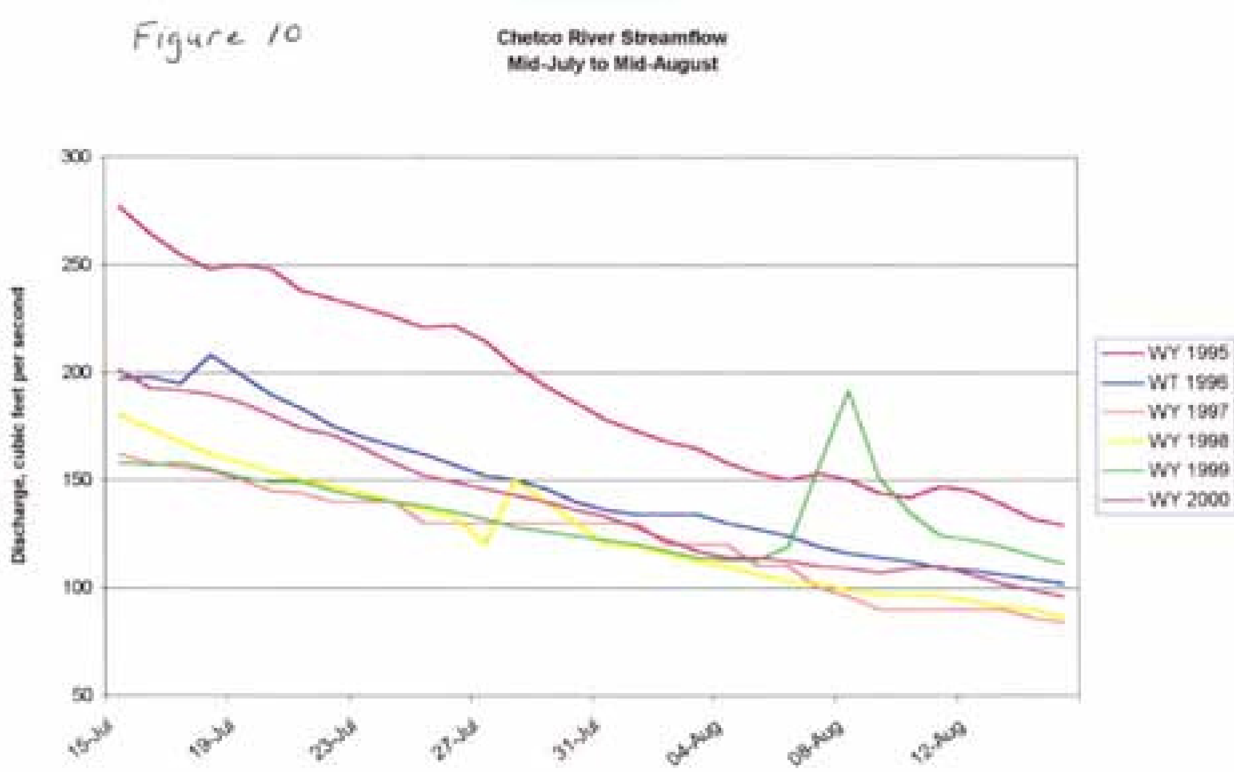


Figure 10
Chetco River Streamflow
Mid-July to Mid-August
Discharge, cubic feet per second
300
250
200
150
100
50
15-Jul
19-Jul
23-Jul
27-Jul
31-Jul
04-Aug
08-Aug
12-Aug
WY 1995
WT 1996
WY 1997
WY 1998
WY 1999
WY 2000

