AN ABSTRACT OF THE DISSERTATION OF

Anne B. Hairston for the degree of Doctor of Philosophy in Forest Engineering presented on September 27, 1996. Title: Response to Water Protection Rule Changes in the Oregon Forest Practices Act: Landowner/Operator Opinions and Streamside Conditions.

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Paul W. Adams

This study assessed implementation of the 1994 Water Protection Rules in the Oregon Forest Practices Act from the perspective of Rule users and post-harvest riparian conditions. A 1993 evaluation found that under the previous rules over half of riparian conifers were removed during harvest, prompting concerns about future sources of desirable instream woody debris. Twenty-four harvest sites throughout Oregon were assessed for riparian conditions after harvest, focusing on potential contribution of future large woody debris to streams relative to conditions at similar sites under prior rules. Industry foresters, logging operators, and nonindustrial private forest owners who had filed harvest notifications in Fall 1994 were sent questionnaires to determine the level of support for the Rules and related concerns. Return rate was 67 percent of 848 sent, yielding 403 usable surveys from people who had harvested. Personal interviews during visits to harvested sites supplemented the survey results.

Most (61%) generally or strongly supported the Water Protection Rules, while 26 percent generally or strongly opposed the Rules. Of choices listed in the survey, those factors that most affected support, or lack of it, were: 1) flexibility of rules, 2) whether rules were backed by good science, and 3) lack of compensation or incentives. For nonindustrial owners, whether the rules take better care of the land (stewardship) was also an important factor. The policy options considered most effective for influencing private forest management were more favorable tax policies and compensation.

Riparian condition measurements were compared to results from the 1993 Oregon Department of Forestry Riparian Rule Effectiveness Study. Significantly more conifers were left under the 1994 Rules than previously: 75% of preharvest conifers/1000 feet of stream was left in 1995 versus 35% in 1993 ($p<0.01$), and 68% of initial conifer basal acre ($ft^2/acre$) was left in 1995 versus 27% in 1993 ($p<0.01$). For the 1995 data, an average of 50 percent of trees could fall directly into the stream, contributing debris over 8 inches diameter and 5 feet long. The number of snags left in the riparian areas in Western Oregon was higher in 1995 ($p<0.01$), but not east of the Cascade Mountains.

Response to Water Protection Rule Changes in the Oregon Forest Practices Act: Landowner/Operator Opinions and Streamside Conditions

by

Anne B. Hairston

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Major Professor, representing Forest Engineering

Head of Department of Forest Engineering

Dean of Graduate School

I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Anne B. Hairston, Author

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INTRODUCTION

Project Description and Approach

This project was undertaken to examine outcomes of the Water Protection Rules, substantial modifications to Oregon's Forest Practice Rules in 1994. The Water Protection Rules apply to forest harvesting and other forest practices near streams and other bodies of water on state, local government, and private lands in Oregon. Federal agencies have agreed to meet or exceed these Rules and be self-policing. With respect to forest resources, such rules can have a major effect on management of large areas of riparian stands, a fundamental link between forestry and forest streams. The change in regulations can be seen as an experiment, a chance to evaluate the effects of the different management directives embodied in the regulations. In practice, regulations are part of public policy, which encompasses ecological, social, economic and political dimensions (Cubbage et al. 1993). The operation of a policy over time can be affected by all of these dimensions. Forest hydrology research typically focuses on physical and biological analysis, but when assessing the effectiveness of a policy, it may be equally important to evaluate social dimensions that relate to the end results. Because of this, a broad approach was used to examine both perceptions among users of the new Rules as well as the physical conditions of riparian stands after Rule application.

The project consisted of two major efforts: 1) clarifying the level of support and the factors important for support by Rule users, and 2) evaluating the post-harvest condition of riparian stands. The Rule users are the link between how the policy is written and the kind and quality of forest practices applied.

This project focused on landowners and operators who had harvested timber under the 1994 Water Protection Rules. Many other stakeholders are affected by the rules, but few are as important for on-the-ground implementation, or are affected as directly. The opinions and experiences of the rule users are important to the policy goals because the landowners and operators are making key decisions and carrying out the land management activities.

With activities such as harvesting, resource effects often depend on how a practice is carried out. For example, rules to limit soil damage during ground-based harvesting may require harvesting operations to stop while the soil moisture is too high. Forest operations are widely dispersed, and enforcement officers are usually few and are responsible for large areas. The risk of being detected in a violation usually is low, even though the potential penalties may be high. In such situations, the control of negative effects often depends on basic awareness and voluntary compliance, such as the operator noticing when large ruts are being formed.

In Oregon, Forest Practice Foresters often can only make infrequent visits, usually to high-priority, sensitive sites. In 1988, only 22% of harvest sites had pre-operation inspections, and 47% were never visited (ODF 1989). In this context, support and understanding among rule users can determine the practical effectiveness of a rule, to the extent that it affects key decisions and voluntary compliance.

Riparian areas have many different ecological functions, such as providing wildlife habitat in the transition from aquatic to upland areas, adding nutrients and energy to the aquatic food web, anchoring slopes with tree roots, infiltrating runoff to protect water quality, storing soil water for stream water supply, and protecting streambeds and banks. Actions taken to manage for one function or benefit can affect how the riparian area provides or does not provide the other functions related to riparian vegetation.

Given the wide array of potentially important factors for evaluating riparian conditions after harvest, the changes made through the Water Protection Rules were used to focus the scope of interest for this research. Some of the most substantial rule changes, such as the retention of more merchantable conifers, were intended to assure future sources of large woody debris (LWD) for aquatic habitat. The 1993 Riparian Rules Effectiveness Study (Mormon 1993) found that most harvesters exceeded the minimum rule requirements, but it also found that over 50 percent of streamside conifers were removed during harvest, and raised concerns about future sources of large, stable woody debris for stream habitat. Consequently, field measurements concentrated on assessing how the residual stand could contribute to future instream large woody debris. Despite the specificity of this focus, the Water Protection Rule goals include water quality, aquatic habitat, and wildlife habitat, and future analysis of policy options should consider the various related functions of riparian vegetation in addition to LWD.

The project scope included forest harvests on private, county, and state land throughout Oregon. Regional comparisons were of interest because the state varies widely in climate, topography, and forest types, as well as social, political, and economic structure. Western Oregon has more operations and volume harvested than Central or Eastern Oregon, and thus more data were collected for Western Oregon.

The study is descriptive rather than experimental research, so observed correlations offer evidence of a relationship but do not establish cause and effect. The study was based on the premise that designing effective policy options for a situation requires information about and an understanding of that situation, an assumption typical in policy analysis (Dye 1978).

Project Goals and Objectives

The purpose of the project was to provide credible information on how the landowners, managers, and operators and the streamside resource conditions have responded to the 1994 Water Protection Rules. This information is intended to be used on at least two levels: 1) to understand some of the specific attitudes and resource conditions after using the Water Protection Rules, providing a basis for identifying where or how implementation could be changed or improved, and 2) to increase general understanding of the relative importance of rule users' motivations, concerns, and constraints, providing information for designing and implementing policies, including regulations, incentives, education, and research.

In a broad sense, this project aimed to provide information that could help identify more effective designs and mixtures of policy approaches for achieving public benefits from private lands. It focused on one example, the Oregon Forest Practices Act, which established a regulatory framework in 1971. The Forest Practice Rules revision process has used several forms of public input and participation: advisory committees, public hearings, workshops, training sessions, and responses to complaints. Landowners and operators have been represented in committees and public hearings, but comprehensive information about their concerns has not been consistently sought and used, despite its importance in Rule implementation. Most opportunities for public participation have occurred when new rules are being proposed, or just before they have become effective. Public hearings have been typically been used in the past, although future rule development, implementation, or evaluation may include other processes for public participation.

Impressions of landowner acceptance have been based on anecdotal evidence from hearings, informal networks, contacts during harvest planning, or in response to complaints. The Forest Practices Rules are reviewed at an annual meeting, but the depth of review and level of public participation have varied. Such information is valuable, but does not provide the robust information of a comprehensive survey. The Forest Practice Rules have had outside reviews in the past, such as Brown et al. (1978), who found that the Rules themselves were generally thought effective in protecting water quality, but improvements should be made in training, supervision, and enforcement.

Policy makers often want innovative, effective, flexible, and enforceable policies, but usually can only speculate about the spectrum of concerns and barriers to these goals. Current information on how recent changes have worked can offer insight into potential concerns or barriers. Do rules or programs need to be simple to avoid confusion, or are more complex options that offer greater choice more workable? What qualities are important for different types of landowners? This research was designed to identify important issues related to the Water Protection Rules in a more comprehensive manner than in the recent past. These questions led to the first objective.

Objective 1: Assess level of support for the Water Protection Rules by harvesters and determine relative importance of key factors influencing these opinions among nonindustrial private landowners, forest industry managers, and logging operators.