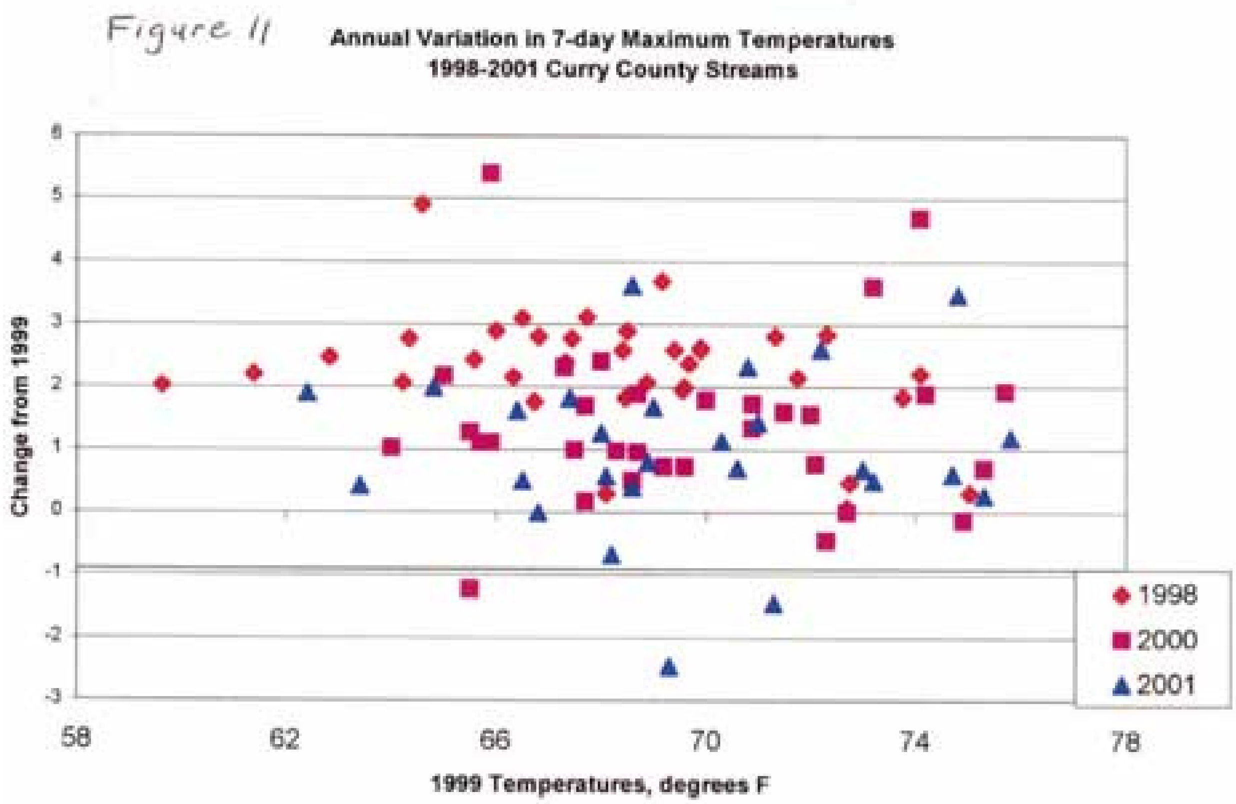


Figure 11
Annual Variation in 7-day Maximum Temperatures
1998-2001 Curry County Streams
Change from 1999
6
5
4
3
2
1
0
-1
-2
-3
58
62
66
70
74
78
1999 Temperatures, degrees F
1998
2000
2001

Appendix B

Forms and Databases

Annual Tree Planting Report Form

Tree Planting Record Form

Database Structure

New Forms:

- Reach Observations for Monitoring Riparian Planting
- Planting Monitoring (Plot Form)

South Coast and Lower Rogue Watershed Councils

20__ Annual Tree Planting Report

Crew: Cecil Ashdown and

Tree Key:

WH = western hemlock
SP = shore pine
CR = coast redwood
SS = sitka spruce
WRC = western red cedar
GF = Grand Fir

Watershed	Stream	Landowner	Owner ID	Date	Prior Yr Record	Quantity/Species						Total	WS Total
						WH	SP	CR	SS	WRC	GF		
												0	
												0	
												0	
												0	
												0	
												0	
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												0	
												0	

Curry Tree Planting and Maintenance Record

Version 12-27-2001

Tree Planter/Observer (s)	
Date	
Landowner	
Stream & Reach Description *	
Length along Stream, feet (double for both sides)	

* example: Windy River: north side, 1000' abv confl with Elk Creek

Current Planting

Species	# of Trees

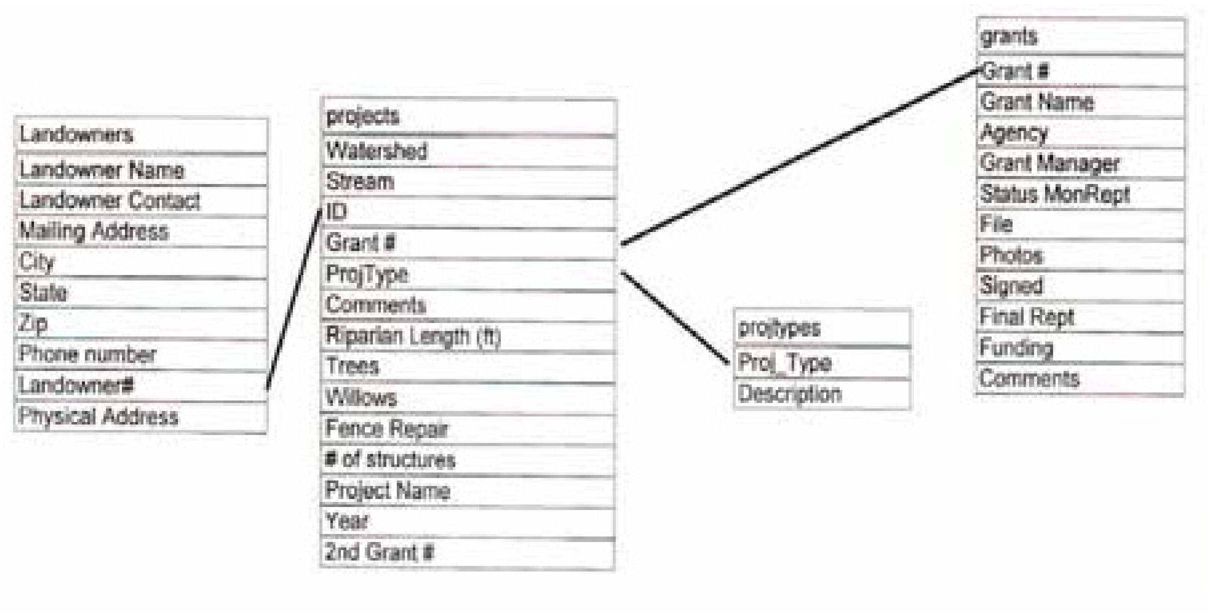
Previous Plantings

Species	Ave. Height, ft	Year, if known	Condition/ Percent Survival	Explanation, if needed

Fence

Type	Condition	Explanation, if needed

Datbase Form



Reach Observations for Monitoring Riparian Planting

Date:
Observer:
Watershed:
Stream:
Stations begin at:
GPS datum:
Comments:

Landowner(s) Name and/or ID #:
Reach Location:

Abbreviations:

Sta/ Photo Point	Species - #	Avg Height	Species - #	Avg Height	Species - #	Avg Height	GPS coord or description	GPS coord or description	GPS Point#/ EPE

Planting Monitoring

Site Name	GPS (plot stake or post)
Plot Number	Description of location
Date	

Tree or Shrub	Species	Height/ Hgt. Class	Diameter/ Stem Class	Landform	Slope	Brush Compet.	Grass Compet.	Browse	Animal Damage	Comments:

Appendix C
Tree Species Purchase Record 1996-2001
Riparian Planting Program, South Coast and Lower Rogue Watersheds

Origin of Seedlings for 1996:

Trees billed to Hire the Fishermen #1

DL Phipps — price/M
2000 Super Poplar 1-1 — $370
Total Cost $ 740.00

Althouse Nursery — price/M

		price/M
300	Oregon ash	$750
500	Bigleaf maple	$750
100	Black cottonwood	$950
100	cascara	$750
100	pacific dogwood	$950
100	vine maple	$950
100	redtwig dogwood	$650
50	chokecherry	$750
1500	willow	$165
2850	Total Cost: $1,312.50	

Hastings' Smith R. Nursery — price/M
10,000 *redwood — *$300
Total Cost: $3,000
*assumed, bill not specific

Adams - Franklin Tree Seedling I — price/M
4000 shore pine 2-0 — $150
500 incense cedar 2-0 — $160
4500 Total Cost: $ 680.00

Reservation Ranch - Logging Di — price/M
19,000 Douglas-fir 2-0 — $185
Total Cost: $3,515.00
Note: due to uncertain future funding & good price, purchased 15,000 to replant and provide 2-1 in 1997