Policy makers also need to know specific results of rule implementation in order to make any judgment about sufficiency of the policy. Are more trees being left in places where they can contribute wood for fish habitat? Is there as much shade as under previous rules? These types of questions led to the second objective.

Objective 2: Assess residual riparian stand conditions to determine if streamside stands are receiving greater protection using the 1994 Rules than using the previous Rules, particularly whether potential sources of future instream large woody debris have increased.

LITERATURE REVIEW

Oregon's Water Protection Rules

Since 1972, the Oregon Forest Practices Act (OFPA) has been the cornerstone of Oregon's program for protecting water quality on private and state forest lands, used to meet Section 208 requirements of the Clean Water Act for silvicultural activities. The Forest Practice Rules for riparian areas initially were intended to provide a filter strip to protect water quality and provide shade for fish habitat. In 1972, this was accomplished by leaving brush and unmerchantable hardwoods in the strip next to fish-bearing streams. Restrictions increased over the years, implemented as regulations developed by the Oregon Board of Forestry and its Regional Committees, sometimes motivated by directive bills from the State Legislature. The Oregon Board of Forestry is the body responsible for enacting regulations for forest lands in the state. The Oregon Department of Forestry (ODF) and its Forest Practices Foresters implement the regulations.

Through the late 1970's and early 1980's, scientific evidence was accumulating on the beneficial roles of instream large woody debris (LWD). In 1985, the ODF Riparian Habitat Technical Task Force recommended changes in forest practices rules to protect snags and down logs, and described the importance of LWD for fish habitat (Carleson and Wilson 1985). Subsequent rule changes in 1987 incorporated recommendations from the Task Force, and required live conifer retention and fixed buffer widths by streams for the first time (ODF 1987, OAR 629-24-546, Aug. 1, 1987, Hairston et al. in press). Despite these changes, concern over management along forest streams continued to grow (ODF 1991). In 1991, the State Legislature passed a bill (Senate Bill 1125) with specific language that enacted some new forest practice requirements, a number of which extended beyond water protection. The vehicle of using state law rather than administrative rules meant that some forest management standards were developed by the Legislature instead of the Board of Forestry, as had been most common. Senate Bill 1125 directed the Board of Forestry to review the stream classification system and prepare a new classification system with at least three categories, a strategy earlier rejected by the 1985 Task Force.

The process of reviewing the stream classification system and drafting the Water Protection Rules lasted from 1991 to 1994, and included a major rewrite of the draft regulations. The Board of Forestry had previously sought input on a wide range of issues, including streamside management, at a Forest Practices Public Forum in 1990 (ODF 1991). This was an initial basis of information for directions needed for rule changes. Lorensen et al. (1993) reviewed the existing stream classification system and presented consequences of several proposed classifications. The Board of Forestry chose a rule concept at one of its regular public meetings in July 1992, and draft regulations were prepared by ODF staff. The development process included field tours and review and hearings by the three Regional Committees. In Fall 1992, The Board of Forestry held public hearings and invited comments on draft regulations, which proved to be very contentious and widely criticized on the basic approach (Solomon 1994).

The sequence of events had followed the usual process of rule development up to this point. Spurred by the strident objections to the first drafts of proposed rules, the Board of Forestry decided to gather more information about stream protection approaches and try a new more participatory approach to rule-making (ODF 1994a, Solomon 1994). They formed the Water Classification and Protection Rules Advisory Committee. This committee consisted of representatives of a wide range of stakeholders and was intended to create more workable rules and develop support from a range of constituencies (ODF 1994a). It included representatives from state agencies, industry and landowner associations, and environmental groups, as follows: Oregon Department of Forestry, Oregon Department of Fisheries and Wildlife, Oregon Water Resources Department, Oregon Department of Environmental Quality, Oregon Water Utilities Council, Pacific Coast Federation of Fisherman's Associations, Oregon Forest Industries Council, Associated Oregon Loggers, Oregon Small Woodlands Association, Portland Audubon Society, and Oregon Trout. The committee helped ODF staff develop a new draft of regulations, which then went through a second set of reviews, public hearing, comments, and adjustments during 1993. The regulations were approved by the Board of Forestry in April 1994, and became effective September 1, 1994.

A few of the major changes to the Forest Practice Rules for streamside harvesting are summarized here. Prior to 1994, streams had been classified as Type I, fish-bearing, or Type II, nonfish-bearing, with some special standards for Type II streams considered important for water temperatures downstream. The 1994 stream classification system created three stream sizes, small (S), medium (M), and large (L), and three stream uses, fish-bearing (F), domestic water use (D), and neither fish-bearing nor used for domestic water (N), with the combination making nine classes of streams (Oregon Administrative Rules, Chapter 629, Dec. 1, 1994). Stream size was based on flow, estimated on a regional basis from drainage area. The new classification system involved greater lengths of streams, encompassing some of the smaller streams used by juvenile fish or for winter habitat that had not previously had Riparian Management Areas (RMAs).

Prior to 1994, RMA widths had been three times the stream width, with a minimum of 25 feet and a maximum of 100 feet slope distance, required on Type I streams (Adams 1988). 1994 RMA widths for fish-bearing streams were 50 feet for a small stream, 70 feet for a medium stream, and 100 feet for a large stream, measured on the slope. Thus, the maximum width for large streams did not change, but many smaller streams had new RMAs or greater widths of RMAs.

Removal of trees in the RMA was allowed both before and after 1994, with very different levels of tree retention required. Prior to the 1994 changes, the Forest Practice Rules required leaving 50% of the riparian canopy, all possible snags (those not a fire or safety hazard), nine live conifers per acre, and 10 square feet of conifer basal area in the Riparian Management Area (Adams 1988). The stream shade requirement specified that 75 percent of the pre-harvest shade be present after harvest. The 75-percent shade standard had proven hard to measure and therefore implement (ODF 1994b). The 1994 Rules contain two main provisions that require trees to be left in the RMA. Twenty feet on each side of fish-bearing streams cannot be harvested, intended to maintain shade and the trees closest to the stream. In addition, target basal areas for conifers and selected hardwoods or snags must be met before trees outside the 20 feet can be removed. The standard target basal areas vary by stream size and region, ranging from 40 to 270 square feet per acre for clearcut harvests (OAR 629-640-100, December 1994). The targets were designed to produce stands that average around the stocking expected in a mature forest, based on a 50-year rotation for clearcuts and 25-year cycle of entries for partial harvesting or thinning (ODF 1994b). Average stand growth rates were based on the Stand Projection System by Arney (1985), used because of its applicability to second-growth Douglas-fir stands (Lorensen et al. 1994). Applicability for riparian sites or mixed-species stands is uncertain because site productivity or levels of competition may differ from the stands used to develop the model.

The 1994 Rules also have provisions for converting a hardwood-dominated riparian area to a conifer stand. The conversion option is available only if the stream has less than half of the target conifer basal area, and it allows cutting in up to 500-foot lengths to within 10 or 20 feet of the stream, separated by uncut areas 200 feet or more in length (OAR 629-640-300, Dec. 1, 1994). In addition, the 1994 Rules have a basal area credit provision for "stream enhancement" that allows harvesting more trees in the RMA if stream habitat management work is carried out, such as placing large wood in the stream. The basal area of additional trees that could be removed is proportional to the basal area of wood placed (OAR 629-640-110, Dec. 1, 1994). These provisions were designed to encourage active management of streamside areas to create favorable fish habitat more rapidly than might occur with no action in the RMA.

The 1994 Rules are substantially more complex than previous rules, with many more stream classes and required targets and possible management strategies. Along most streams, greater conifer basal area is required to be left. If harvest is intended in the RMA, laying out the RMA along a stream could take longer because the preharvest basal area of all conifers has to be estimated or measured to determine whether the area exceeds the target basal area, an exercise that was often not necessary under the previous rules. With the complexity of the new Rules comes a variety of options for streamside management. Perceptions of these characteristics of the Rules and their relative importance were explored in the written questionnaire for Rule users.

Science and Policy

Public policies in a democratic society are social and political decisions. They set out which goals to pursue, who pays, and who has rights to what (Batie and Diebel 1990, Cubbage 1995). Political, social, economic, and legal issues play central roles (Cortner and Shannon 1993). Science is only one of the players in the complex array of factors shaping natural resource policy directions, but it has occupied a favored role for some time.

Scientific research has been sought for developing policy in many arenas, not least of which is forest management. The existing research was influential during the development of the Oregon Forest Practices Act in the early 1970's and during subsequent changes (Hairston et al. in press). The reliance on research and technical information in public policy has only expanded over time, coincident with the growth of our technical capacity. The increasing use of science advisory boards, expert witnesses, and full-time science advisors bears witness to this trend (Jasanoff 1990).