Growth Unlimited Nursery — price/M
5500 sitka spruce 2-1 — $140
Total Cost: $ 770.00

hardwood spp planted on Pea Ck and Cedar Ck
some cuttings lost in storm while stored in riparian zone
Total Trees Purchased = 28,850
Total Trees Planted = 30,719 (Hire the Fisherman Report)

Origin of Seedlings for 1997:

Trees billed to Hire the Fishermen #2

Hastings' Smith R. Nursery — price/M
3000 redwood P-1 — $325
1095 sitka spruce — $190
Total Cost: $ 1,148.50

Sylvan Options — price/M
1500 KMX Pine plug-1 — $450
Total Cost: $ 675.00

Growth Unlimited Nursery — price/M
13,818 Doulas-fir 2-1 * — $122
5000 sitka spruce — $160
500 sitka spruce — $192
Total Cost: $2,581.80
*replant fee, purchased in 1996

Purchased tubes $1040 and stakes $641.25
Total Trees Purchased = 24,913
Total Trees Planted = see below

Origin of Seedlings for 1998:

Trees billed to Hire the Fishermen #2

Hastings' Smith R. Nursery — price/M

		price/M
1950	shore pine 2-1	$325
1025	redwood 2-1	$325
300	sitka spruce 2-0	$190
960	Port-orford cedar 2-0	$190
4000	western redcedar 1-1	$275
8235	Total Cost: $ 2,306.28	

DL Phipps Forest Nursery — price/M
3100 sitka spruce 2-0 — $243
Total Cost: $ 753.00

Growth Unlimited
1579 sitka spruce P1-2 — $300
Total Cost: $473.00

Total Trees Purchased = 12,914 (for 1997 + 1998, 37,827)
Total Trees Planted, 1997 + 1998 = 37,802

Origin of Seedlings for 1999:

Trees billed to BBN

Moore Mill & Lumber Co.	price/M
2000 sitka spruce (1-1)	$320
2000 western red cedar (1-1)	$320
2000 western hemlock (1-1)	$320
2000 Douglas fir (1-1)	$320
8000 Total Cost: $ 2,560.00	

Trees billed to 98-025

Hastings' Smith R. Nursery	price/M
500 western redcedar (P-1)	$350
726 shore pine (P-1)	$350
2300 sitka spruce (P-1)	$350
10000 Douglas fir (1-1)	$350
13526 Total Cost: $4,734.10	

Other
1600 hybrid poplar

purchased large number of Douglas-fir to plant in more upland sites on Crystal, N Fk Floras, Edson (L.Rogue)
Total Trees Purchased = 23,126
Total Trees Planted =26,339

Origin of Seedlings for 2000:

Labor charged to Rural, BBN and 97-095 Riparian Restoration
Trees billed to BBN and 98-208

Moore Mill & Lumber Co.	price/M
3000 sitka spruce	$360
2000 western red cedar	$360
1000 redwoods	$360
3000 Douglas fir	$360
9000 Total Cost: $ 3,240.00	

Trees charged to Rural, BBN and 97-095 Riparian Restoration

Hastings' Smith R. Nursery	price/M
2068 shore pine	$400
2553 grand fir	$400
2000 western redcedar	$400
9250 sitka spruce	$400
2000 coast redwood	$400
17871 Total Cost: $7,148.40	

western hemlock ordered, but not received
grand fir available
Total Trees Purchased = 26,871
Total Trees Planted =25,225

Hardwoods - billed to Rural, January 2000

Althouse	price/M
100 bigleaf maple plugs	$500
100 twinberry, gal size	$2,000
100 red elderberry plugs	$500
Total Cost: $$300	

planted gaps in prior plantings on Scott McKenzie's, Waterman's, and Pommerane's
Bruce noted some survival on upstream sites on Crook Creek. Cottonwoods tall, not sure about other species - may have switched maple and twinberry - put on wrong site type
Also planted maple and cottonwood on front nine at Salmon Run Golf - Jacks Creek

Origin of Seedlings for 2001:

Labor billed to 97-095
Trees billed to 97-095, 98-208, and 98-207

Moore Mill & Lumber Co.	price/M
1000 western hemlock	$400
2100 grand fir	$300
900 western red cedar	$300
4000 Total Cost: $ 1,300.00	

Trees billed to 97-095

Hastings' Smith R. Nursery	price/M
5500 sitka spruce (2-0)	$195
3000 western redcedar (1-1)	$290
1000 coast redwood	$290
9500 Total Cost: $2,232.50	

douglas-fir not ordered due to swiss needle cast concerns

DREAM Grant Experimental Plots -(only 700 shore pine included in total trees purchased and planted)

Brooks Tree Farm		price/M	**Althouse**		price/M
2000	shore pine	$200	1400	Oregon ash tree pots	$2,250
	Total Cost: $ 400.00			Total Cost: $ 3,350.00	

Total Trees Purchased = 14,200

Total Trees Planted = 14,025

Appendix D:

Youth Conservation Corps 1997 Riparian Surveys:

See attached maps showing survey reaches in the Euchre and Floras watersheds.
Plots consisted on a 15 meters wide strip counted within every 50 meters. The average width gives the set back from the active channel to the fence. The Area per Tree should be used only to compare stream reaches and not to indicate stocking levels. The plot area from the edge of the active channel included gravel terraces that would not be expected to support trees. The crew also took photographs along the survey area.

Table: 1997 Riparian Survey Results

Location	Side	Avg width (meters)	Total Trees	Area/Tree (sq meter)
Euchre Reach 1	L	10.6	17	37
	R	12.5	12	78
Euchre Reach 2	L	5.5	104	10
	R	9	20	88
Euchre Reach 3	L	9.7	9	194
	R	14	1	2,730
Euchre: Pea Ck	L	5.8	21	16
	R	4.8	10	29
Cedar Reach 1	L	8.3	61	23
	R	9	31	52
Cedar Reach 2	L	12.3	56	49
	R	11.4	92	30

Location	Side	Ave width (meters)	Total Trees	Area/Tree (sq meter)
Floras Reach 1	L	8.4	13	574
	R	9.1	128	63
Floras Reach 2	L	9.6	196	21
	R	9.4	185	22
Floras Reach 3	R	10.2	167	14
Willow Reach 1	L	7.5	0	-
	R	7.6	0	-
Willow Reach 2	L	10	176	25
	R	9.9	160	26

Appendix E:

Summary of First Year Results:
Riparian Establishment and Maintenance Trials, DEQ Project 148-00

The project was designed to determine the appropriate level of investment per tree of time and resources to ensure a high survival rate and vigorous growth for planted native trees in riparian zones along South Coast streams. Plots were established with four species, on four sites, using four experimental treatments with one control. This summary provides only the results from the coniferous species, and presents some additional analysis and interpretation of the data. The full report by Dr. Bruce Follansbee is available in the Watershed Council office.

Shore pine treatments were installed on a floodplain terrace on the north bank of Floras Creek, approximately 0.5 miles inland and subject to persistent northwest winds in the late spring and summer months. The soil is a loam, with good fertility and water-holding capacity; competing vegetation includes herbaceous species and limited grasses. Sitka spruce treatments were installed on the north bank of the Rogue River near Wedderburn Ranch, approximately two miles inland. The alluvial soil is a loam, introduced perennial grasses are present, and scattered small patches of blackberries occupy the plot.

The control planting technique used a hoedad and no other site preparation. All of the treatments, but not the control, were augered and received a slow release fertilizer pellet (20-10-5, five grams). Three techniques were tested: scalp and mulch (remove sod to bare dirt in a 30" circle, place sod upside-down around seedling), watering basin (remove 3-4" of topsoil/root mat in a 30" circle), and weed mat (lightweight tar paper square folded to 30" circle and stapled).

Shore Pine - Floras Creek * growth excludes trees that did not survive.