The wide expansion of environmental regulation during the last few decades triggered an increased reliance on science in policy-making in a variety of forms (Jasanoff 1990). Science is seen as a source of objective, verifiable information, and the concept of relying on science rather than politics in making policy decisions has popular support (e.g., Shindler et al. 1996). The classic model of policy formation is based on comprehensive evaluation and rational decision-making, relying on science to identify consequences of policies (Nakamura and Smallwood 1980). Although science has enjoyed wide use and popular support, the application of rational decision-making and expert knowledge have not been sufficient to consistently produce stable and uncontested policies and regulations (Jasanoff 1990).

The differing natures of policy and science affect their interaction. Policy makers are looking for answers, actions that will achieve their intended goals. Science gives technical information, but it often does not address the socio-economic factors important to policy makers (Adams 1993). Science gives probabilities not certainties, and conclusions may be relevant to only a portion of the area in which policy makers are interested. Not all sources of scientific information have equal quality control. Peer review is the major process for outside evaluation of research by other experts, but it has some limits from the perspective of policy. Only a portion of the research receives such review, publication in a peer- reviewed journal can take a year or more, and level of scrutiny varies (Jasanoff 1990, Adams and Hairston 1994). Policy makers are left in the unenviable position of extrapolating results and working with many areas of uncertainty. Policy is commonly ahead of well-established and published research findings, and may not be able to wait for peer-reviewed literature and scientific consensus.

Several avenues are used in policy to apply more relevant and timely scientific information. “Gray literature”, research results or interpretive summaries that are published without outside review, abounds in the policy arena to fill a variety of needs. Experts or advisory boards also are frequently used, providing policy makers flexible access to current expertise (Jasanoff 1990). Gray literature and expert advice can be well-prepared and useful, and may address the questions raised by proposed policies more directly than peer reviewed literature. However, they may also include messages that are formed more by the values of the author or organization than by the research results. The use of multiple sources whenever possible can help users evaluate the accuracy and reliability of unreviewed publications and other technical input (Adams and Hairston 1994). Careful evaluation of the presentation of results, paying attention to associated uncertainty, and taking common judgment biases into account are also important steps in evaluating the quality of information sources (Cleaves 1994). Since this research has inevitably had to draw upon gray literature, especially in exploring interactions of science and policy in the Forest Practices Act, multiple sources have been sought and used wherever possible, with attention to probable biases of the sources.

Science cannot provide answers at all steps of policy making. Science can help define likelihood of potential hazards of a policy, but cannot determine acceptable levels of risk (Adams and Hairston 1994). Science is useful for setting bounds on possible goals, describing the scope of uncertainty, and identifying consequences of alternative policies (Adams and Hairston 1996). The policy makers still have to choose the social goals and work with political and institutional realities.

Some scientific publications and testimony extend beyond communicating research results and possible implications for policy choices to recommending the policy direction or decision. Most people have seen instances where different scientists or experts present diametrically opposed views, both claiming to be supported by scientific evidence. The credibility of science is inevitably questioned and trust in science experts is shaken (Gillis 1992). The lack of consensus among scientists can result from uncertainty in science (Cleaves 1994) or differing values and biases (Ingram et al. 1991, Duncan 1994). Regardless of source, the loss of scientific credibility is probably the greatest hazard from the use of science in policy (Jasanoff 1990). Scientists have opinions and biases and can certainly make recommendations about policy like any citizen, but this activity should be clearly labeled as opinion, not science or scientific research. Science will continue to be used in policy formation. The appropriate labeling of the boundaries between opinion and research could be a step towards maintaining or increasing credibility of science in the policy process, especially if policy-makers become more familiar with typical constraints of scientific results.

Policy makers should realize that the scientific perspective may not be taking into account other relevant dimensions of policy. Some suggest that integrating knowledge of human behavior is key for success of public policy (Korsching and Nowak 1983, Soil and Water Conservation Society 1993). The way in which policy is implemented can greatly affect success or failure (Adams 1993), a factor not considered in the classic policy approach (Nakamura and Smallwood 1980). Public education or understanding may be the limiting factor for adoption of a policy, rather than technical capability (McMahon 1992). Hobbs et al. (1983) concluded that adoption of newly developed reforestation techniques depended most importantly on the use of a local team, rather than primarily on the excellence of the technique.

Stern (1993) suggests that a second environmental science, studying human-environment interactions, is needed to complement our science of environmental processes. He points out that some elements are technical, such as determining causes of environmental changes and how those changes affect resources, but other elements inherently involve human response. How individuals and organizations act in the face of actual or anticipated environmental change can greatly affect the future course of that change. Social setting, economic incentives, trust, and attitudes all can affect how humans make choices about activities affecting the environment (Stern 1993). The interface between science and policy is the venue for the implementation of our science, the place where research can make a difference or fail to do so.

Policy Approaches for Private Forests

Spurred by requirements of the 1972 Clean Water Act (Sections 208 and 319) to limit nonpoint source water pollution, forestry Best Management Practices (BMPs) were developed. Both regulatory and voluntary programs have been used and thought effective. Some programs combine required and voluntary BMPS (Brown et al. 1993). Commonly, the policy approach has been for states to develop the BMPs for how forest management activities will be conducted (Cubbage 1994).

Voluntary programs are viewed with some skepticism about effectiveness: 80 percent of forestry program administrators nationwide thought that voluntary programs for private forest owners were neutral or ineffective in meeting water quality goals (Ellefson and Cheng 1994). However, voluntary programs may be more cost-effective (Ellefson et al. 1995), and avoid the adversarial relationships set up by regulatory programs. Within regulatory approaches, Salazar and Cubbage (1990) identify two policy models, comprehensive regulation by a state agency and fragmented regulations administered by various state and local agencies. State-level regulations sometimes have been developed to replace the complexity and potential inefficiency of different rules in each local jurisdiction (Ellefson and Cheng 1994).

In recent years, regulations have become an increasingly common approach to limiting impacts of forest management activities (Cubbage 1991, Ellefson and Cheng 1994, Martus et al. 1995). Policy approaches also include research, monitoring, education, technical assistance, cost-share and tax incentives (Adams 1993, Brown et al. 1993). The Oregon Forest Practices Act is a regulatory program and is the mainstay of

Oregon's forest policy for private lands. However, Oregon also has program elements for monitoring, public education and awareness, technical assistance to small landowners, and subsidized loans to manage underproductive forest land.

The different policy approaches have different costs and consequences. Regulations set minimum standards, allow enforcement, assuring some recourse when damage has occurred in most cases, clearly assigning liability to the landowner to prevent environmental damage. Regulations have resulted in significant improvements in reforestation rates and resource conditions (Green and Gallez 1982, Henly et al. 1988). Regulatory programs were thought to be quite effective by program administrators in the West and Northeast U. S., particularly for water quality, reforestation, and harvesting practices, but regulations were not thought as effective in other regions (Ellefson et al. 1995). Compared to technical assistance and education, regulatory programs were not considered as effective in most regions by forestry program administrators (Ellefson et al. 1995). Regulations can induce behavior counter to the intention of the rule, such as when landowners cut earlier than intended to assure that their forests will not be attractive to a threatened species (Bourland and Stroup 1996). A highly restrictive rule also may discourage active management that would promote future habitat, even though it may help maintain existing habitat in the short term. At the same time, regulations can have their greatest effect on those who would not voluntarily protect non-timber resources (Green and Gallez 1982).

Regulations are seldom noted for their flexibility or popularity. The issue of regulatory takings, where the cumulative effect of regulations significantly restrict or prevent economic uses of property, has become prominent in property rights concerns (Flick et al. 1995). Administration of, enforcement of, and compliance with forest practices regulations can be costly for both governments and private landowners (Henly et al. 1988, Ellefson and Cheng 1994, Ellefson et al. 1995). The increasing use of regulations is spurred by many social, institutional, and ecological factors: the desire for clear accountability in the legal structure, the ability to assure set standards of performance, the political need to produce tangible results in response to public anxiety over environmental damage, the landscape-level nature of evolving concerns, and public reactions to misapplied forest practices (Ellefson and Cheng 1994).

Financial incentives and technical assistance are widely used to encourage actions considered in the best interests of the public, such as reforestation on nonindustrial private land (Cheng and Ellefson 1993, Cubbage et al. 1996). Both cost-sharing and technical assistance were important factors in landowners' decisions to reforest (Royer 1987). Bliss and Martin (1990) found that cost-sharing had little influence on deciding whether to manage, but may encourage rapid completion of larger projects, essentially affecting the timing and extent of management. Technical assistance has been found to improve forest stand conditions, increase reforestation, and raise timber prices received (Alig et al. 1990, Cubbage et al. 1996). Landowners receiving technical assistance were found to harvest less volume and partial cut more than unassisted landowners, and more frequently had goals relating to silvicultural rather than income objectives (Bullard and Moulton 1988, Clark et al. 1992). Technical assistance was consistently rated as the most effective policy option by state forestry program administrators for most program goals for private lands (Ellefson et al. 1995).

Direct cost-shares and hiring technical assistance foresters to inform and aid landowners involve substantial costs to governments. Technical assistance may be available in a fragmented fashion with multiple agencies handling narrow land management concerns, which can make these programs confusing and unattractive to landowners (Bliss and Martin 1990). Some question whether these public investments are merely substituting public money for private money that would have been invested in the forest practice anyway (Cubbage 1994).