	Survival 1st year	* Average Growth, cm	Growth, Std Dev	Growth x Control
Control	50%	7.9	5.0	
Scalp and Mulch	59%	18.8	9.4	2.4 x
Scalp and Mulch +Weed Mat	61%	13.3	10.7	1.7 x
Watering Basin	80%	17.8	9.7	2.3 x
Watering Basin + Weed Mat	77%	21.0	9.4	2.7 x
All Treatments	69%	17.9	10.2	2.3 x

Sitka Spruce - Lower Rogue

	Survival 1st year	* Average Growth, cm	Growth, Std Dev	Growth x Control
Control	75%	4.1	4.0	
Scalp and Mulch +Weed Mat	95%	13.2	7.3	3.2 x
Watering Basin	81%	11.4	7.1	2.8 x
Watering Basin + Weed Mat	96%	14.1	8.9	3.4 x
All Treatments	91%	13.0	7.9	3.2 x

The experimental design intended to vary the level of post-planting maintenance of competing vegetation, but all of the treatments and the control received the same maintenance. It was found that the competition was blocking all light to the seedlings and provided cover for voles to evade predators. Voles ate bark off the tree stems and in some cases clipped the new top growth. All plantings were watered every 2-3 weeks from early May to late October.
The report cites the summer of 2001 as having a lower survival for all plantings than an average year. NOAA precipitation records for the summer months were examined to compare the long term average monthly precipitation and the values over 1996-2001. June-September, 2001 precipitation was 54% of normal at the Gold Beach station and 75% of normal at the Port Orford 5E station. However, three out of the last six years had less precipitation at Gold Beach, and four of the last six years at Port Orford 5E. Precipitation levels alone don't reflect other influences on survival, such as solar radiation or winds, but the summer of 2001 was not unusually dry.

Watering basins clearly improved shore pine survival, but not sitka spruce survival in comparison to the scalp and mulch +weed mat. This finding may result from higher moisture stress at the Floras site, making the watering basin more critical for survival. Sitka spruce survival was improved by 15% from the weed mat over just the watering basin.

Statistical analysis is likely to show that growth on the watering basin + weed mat is not significantly faster than the other treatments (standard deviations are high in the growth data). However, some level of treatment appears to improve the growth significantly for both species. Because no fertilizer was applied to the control, it is not possible to separate the influence of fertilizer from the treatments on growth rate.

The experiment did not evaluate survival and growth for the conifer species on more than one site with different soil and environmental conditions. Thus it is difficult to extrapolate the increased survival and growth from the treatments. The average treatment on shore pine increased survival by 19% (and 30% for the watering basins), but on a less stressful site, would the increase be as pronounced? The average treatment on sitka spruce increased survival by 16% (up to 21% for the weed mats), but it is difficult to determine whether this different response is unique to sitka spruce, or a function of the better site conditions and higher survival of the control (75%).
Because the report does not discuss time or cost for installation of the various treatments, it is not feasible to interpret an appropriate level of investment per tree of time and resources.

Appendix F:

Propagation and Planting of Riparian Species in Curry and Coos Counties

by Bruce Follansbee 4/25/01

Species Planted as Cuttings

Willows - willows live on the sloped portion of the bank near the water table. In a young, vigorous willow stand you can cut every 20th tree for use as cuttings without changing the stand - be sure to spread out the damage.

Black Cottonwood - cottonwoods live just above willows where the bank has flattened out but still floods every couple of years. Collect basal sprouts or the lowest branches for cuttings. Stems with several ribs running lengthwise are the most vigorous and make the best cuttings.

Red Osier Dogwood - this dogwood is found on medium to small streams. It lives on the upper sloped portion of the bank or just above on the flat portion. Red osier dogwood can be grown from cuttings or seed.

Species Planted As Seedlings

Douglas-fir - when found in riparian it is along higher gradient streams or in narrow canyons on lower gradient reaches.

Western Redcedar - found as scattered individuals in many riparian communities. Can grow in areas of high water table, in shade, and right down to the stream edge in high gradient reaches.

Sitka Spruce - usually found close to the coast at low elevations. Can grow on areas with high water table, can grow through blackberries, and also tolerant of salt.

Shore Pine - a great species for windy areas along the coast where other trees don't survive establishment.

Western Hemlock - great species for interplanting in alder stands to diversify species, and fast growing.

Grand (White) Fir - does well on north-facing slopes and cool, moist areas. Fast growing and can grow through blackberries.

Red Alder - a good species for planting on eroded subsoil that is low in nutrients - will build up the soil so other species can be planted later. Can be planted over a wide range of soil and water conditions.

Oregon Ash - grows on top of bank among cottonwoods. Very physically resistant to flood damage.

Bigleaf Maple - grows higher in the riparian zone and can be interplanted to increase species diversity.