Tax incentives and credits are not as widely available as cost-sharing and technical assistance (Cheng and Ellefson 1993), but similarly intend to encourage landowners to invest in timber management or other public goals. Capital gains taxes, estate taxes, and tax credits for reforestation are different manifestations of tax policies. Because tax policies are enmeshed in the entire tax systems and can affect local or national revenues, these changes are usually more difficult to bring about than simpler targeted programs for technical assistance or cost-share (Cubbage 1994). Royer (1985) concluded that the addition of a tax credit to a cost-share program in North Carolina acted more as a reward to landowners, rather than as an additional incentive to reforest, and was economically inefficient for the state. State forestry program administrators considered tax incentives to be generally less effective than technical assistance and direct financial incentives for private lands (Ellefson et al. 1995).

Education is always a popular approach that is seen as a low-cost means of pursuing public goals without being intrusive or costly to landowners (Cubbage 1994). Education programs can be targeted for very different audiences or messages, so effectiveness is undoubtedly connected to the match between the program, audience, and desired behavior. Bliss and Martin (1990) found that education had the most enduring effect of all the public programs for motivated tree farmers. Ellefson et al. (1995) found that forestry program administrators rated education as one of the more effective policy options, especially for forest health, wildlife, and recreation goals.

Other programs and policies are being developed, especially as ideas such as ecosystem management and global sustainability push public interests in private forests to include more noncommodity values (Best and Wayburn 1995). Bourland and Stroup (1996) propose rent payments for endangered species protection much like the Conservation Reserve Program for erodible cropland; this kind of program would build incentives for some landowners to develop habitat for endangered species rather than take actions to prevent suitable habitat on their property. Payments for planting to build global carbon reserves have also been considered (Cubbage 1994). Kennedy et al. (1996) propose transferable endangered species certificates that would allow relocation of young or purchase of others' certificates to mitigate for activities that would harm habitat of concern.

To aid landowners in managing for diverse goals, Wayburn and Best (1995) suggest "bundled" government assistance programs, where landowners could easily receive assistance for a variety of commodity and noncommodity objectives with one contact. Adams (1996) similarly argues for coordination of research, education, and assistance programs to more effectively address contemporary forest issues. Streamlining and interagency coordination for regulations are also mentioned as a means to improve efficiency and effectiveness of protecting public values on private land (Cubbage 1994).

While these suggestions are not currently used much, other approaches such as conservation easements are in use. Conservation easements are deed restrictions that can be tailored to individual situations where the landowner cedes rights that they do not intend to use, such as subdivision or harvesting, in exchange for tax benefits from donating the rights to a land trust (Cubbage 1994, Best and Wayburn 1995). Direct purchase of development or harvest rights by governments is also an option, although they can be expensive and some landowners fear limitations on control of their land (Cubbage 1994). Awards recognizing good stewardship and wildlife management are now being used in some states as motivation for landowners to manage for noncommodity goals (Cubbage 1994). Land swaps have been used by federal agencies to protect sensitive habitat, but land exchanges between willing landowners with different goals may also have a role in some circumstances. Land exchanges, Forest Trust Accounts similar to Individual Retirement Accounts, forest stewardship awards, and regulatory streamlining are all included in recommendations by the Forest Incentives Group (Schroeder 1996) to the Oregon Board of Forestry.

Social factors also play important roles in how policies are perceived and used. Bliss and Martin (1989) found that ethnic, family, and personal identity were the primary management motivators of award-winning tree farmers. The characteristics and social networks of a community can influence forest practices used, especially how new practices are incorporated. Some people in communities typically try new approaches, while others hang back and see how effective the new techniques are, a behavior model called diffusion of innovation (West et al. 1988). The presence of "early adopters" in key positions in the community can influence the rate at which others adopt a technique (Muth and Hendee 1980). West et al. (1988) found that peer influence was as important as advice given by private forestors and more important than advice from state or federal foresters, and emphasized the importance of communicating with local opinion leaders about forest practices. Cheng and Ellefson (1993) found that forestry program administrators in the West and Northeast were more favorable to regulatory programs than were their counterparts in the South and Central U.S., a distinction that is probably more related to historical use and social and political environment than to the technical aspects of implementing regulations.

A range of policies are used to varying degrees to influence private forest management, each of which has its strengths and disadvantages. Given the complexity of forest ownership, public and private goals, and biological realities, future policy approaches are likely to need all the options. Even in areas based on ecological ideals and philosophy such as biodiversity, economic considerations are important for realizing goals (Montgomery and Pollack 1996). Information, ideals, and economics are all important contributors in private forest management, so policy approaches will need to pursue and coordinate each.

Survey Methods

Survey methodology was reviewed to identify approaches available to reach Oregon Forest Practices rule users and obtain information that could be summarized and compared among groups. Survey techniques range from in-person or telephone interviews to written questionnaires with many formats. Identifying the goals of the survey and the population of interest are crucial steps to focus effort and resources and to secure useful results. Questions must be designed carefully to tap the appropriate dimension (belief, attitude, or behavior), to use relevant indicators where concepts cannot be measured directly, and to avoid biasing responses (Babbie 1979).

Written surveys have the advantages of being relatively inexpensive, allowing large sample sizes, and, with suitable followup, achieving acceptable response rates (Dillman 1978, Frey 1989). Telephone interviews are somewhat more expensive, but are the most rapid technique, allowing wide geographic coverage quickly. Of course, the telephone generally excludes people without phones or with unlisted numbers. Response rates for telephone interviews are usually good, although they have dropped with the increase in telephone solicitation (Frey 1989). Telephone interviews give the researcher control over question order and exact time and date of response. However, responses during telephone interviews must be immediate, possibly rushing the respondent, while written surveys allow the respondents time for consideration of questions and responses at their desired pace. Written surveys can reach a large number of respondents and avoid biases from interviewer effects, although careful wording of questions is necessary to avoid confusion and bias (Babbie 1979). The information can be summarized for regions and groups, allowing comparisons and statistical tests of differences. These qualities made written questionnaires a suitable instrument for gathering quantitative data on landowner and operator opinion. The speed and question order control of telephone surveys was not needed for this study, and the database of the population of interest, people filing harvest notifications, was more complete for addresses than for telephone numbers.

Written surveys have some limitations for complex issues like the details of the forest practice rules, and may not capture situation-specific features or reasoning behind a response (Frey 1989). With written surveys, there is no knowledge of exactly what individual or how many individuals are answering a questionnaire, and no control over the sequence in which questions are answered. Personal interviews are more time-consuming and expensive, thus limiting sample size, already limited by the number of landowners cutting riparian areas under the 1994 Rules. There are also concerns about interviewer bias, where results differ among interviewers, and social desirability bias, where people tell you what they think you want to hear (Frey 1989). Despite the cautions needed to minimize these biases, personal interviews are invaluable for gaining insight into complex issues and unforeseen situations. The travel required for the personal interviews over large geographic areas, like the state of Oregon, makes this an expensive approach, which often limits sample size.

Related Surveys on Forest Policy

General Public

This research focused on the rule users as the most affected and influential actors in implementing regulations. However, public opinion has often played a major role in setting forest policy (Bliss et al. 1994). What do we know about the opinions of the general public regarding forest management? In a nationwide survey on federal forest management, most people wanted to balance environmental and economic concerns, although few are willing favor economic issues at the expense of the environment (Shindler et al. 1993, Bliss et al. 1994). Most favored ecosystem-based policies over commodity-oriented policies for federal forests; looking only at Oregon, significantly more people supported the commodity-based policies, but they were still a clear minority (Shindler et al. 1993). A survey of U. S. voters found that a majority (52%) favored human management of forests compared to letting nature take its course (40%), using questions that briefly identified ecological and economic costs and benefits of both choices (Frederick/ Schneiders, Inc. 1994). A 1995 survey of the public found that 61 percent agreed that technology will solve environmental problems, and 69 percent believed that environmental protection and economic development can go hand-in-hand, but if a choice had to be made between environmental protection and economic development, 63 percent chose protection and only 23 percent chose development (Pace 1996). Environmentalist leanings of the U. S. public are evident, even in regions where timber production is a fundamental part of the economy. However, management of forests to achieve mixes of ecological and economic benefits seems to be a widely favored course of action.

Forestry issues are important to the public, but are not central daily issues to most people. A survey of Oregonians found that the economy, education, and crime were the major issues, not forest management (Moore Information, Inc. 1994). However, among environmental issues, forest management was of the greatest concern to Oregonians, with 32% choosing forest management compared to 23% each for water quality and garbage and 17% for air quality (Moore Information, Inc. 1994). Given forest uses of a source of clean water, fish and wildlife habitat, and a source of timber jobs, Oregonians chose clean water as important or very important most frequently (86%), habitat next (74%), and jobs last, although a clear majority (61%) believed that forests were important as a source of jobs (Moore Information, Inc. 1994).