Propagation and Planting Information

Hardwood Cuttings - collect cuttings when the trees are dormant after leaf fall in autumn or in winter just before planting. If collecting cuttings when there are leaves on the trees, do not take the cuttings when the tree is actively growing (lots of new foliage at the branch tips). Cottonwood and willow cuttings should be 3 feet long and at least 1 inch diameter at the basal end. Dogwood cuttings can be smaller diameter and shorter. Planting in January-March is optimal. Plant in augered holes if possible or push into soft soil with 3/4 of the cutting's length in the ground. The cuttings should be trimmed after planting if you can't get them deep enough to get 3/4 in the ground - this keeps the ratio of roots to shoots favorable for establishment.

Pounding cuttings should be avoided because they split easily and it damages the bark, which is the living part of the cutting. If they will be planted where it floods regularly, then try to angle the cuttings downstream some so they don't collect a lot of trash from the flood waters.

[Other tips from Bruce, recorded by Cindy Myers: When collecting cuttings, cut the base with a slant and cut the top perpendicular to the stem. Allow a callus to form over the cut surface to retard pathogens. Store cuttings out of the sun. You can soak the cuttings in a bucket before planting. In mild climates, such as our coastline, cuttings can be planted in wet ground instead of soaking. Plant with the buds pointing up!]

Conifer Seedlings - conifer seedlings can be planted in the fall after the first couple of rains or in mid-late winter before they break dormancy. Fall planting allows additional root growth before winter dormancy sets in, but bare root stock is not available at that time. Conifers can be purchased as bare-root seedlings or in small containers (bullet tubes or styrofoam blocks).

Hardwood Seedlings - hardwood seedlings can be planted in mid-late winter before they break dormancy. They are usually purchased as dormant, bare-root seedlings.

Planting Conifer and Hardwood Seedlings

• If there is heavy competition from grass or blackberries, then larger seedlings will outgrow these competitors sooner than small seedlings. Larger seedlings take more care such as weeding and supplemental summer watering than do small seedlings.

• Conifer seedlings can be purchased from a number of forestry nurseries around the state, but you have to be careful to purchase seedlings grown from local seed. As an example, Douglas-fir for Coos Bay is in seed zone #I and Coquille is on the border between seed zones #I and 2. Information on forest nurseries and maps of seed zones are contained in an ODF publication "Sources of Forest Nursery Seedlings", which is available from the local ODF office or the state office in Salem at (503) 945-7200.

• Planting holes for conifer seedlings can be augered, dug with a shovel, or made with forestry planting tools such as a hoedad or a dibble. Augering or using a shovel loosens a pocket of soil around the newly planted tree that allows for rapid root growth following planting. Augering is not recommended for clay soils because it glazes the inside of the hole; roots cannot penetrate the glazed soil and circle around in the hole like in a nursery pot.

• Watering basins are a shallow bowl around the base of the newly planted tree that allow irrigation water to pond next to the tree so it doesn't flow away across the soil surface during watering. During late Summer, the soil around the trees will get so dry that irrigation water will mostly run off rather than sinking in; watering basins hold the water next to the tree until it can sink in. Constructing the watering basin at the time of planting also kills competing grasses and weeds within the basin area.

• Watering basins or the area around a newly planted tree can be lined with tarpaper (lightweight 15#) or a commercial weed mat. This weed mat keeps grass and weeds from growing next to the seedling and stealing its water. The weed mat must be in close contact with the soil so that rodents (mostly voles) won't hide under the weed mat and chew the bark off of the seedling. Wire staples can be home-fabricated or purchased to attach the weed mats to the soil. Since voles are a common problem in pastures, keeping a weed mat or bare patch of soil around the base of each seedling is the best protection against vole girdling of seedlings.

Direct Seeding - establishing trees by directly planting seed is difficult in riparian areas. This is due to the amount of competition at the time of planting and during the first couple of years. To make it possible you would have to keep the soil bare for two years, which would lead to soil eroding directly into the stream.

Shade and Flood Tolerance - use the table below to help you decide where to plant the different species. Trees with no shade tolerance like shore pine, cottonwood, willow (and to a lesser extent Douglas-fir and dogwood) cannot be planted under any other vegetation and competing vegetation cannot be allowed to overgrow them. Species that really tolerate shade like redcedar, spruce and hemlock (and to a lesser extent grand fir and bigleaf maple) can be interplanted in an existing sparse riparian area to fill it out and diversify the current species composition. Trees with high flood tolerance like Oregon ash and willows can be planted where there is regular flooding every year. Trees with no flood tolerance will die in low spots where there is frequent flooding or ponding during the growing season.