Who is credible to the public as a source of information on natural resource policies? Forest industry generally has relatively low credibility, with environmental organizations often not much higher (Frederick/Schneiders, Inc. 1994, Moore Information, Inc. 1994). In other situations, such as a survey of Florida residents by Soden et al. (1992), environmentalists have been found to be a relatively trustworthy source of technical information, comparable to state natural resource agency personnel. University scientists often have comparatively high trust (Soden et al. 1992, Frederick/Schneiders, Inc. 1994, Moore Information, Inc. 1994). In a survey of Oregonians, forest scientists were trusted a lot or quite a bit by 55%, compared to 25% for environmental organizations and 18% for industry foresters (Moore Information, Inc. 1994). Nationwide, scientists employed by universities were considered persuasive in forming opinions on forest management issues more than twice as often (43%) as environmental group scientists (21%), federal forest agency scientists (16%), and timber company scientists (7%) (Frederick/Schneiders, Inc. 1994). Note that even the most trusted of sources are perceived as trustworthy or persuasive by only a small majority or a minority of the public, suggesting that most view information skeptically.

Forest-based Communities

Policies affect, and are affected by, communities as well as individuals. The social context of a community can make it easy or difficult to hold a particular opinion about forest management. A survey of people in communities near National Forest Adaptive Management Areas found that rural timber-dependent communities tended to favor policies that support timber workers while a more urban and economically diverse community did not favor those polices (Shindler et al. 1996). Shindler et al. (1996) found some common areas of agreement among the diverse communities, such as putting more faith in science than politics for setting forest policy.

Oregon Forest Landowners

This research sampled only nonfederal landowners who had harvested under the 1994 Water Protection Rules. Other surveys provide information about attributes and attitudes of Oregon forest landowners, a broader population. In Oregon, nonindustrial private owners (NIPF) hold about 16 percent of the forest resource and forest industry owns another 21 percent (Bourhill 1988). Nonindustrial landowners tend to own land for a multitude of reasons. Some own land primarily for the timber income, but many more list intangible reasons as more important, such as for pride of ownership, aesthetics, or wildlife habitat (Haymond 1988, OSU Survey Research Center 1989, Bennett 1993, Johnson et al. in review). Bliss et al. (1994) concluded that NIPF owners essentially mirror the attitudes of the general public, favoring a balance between property rights and regulation that ensures environmental protection, even though some may be likely to assume that NIPF owners are highly protective of property rights.

Most NIPF owners are open to the idea of harvesting their forest when mature, but 20 percent of landowners in Western Oregon and Washington said they would never harvest (Cleaves and Bennett 1995). Most owners harvest to meet income needs or silvicultural objectives (Bennett 1993). The likelihood of harvesting is higher for large ownerships and longer tenure (Straka et al. 1984, Cleaves and Bennett 1995). Owners of large (>100 acres) parcels also tend to place more importance on harvest income than owners of small parcels; in Western Oregon and Washington, Johnson et al. (in review) found that timber production was the primary reason for owning forest land for 22 percent of large-parcel owners, but only for 6 percent of small-parcel owners. The majority of the land is owned by people who generally intend to harvest at some point;

more than two-thirds of the NIPF land in Oregon is owned by people with definite intentions of harvest (Cleaves and Bennett 1995).

Less research has been done on forest industry because their motivations and intention to harvest are usually clear and focused on income production. Industrial owners harvest a much higher proportion of stands, use more clearcutting, and manage more intensively than NIPF owners (ODF 1994a, Gedney 1983). Even with similar goals for various industrial ownerships, attributes such as extent and type of forest owned can affect forest management. Kreutzwiser and Wright (1990) found that size of a company's landholding and state policies strongly influenced the likelihood of the company adopting integrated forest management approaches, which incorporate non-timber values.

How can forest policies or potential regulations affect harvesting behavior? Impending regulations are thought to motivate some owners to "cut while they can", and avoid future restrictions. Cutting may be earlier than intended, well before economic or biological maturity of the stand. Reports on the importance of threat of regulation to NIPF harvesting behavior vary. Bennett (1993) found that 8% of NIPF owners in Western Oregon chose "to avoid possible future harvest restrictions" as one of the top three most important reasons for harvesting, but these owners accounted for 15% of the volume harvested. Only two percent listed potential regulations as the most important reason for harvest (Bennett 1993). Johnson et al. (1994) found that 6 percent or less of NIPF in Western Oregon and Washington listed possible harvest restrictions as one of the top three reasons for harvesting. When the same survey asked about importance of proposed riparian harvest restrictions in their most recent harvest decision, 25 percent indicated that they were important or very important; 64 percent said that they were unimportant or not at all important.

Although only a minority of NIPF owners seem very concerned about regulatory uncertainty, Johnson et al. (in review) noted that more owners of large parcels were concerned about possible restrictions. A survey of Washington Farm Forestry Association members found that uncertainty about regulations was broadly affecting forest management decisions, even more so than amount of taxes (Northwest Renewable

Resource Center 1995). Half of the respondents said that they had taken some action in response to regulation, such as harvesting earlier than planned, harvesting more than planned, or selling the land. The survey also asked about other uncertain elements of forest management, and found that respondents were much more concerned with state and federal regulatory actions than market fluctuations or natural disasters.

The survey of the Washington Farm Forestry Association members may most accurately represent the active harvesters, while the other surveys probably reveal the mix of attitudes in the broader population of NIPF owners. The general picture seems to be fairly wide concern about regulations, but not as a primary determinant for harvesting decisions. Those with the largest financial stake in the forest land seem to be most threatened by regulations and most likely to take actions in response to proposed regulations (Johnson et al. in review).

Sauter (1994) conducted a telephone survey on harvesting decisions specifically for riparian management zones in Washington State. She did not find any significant differences in compliance among forest industry, private nonindustrial and state landowners and managers, with a sample size of 36. Ninety-one percent of respondents said that the regulations were not the main reason that they left buffers, but over half also thought that most landowners would not leave buffers if not required. Sauter (1994) found that almost all landowners (over 90%) said they were willing to consider leaving more trees than required for fish, soils, slopes, water quality, and operational considerations. Most (74-83%) said they would leave them for aesthetics, neighbors, wildlife, or timber value. Public opinion and penalties generated the least motivation to leave extra trees, but this still represented just over half of the respondents. Sauter (1994) also compared responses by landowner groups, but found only a few differences. Just under half of the private landowners said that they considered wildlife in their harvesting decisions while essentially all of the industry managers said so. Johnson et al. (in review) found that most NIPF owners said that they would be willing to alter the timing and amount of their harvest if it was necessary to maintain a healthy ecosystem. These detailed surveys provide evidence of the variety of views held by private owners, and some of the important characteristics for harvesting decisions such ownership size, reason for owning land, and financial stake in land.

Economic Studies and Oregon Forest Practices

Economic impacts are an important part of policy considerations. Several reports have presented information on economic consequences of the Forest Practices Act and Water Protection Rules (Olsen et al. 1987, Lorensen et al. 1993, Lorensen and Birch 1994). Streamside harvesting restrictions can incur substantial costs to the timber owner. Costs include value of live trees retained, additional planning expenses, and costs for more careful felling, yarding, and road-building around streams (Olsen et al. 1987). For the Water Protection Rules, the greatest potential costs are attributable to the increase in trees retained along streams and the increase in length of streams requiring buffers (Lorensen and Birch 1994). Harvesting costs for logging the adjacent upslope timber can also increase, but these increases are usually not as large as costs of leaving the uncut trees. Lorensen and Birch (1994) estimated that increased costs would be greatest in Western Oregon, about double the cost under previous rules, while Eastern Oregon would see relatively few changes, about 1.2 times the cost under previous rules. Forest industry generally owns land higher in the watershed than NIPF owners. Industrial owners were expected to have more cost increases than nonindustrial owners, because more of the small, newly regulated streams would be on industrial property (Lorensen and Birch 1994).

Riparian Area Assessment

The ODF conducted a Riparian Rule Assessment from 1990 to 1993 as an information base for revising the Water Protection Rules (Morman 1993), which provided baseline data for comparison with results of this study. The assessment found that many buffers were larger than required then, and that about half of the preharvest conifers were likely to be removed from streamside stands in Western Oregon. Such a decreased pool of conifers was not considered likely to provide sufficient conifers for long-term sources of large woody debris for fish habitat in Western Oregon (Morman 1993, Lorensen et al. 1994). In Eastern Oregon, higher proportions of conifers were retained, so there were fewer concerns about reduced sources of future woody debris (Morman 1993). Morman (1993) also reported concerns with shade loss along Class II streams affecting downstream water temperature, scarcity of snags for wildlife along Western Oregon streams, and an estimated one percent reduction in land base for timber production from compliance with Forest Practices Rules.

The goals of the 1994 Water Protection Rules are maintaining water quality, providing aquatic habitat components and functions such as shade, large woody debris, and nutrients, and maintaining wildlife habitat components such as live trees of various species and size classes, shade, snags, downed wood, and food with the riparian management areas (OAR 629-635-100, Dec. 1, 1994). The major changes in the Water Protection Rules, in addition to the new stream classification system, seemed to focus on replacement of the 75% shade standard and relatively limited tree retention requirements with the 20-foot no-harvest buffer and the substantial basal area targets. The new basal area targets were intended to increase trees left near streams, which could serve both as future sources of instream large woody debris and as a varied streamside stand for wildlife. The approach taken to the Forest Practices Rules by ODF includes an active monitoring program to document performance of the Rules. The initial focus of monitoring for the Water Protection Rules has been stream shade and temperature, especially in hardwood conversion projects, which remove most of the canopy in cut blocks. Little information is available on the post-harvest stand composition. A major reason for increased conifer retention was to promote stable large woody debris in streams (Lorensen et al. 1994). The requirements to retain conifers were thought the most expensive part of the new rules (Lorensen and Birch 1994). Because of the relative lack of information on post-harvest stands and economic and policy significance of retained conifers, this study focused on residual stand measurements and the potential of the retained trees to provide instream large woody debris.

Large Woody Debris

The study's focus on the role of streamside stands in contributing wood to streams merits a consideration of the various functions and processes associated with instream large woody debris (LWD). LWD is often considered to be material over 4 inches (10 cm) in diameter and at least 3 to 7 feet (1-2 m) in length (e.g., Long 1987, Bilby and Ward 1989, Ursitti 1990). For uses as stream structure, larger pieces such as 12 inches or more in diameter and 35 feet or more in length may be of interest (e.g., USDA and USDI 1995). Many studies have examined effects from logging on fish habitat, populations, and stream temperature (e.g., Murphy and Hall 1981, Bisson and Sedell 1984, Beschta et al. 1987, Scrivener 1987). This review concentrates on studies about responses to debris removal or addition, which are often conducted at the same time as logging of adjacent stands.

For some streams, woody debris reductions likely began a century or more ago with the practice of splash damming. Splash damming was a method of transporting logs downstream. The dams were constructed to back up water until suddenly released, sending a torrent of water and logs downstream, scouring the streambed for considerable distances. In more recent decades, woody debris was removed from streams to prevent blockage of fish passage, damage to culverts or bridges, and depletion of dissolved oxygen from organic material loading (Narver 1971, Hall and Baker 1975, Holderman 1977). The 1972 Forest Practices Act included restrictions for keeping logging slash out of streams. The practice of stream cleaning often included removing existing debris as well as material added during logging. During the 1970's and 1980's, concern grew that large wood played an important role in fish habitat and stream stability and not all wood should be removed (Hall and Baker 1975, Bilby 1984).

Substantial research has now demonstrated the various functions of LWD in streams. The current policies still limit additions of logging slash to streams but also encourage the retention and periodic addition of large wood. In practice many streams in managed forests now have a legacy of low levels of LWD because both the previous instream wood and riparian forest was removed. LWD has been documented as lasting over 100 years or more in Oregon Cascades streams (Swanson et al.1976) and over 50 years in the Coast Range (Andrus et al. 1988). Turnover rates for instream LWD were estimated at 12 to 83 years for several Oregon Cascades streams (Lienkaemper and Swanson 1987), suggesting that wood removals from streams can have effects lasting several decades or more. The provisions for basal area credits and conversion units in the Water Protection Rules are intended to provide wood to streams more quickly than the natural input rates would, attempting to replace the cleaned-out wood through active management strategies.

LWD is important in many streams for fish habitat, building pools and riffles, adding cover habitat, increasing habitat complexity and adjacency, and forming a substrate and nutrient reserve for biological activity (Meehan et al. 1977, Bisson et al. 1987, Sullivan et al. 1987, Andrus et al. 1988). Debris complexity was found to be an important factor in providing appropriate cover and water velocity for salmonid winter habitat (McMahon and Hartman 1989). Removal of debris has been linked to losses in fish abundance in the Oregon Coast Range (House and Boehne 1987), British Columbia (Fausch and Northcote 1991) and Southeast Alaska (Dolloff 1986, Elliot 1986, Murphy et al. 1986). On the Olympic Peninsula, Washington, salmonids were found to be significantly correlated with cover from LWD in winter, whereas steelhead and cutthroat were correlated in summer (Grette 1985). In British Columbia, smolt abundance was correlated to presence of debris (McMahon and Holtby 1992). Removal of debris reduced salmonid habitat in Southeast Alaska (Lisle 1986) and Western Washington (Bisson and Sedell 1984). Addition of woody debris structures increased summer and winter salmonid habitat in an Oregon Coast stream (Crispin et al. 1993).

Other cases are less conclusive, a testament to the variety of factors affecting fish populations. Removal of debris jams in Oregon Coast and Cascade was not seen to reduce salmonid populations during a drought year, although increased turbidity and sediment deposition were recorded (Baker 1979). Removal of debris and streamside vegetation was not seen to affect summer abundance of young salmonids in Southeast Alaska (Bjornn et al. 1991). Lestelle and Cederholm (1984) found only short-term losses in cutthroat trout abundance after debris removal in the Olympic Mountains of Washington; populations and stream stability recovered after one year, credited to the fresh debris that had entered the stream.

Cutting can increase light to the stream, stimulating primary productivity and growth of young fish. In Western Washington, Bisson and Sedell (1984) found increased salmonid biomass in logged stream sections versus unlogged sections, but also noted the decline of species and sizes of fish that depend on pool habitat in cleaned reaches. The season in which fish populations are assessed can affect observed results. In Southeast Alaska, Murphy et al. (1986) also found that clearcutting could increase fry abundance in the summer through increased primary productivity, but observed decreased populations in winter if debris was removed. This mixture of results shows that habitat is not the only variable affecting fish populations, but generally demonstrates the importance of LWD in creating and maintaining fish habitat in the Pacific Northwest.

LWD also has important roles in shaping stream channels, in addition to associated effects on instream habitat (Robison and Beschta 1990a). Debris stores large amounts of sediment and organic matter, many times the annual export (Bilby 1981, Megahan 1982). This storage generally buffers sedimentation impacts downstream (Swanson and Lienkaemper 1978). Removal of debris can greatly increase sediment and particulate organic matter export and channel scour, and can diminish pools and gravels bars (Beschta 1979, Bilby 1981, Megahan 1982, Bilby 1984, Harris 1986). Channel morphology and pool occurrence are strongly affected by LWD in forest environments (Keller and Swanson 1979, Smith et al. 1993). LWD, along with channel type, slope, and width, were correlated with pool spacing in Washington and Southeast Alaska (Montgomery et al. 1995). LWD slows water velocity (Shields and Gippel 1995) and dissipates erosive energy of the water (Heede 1972). LWD plays a major role in small steep streams by forming step pools and waterfalls, greatly modifying the ability of the stream to transport sediment (Swanson and Lienkaemper 1978, Heede and Rinne 1990).

Debris can enhance or detract from stream stability as flow interacts with bed and banks. In a flume study, unanchored wood oriented downstream generated less scour and protected banks, while upstream-oriented pieces had greater scour and directed flow into banks (Cherry and Beschta 1989). Most natural instream woody debris is oriented downstream or perpendicular to the channel (Bilby and Ward 1989, Robison and Beschta 1990a), and root wads can anchor pieces, decreasing likelihood of downstream movement. Debris removal resulted in local bank erosion and channel widening in a small gravel bed stream in Southeast Alaska (Smith et al. 1993). Debris can act to stabilize the local base level, armoring knickpoints and retarding erosion or degradation of the streambed (Heede and Rinne 1990). Local flow conditions and sediment are modified by the large wood, but smaller pieces are transported or reworked into debris accumulations.

Additions of sediment, especially large ones, are generally thought to reduce fish survival and abundance, but studies have shown increases in some cases (Koski 1965, Hall and Lantz 1969) and tolerance of sediment or no effect on populations in other cases (Everest et al. 1987, Kaufmann 1987). Even catastrophic events such as debris torrents that eliminate existing habitat as they scour the channel may have longer-term benefits where the mix of sediment, gravel, and debris deposits downstream (Everest and Meehan 1981). Kaufmann (1987) found higher pool volumes and greater habitat complexity in reaches about 12 years after torrent deposits than in undisturbed reaches in the Oregon Coast Range. Following a debris flow in a third-order stream in the Oregon Cascade Mountains, stream macroinvertebrate and trout populations were initially decimated but recovered to upstream population levels within one year (Lamberti et al. 1991). However, abundance fluctuated broadly over time, and Lamberti et al. (1991) suggested that ecosystem stability was diminished by the debris flow despite the rapid recovery in populations, at least during the three-year period of study. Coats et al. (1985) reported substantial recovery of upper portions of a Northern California stream within a year after extensive flooding and landsliding, but found continued instability in lower reaches as well as an altered sediment transport regime. These results suggest that even extreme events of sediment input can have both benefits and hazards to aquatic organisms and their habitat, and reveal great resiliency to catastrophic disturbance in some cases.