Species	Shade Tolerance	Flood Tolerance
Douglas-fir	2	1
Western Redcedar	5	4
Sitka spruce	5	4
Shore pine	1	4
Western hemlock	5	2
Grand fir (white fir)	4	3
Red alder	1	3
Oregon ash	3	5
Bigleaf maple	4	3
Black cottonwood	1	4
Willows	1	5
Red osier dogwood	2	4

Notes: 1 is very intolerant, 5 is very tolerant
Information provided by Dr. David Hibbs, OSU Forestry

Appendix G:

Black Cottonwood Cuttings Collection and Planting Protocol
by Bruce Follansbee 12/14/01

Introduction - cottonwoods live just above willows either near the top of bank or where the bank has flattened out but still floods every couple of years. Cottonwoods are commonly associated with Oregon ash, alder, and occasionally with Sitka spruce, western redcedar, bigleaf maple, myrtle, Port Orford cedar, and other species. Cottonwoods have good flood tolerance and very low shade tolerance. Natural reproduction occurs when the seed is released as floodwaters recede. The tiny seed drifts on the wind and lands on silt beds left by flooding and germinates immediately in large numbers. Because each tree is either male or female (termed dioecious), the minimum number of trees required for reproduction is two or more until you get at least one tree of each sex. Cottonwoods do not do well in heavy wind or salt so they shouldn't be planted within 1/2mile to a mile (depending on how exposed to wind) of the ocean or in a wind-swept area. Cottonwoods can be planted on wet areas or seeps in uplands - anywhere they will have their roots in year around water.

Hardwood Cuttings - collect cuttings when the trees are dormant after leaf fall in winter just before planting. Stems with several ribs running lengthwise (as opposed to smooth bark) are the most vigorous and make the best cuttings. Collect cuttings in the beds across the rows (not along the rows) to get the maximum genetic diversity for each site that you plant. Cottonwood cuttings should be at least 3 feet long and at least 3/4 inch diameter at the basal end. Planting in late October-November or January -March is optimal. Plant in augered holes if possible or push into soft soil with3/4of the cuttings length in the ground. The ideal is a 4 foot cutting with 3 feet in an augered hole. The cuttings should be trimmed after planting if you can't get them deep enough to get3/4in the ground - this keeps the ratio of roots to shoots favorable for establishment. Pounding cuttings should be avoided because they split easily and it damages the bark, which is the living part of the cutting. If they will be planted where it floods regularly, then try to angle the cuttings downstream some so they don't collect a lot of trash from the flood waters. The newly planted cuttings are a favorite browse species for elk, deer, cattle and other livestock. Planting the trees in clumps and putting a temporary fence around the clump can lessen browsing problems. Beaver will preferentially cut cottonwood over most other species. Again, temporary fencing helps protect trees planted in clumps. For long term protection, individually wrap trees with woven wire or chain link so that it can expand as the trees grow over time.

Propagation Beds - the beds at Chetco, Rogue and sixes Rivers need minimal care to thrive.Competing vegetation should be knocked down in the late spring and late summer. This involves cutting blackberries and willows back to ground level, cutting or pulling alder and coyote bush seedlings, and knocking down larger herbaceous competing vegetation. The Chetco and Sixes beds have drip irrigation systems installed and these should be turned on whenever someone is watering other plantings in the area. It is best if they run for a few hours. This supplemental watering will greatly increase growth and the production of cuttings. Once a watering season the drip systems should be inspected for holes in the tubing and to make sure that each tree has an emitter. Bruce will leave behind a repair kit at Knapp Ranch with extra emitters, a tool for making the holes to insert them in the tube, and plugs for putting in holes where emitters have been removed because the tree is dead. The trees can be fertilized to increase growth also, but this may make the cuttings more attractive to deer and other herbivores because the foliage will be more nutritious when they are planted.

Take only the larger branches for cuttings and leave the small branches for next years cuttings. Cuttings can be any diameter, although they are less vigorous after they develop real bark (general rule).