Large woody debris and stored sediment are generally part of a stable and productive stream channel (Everest et al. 1987), and debris removal obviously can destablize the channel. However, addition of debris also can decrease channel stability in some situations. Some types of debris such as heavy loading of slash or floatable logs can increase channel scour, erode banks, and destabilize existing instream debris complexes (Bryant 1983, Sullivan et al. 1987). Alluvial or gravel-rich streams have been noted as prone to LWD-induced scour, while bedrock-controlled streams are not (Swanson and Lienkaemper 1978). Investigating a situation where both sediment load and LWD load dramatically increased, Lisle (1995) found that LWD played a role in retaining pools and preventing scour, bed coarsening, and pool shallowing. Depending on variables such as stream substrate, sediment load, slope, debris size, species, and orientation, introduction of new woody debris therefore can have various consequences for a stream. Heede and Rinne (1990) emphasized the importance of considering basic stream hydraulic and morphologic factors and the equilibrium state of streams when adding structure to stream for fish habitat improvement. Intentional additional of debris should consider all these factors in placement projects.

The 1994 Water Protection Rules targeted conifers as desirable sources of woody debris. In the Pacific Northwest, conifers generally dominate the LWD load in streams (Grette 1985, Ursitti 1990, Veldhuisen 1990, Bilby and Ward 1991). In a second-growth stand in the Oregon Coast Range, red alder was seen to add debris to streams much sooner after harvest than conifers, but the alder debris disappeared more rapidly than did the coniferous debris from the preharvest forest (Grette 1985). The alder debris was shorter, smaller diameter, more easily broken, and less well-anchored. Coniferous debris is often more decay-resistant and of larger size, qualities that make it more stable and long-lasting in the stream (Grette 1985). For these reasons, conifers have been favored as a source of LWD in the Pacific Northwest.

Studies of undisturbed forests have established some examples of frequencies and ranges of LWD (Table 1). LWD has also been measured in younger stands, where large trees would not be present to contribute new debris (Table 2). Other studies have reported debris volumes, a measure which more effectively captures differences between large and small pieces (Ralph et al. 1994). Frequencies are reported here for comparison with the rapid assessment used in this study. Standards or management targets for LWD loading exist, but are not widely accepted. A few forest industry companies are trying targets such as one piece every active channel width. An Environmental Assessment document for managing anadromous fish habitat set objectives for LWD in streams on a regional basis, using 80 pieces per mile (>24-inch diameter, >50-foot length) west of the Cascades, and 20 pieces per mile (>12-inch diameter, >35-foot length) east of the Cascades (USDA and USDI 1995). Existing standards generally have been developed internally by agencies or organizations, are not widely accepted, and are being used experimentally.

The LWD estimates cover a range of regions, minimum LWD sizes, stream sizes and types, and areas in which LWD was counted (active channel, bankfull channel, floodplain). While the estimates of LWD are not strictly comparable, they do offer valuable information about general ranges of LWD loadings and major controlling variables. Stream order, width, flow, stream gradient, and sinuosity all affect expected levels and distributions of LWD (Bisson et al. 1987, Bilby and Ward 1989, Nakamura and Swanson 1994). Low-order channels have greater amounts of LWD while higher order channels tend to have less debris because their flows are capable of floating more debris downstream. Stand age has also been correlated to LWD loading, with greater instream LWD observed in older stands (Summers 1982, Bilby and Ward 1991). Bank slope and stream substrate affect how the wood interacts with the channel (Bisson and Sedell 1984). Small steep-sided streams tend to have more wood suspended above the channel, and smaller pieces of wood are stable and influential in the channel. Larger, low-gradient streams tend to transport debris, forming debris accumulations on bars or islands. Sediment-rich streams can build bars and scour pools around debris, while

Table 1: Reported frequencies of large woody debris (LWD) in streams in stands 80 years old or more in the Pacific Northwest

Study Location	Stream Orders sampled	LWD #/100 m (range)	Stand Age (years)	Minimum diameter LWD (cm)	Minimum length LWD (m)	Source
Oregon Coast Range		61 (37-124)	80-140	10		Heimann 1988
SW Oregon Coast Range	3rd-5th	42 (26-80)	80-150	10	1	Ursitti 1990
Oregon Coast Range	1st-5th	10	100-150	15	2	Veldhuisen 1990
SW Oregon Coast Range	3rd-5th	58 (47-81)	290-410	10	1	Ursitti 1990
Oregon Cascades	5th	40 (0-264)	Old	10	1	Nakamura&Swanson 1994
Western Oregon	1st-3rd	44 (25-72)	Old	10	stream width	Summers 1982
Olympic Peninsula, WA	small	60	100+	10	3	Grette 1985
Western Washington	2nd-5th	26 (10-84)	Old	10	2	Bilby & Ward 1991
Western Washington	3rd-5th	13	75-330	10	3	Bisson & Sedell 1984
Western Washington	2nd-5th	25 (8-40)	80+	10	3	Ralph et al. 1994
Southeast Alaska	1st-2nd	25	Old	20	1.5	Robison & Beschta 1990
Southeast Alaska	2nd-4th	39	Old	20	1.5	Robison & Beschta 1990
Southeast Alaska	3rd-5th	35 (15-46)	Old	10	1	Murphy & Koski 1989
Southeast Alaska	2nd-3rd	31 (30-33)	Old	10	1	Murphy & Koski 1989
Idaho Batholith	2nd-3rd	12	Old	20	0.6	Megahan 1982

Table 2: Reported frequencies of large woody debris (LWD) in streams in stands less than 80 years old in the Pacific Northwest

Study Location	Stream Orders sampled	LWD #/100 m (range)	Stand Age (years)	Minimum diameter LWD (cm)	Minimum length LWD (m)	Source
Oregon Coast Range	1st-4th	45 (36-55)	50+	10	1	Long 1987
Western Oregon, Coast & Cascades	1st-3rd	34	0-29	10	stream width	Summers 1982
Western Washington Coast & Cascades	2nd-5th	14 (5-49)	40-60	10	2	Bilby & Ward 1991
Western Washington Coast & Cascades	3rd-5th	8	1-11	10	3	Bisson & Sedell 1984
Western Washington	2nd-4th	17 (7-26)	40+	10	3	Ralph et al. 1994
Idaho Batholith	1st-3rd	13	Logged	20	1.5	Megahan 1982

bedrock-based, sediment-poor streams would be less likely or take longer to build these channel features.

Managed stands generally have trees that are younger and smaller in diameter than those in the measured old-growth systems. This circumstance seems likely to continue as stands are often cut before they are 100 years old on most private land, with rotations dropping below 60 years on some industrial land. In Western Oregon and Washington, McDade et al. (1990) found the LWD piece length and diameter were significantly less in mature second-growth than in old-growth stands, and less in hardwood than in conifer stands. These differences were related primarily to tree height. Under the 1994 Rules, selective harvesting is allowed outside the first 20 feet once the minimum basal area is satisfied. The basal area targets are based on estimates from mature stands, and can be expected to provide riparian trees for future LWD. However, most trees outside the 20 feet could be harvested before reaching the substantial sizes common in old-growth stands, and trees outside the RMA that might have contributed in old-growth stands would generally be harvested and unavailable to the stream.

This management pattern suggests that sources for debris will continue to be smaller in diameter than old-growth stands (Bisson et al. 1987, Harris 1987). LWD that is smaller in diameter and shorter in length has been found to be less stable in the streams (Bilby 1984). Smaller pieces also decay more rapidly, so turnover of smaller pieces LWD could be greater both from decay and transport. Without substantial riparian tree retention, harvest rotations of less than 100 years have been expected to reduce conifer LWD loadings to substantially less than those seen in old-growth forests (Grette 1985, Heimann 1988). Of course, mature forests may have more stems per area than an old-growth forest, and be able to contribute more pieces, though not of the same size. Depending on stream size and type and size of piece needed to influence the stream, the loading from mature forests or substantial riparian reserves may result in greater piece frequency of sufficient size to modify channel conditions. Whether or not these potential differences in piece size or frequency would be significant enough to markedly affect channel morphology and other functions remains an important question.

Inputs of Large Woody Debris

The potential role of the riparian stand in supplying LWD depends on the processes by which LWD is delivered to the stream. Stream characteristics such as width, flow, gradient, and bank slopes profoundly affect how LWD is supplied to and transported in the stream, how it is lost from the stream, and what type of stand is adjacent to the stream (Keller and Swanson 1979, Andrus and Froehlich 1988). Small steep streams have low flows and thus little ability to transport large debris and form floodplains. They tend to have wood supplied from the banks, not from upstream, have steeper banks that support more conifers. Larger streams tend to be lower gradient and have higher flows and a saturated floodplain; wood is supplied both from upstream and from the adjacent stand, smaller pieces of debris are easily transported downstream and the floodplains support more hardwood than conifer (Keller and Swanson 1979, Andrus and Froehlich 1988).

LWD can enter a stream through any of several mechanisms: windthrow, bank cutting, collapse from ice and snow loading, and mass wasting such as debris slides (Keller and Swanson 1979). In managed systems, logging is another entry mechanism. Working in first through fifth order streams in mature forests of the Oregon Cascades, Lienkaemper and Swanson (1987) concluded that wind was the major mechanism for debris entry; they found that 66% of the trees added to the stream were not in areas subject to bank erosion, and 34% of the trees were from close to the bank. They noted that debris slides were locally important delivery mechanisms in other areas of the basin. In streams of the Oregon Coast and Cascade Ranges, McDade et al. (1990) found 89% of trees adding LWD were not very close to the bank, presumably delivered through windthrow or snow/ice loading, and 11% were within 1 m of the bank, presumably delivered by bank cutting. In first through fourth order stream channels in the Oregon Coast Range, Long (1987) also found that windthrow was the major mechanism for LWD entry prior to cutting and wildfire; 45% entered via windthrow, 34% were floated in, 7% was from mass movements, 9% was from logging, and only 5% was from bank cutting. Looking at debris added after the harvesting and wildfire, bank cutting became the major entry mechanism (44%), although windthrow was still important (35%) (Long 1987). In Southeast Alaska, Murphy and Koski (1989) found that windthrow, mortality, and landslides were the most frequent sources of LWD to bedrock channels, but bank erosion delivered most debris in alluvial channels (52-60%).

Wind seems to be a dominant entry agent in small streams where little bank erosion occurs. On larger streams with saturated soils and canopy openings, wind is important, but perhaps not as much as bank cutting and transport from upstream sources. Studies have attempted to find factors that predict potential for windthrow in buffers. Steinblums et al. (1984) related windthrow loss to distance to cut edge and nearest windward major ridge, slope, elevation, orientation of stream, soil moisture class, and tree volume. Buffer width and stand age were not found to be significant as predictors of windthrow (Steinblums et al. 1984). Andrus and Froehlich (1992) related percentage basal area of buffer blown down to several factors: percentage of trees on boggy terraces, initial basal area, conifer basal area, orientation of stream relative to southwesterly winds, and whether the stream was protected by hillslope shape from southwest winds. Sinton (1996) found that windthrow patterns in a managed basin in the Oregon Cascades were associated with clearcut edges and shallow soils. Reconstruction of windthrow patterns from stands prior to logging showed that topographic exposure had been a more important contributor to windthrow in the old unlogged stands than in managed stands (Sinton 1996).

Rates of windthrow are extremely variable. Andrus and Froehlich (1992) reported that wind had damaged from 0 to 72 percent of the initial live basal area of 1 to 6-year-old buffers in the Oregon Coast Range, with most buffers losing less than 20 percent basal area. Buffer width did not seem to affect losses from wind (Steinblums et al. 1984, Andrus and Froehlich 1992). In Washington harvest units, 82 percent of 91 buffers surveyed had less than 10 percent of the trees blown down, with only one site exceeding 50 percent loss (TFW Field Implementation Committee 1994). Andrus and Froehlich (1992) suggested that windthrow occurred in a catastrophic (episodic) fashion at least the several years following logging. In the Oregon Cascade Range, Steinblums et al. (1984) reported volume losses ranging from 22 to 100 percent of initial volume in buffers, and suggested that much of the susceptible tree volume was windthrown in the first few years of exposure. Average percent windthrow differed significantly among species, from the windfirm western redcedar (11% loss) to the moderate Douglas-fir (22% loss) and the vulnerable true firs (54% loss) (Steinblums et al. 1984). Steinblums et al. (1984) also observed that trees of above-average height and diameter were more susceptible to windthrow. Sherwood (1993) investigated buffers after 20 years and found that most buffers had increased in conifer volume due to ingrowth, although a few buffers had blown down completely. He suggested that windthrow losses were generally chronic (relatively frequent, random tree fall) and occasionally episodic (e.g., large, rare windthrow events). Sinton (1996) calculated return intervals for windthrow-generating storms at as low as three years, a frequency that could contribute LWD routinely over a rotation, but she also noted that distribution was extremely patchy.

Other mechanisms besides windthrow can be either chronic or episodic (Bisson et al. 1987). Tree mortality due to endemic levels of disease and insects can be low-level and continual, while epidemics can cause massive and rapid tree loss. Tree mortality may act in combination with wind to deliver debris to the stream. Mortality during epidemics can involve substantial portions of the stand. For example, Ferrell et al. (1994) reported 36% of the trees dying in white fir stands in a fir engraver outbreak. Fire can also cause episodic mortality in ranges of 20 to 87%, sometimes interacting with insect infestations (Ryan and Reinhardt 1988, Swezy and Agee 1991). Infestation at chronic levels involves mortality at a lower order of magnitude, such as the death of 5% of Douglas-fir over 10 years from dwarf mistletoe (Filip et al. 1993) and the loss of 3% of conifer saplings over 6 years due to annosus root rot (Slaughter et al. 1991). Managed stands are likely to have some level of mortality from insects, disease, and fire, although management and fire suppression are likely to keep loss to the lower end of natural ranges.

Mortality can also be induced by competition, a concept embodied in the self-thinning rule (e.g., Hibbs 1987) and forest growth models (e. g., Arney 1985, Smith and Hann 1986). Competition-based mortality depends on density. Most managed forest stands are kept below the density that would induce substantial mortality. Relatively few trees of large size would be expected to die from competition-based mortality from managed stands.

Mortality rates in unmanaged stands are often less than one percent. Spies et al. (1990) observed annual mortality of 0.88 percent in mature (150 year-old) stands and 0.41 percent in old (400-500 year-old) stands in the Oregon Cascades; most trees (74% in mature stands) remained standing, but western redcedar was usually lost to windthrow. Annual mortality in old-growth stands in the Olympic Peninsula of Washington was between 0.8 and 0.9 percent (Edmonds et al. 1993). Franklin and Debell (1988) reported an annual mortality rate of 0.75 percent in old-growth stands of the Washington Cascades, with almost half caused by wind. Annual mortality in a 130-year-old spruce-hemlock forest on the Oregon Coast ranged from 0.5 to 1.2 percent (Harcombe 1986). In managed stands of Southwest Oregon, annual mortality was slightly higher, 1.25 percent at lower densities and 2.3 percent at a higher density (Hann and Wang 1990).

Windthrow can affect both live and dead boles, but snags may be more susceptible as strength diminishes. In second-growth managed stands in Western Washington, Ohmann (unpublished data) found that over 30% of snags fall within ten years of death, with highest losses for western hemlock (56%), lowest losses for western redcedar (30%), and Douglas-fir in between (39%). Mortality and chronic windthrow rates are probably interrelated.

Soil creep can encourage chronic addition of trees through bank undercutting, while debris slides or torrents can strip or suddenly increase loading of sediment and LWD in rare catastrophic events. Mass movements tend to affect the steep headwater areas of streams, although debris torrents may move to downstream tributaries (Keller and Swanson 1979). Using data on frequencies of debris slides presented in Amaranthus et al. (1985), the Coast Range and Klamath Mountains were estimated to have the greatest frequencies of debris slides, about one per year for every 1100 to 1590 acres. The Cascades had fewer debris slides, about one per year for every 6250 to 17,241 acres. Debris slides have been found to be related to logging and roadbuilding in the Coast, Cascade, and Klamath Mountains of Oregon (Swanson and Dyrness 1975, Gresswell 1979, Lyons and Beschta 1983, Amaranthus et al. 1985). However, other studies have found similar rates of slides in harvested and undisturbed areas, such as a study by Ketcheson (1978) in the Oregon Coast Range. Increased slide frequencies in managed landscapes are credited to loss of tree root strength after cutting and unstable fill on roads, and slides are more frequent on steep slopes (Burroughs and Thomas 1977, Gresswell et al. 1979).

Like debris slides, major bank undercutting during large floods or widescale blowdown during windstorms are episodic inputs. Bank cutting is usually presumed to be important only in the areas immediately adjacent to the stream (Lienkaemper and Swanson 1987, McDade et al. 1990). Bank stability, degree of constraint, and channel sinuosity would affect the likelihood of contribution of trees by bank cutting (Nakamura and Swanson 1994). Bank cutting plays a minor role in the small, steep streams of the Oregon Cascades (Lienkaemper and Swanson 1987, McDade et al. 1990). Bank cutting or lateral channel movement in forested mountain streams tends to occur in relatively wide, unconstrained reaches, reworking the same areas in consecutive events, maintaining young stands of one age class in those areas (Swanson 1994). On larger meandering or multiple-channel rivers, lateral channel movement can occur along most of the banks, so that areas of bank cutting vary from event to event and different age classes of tree develop along the banks (Agee 1988, Swanson 1994). The greatest delivery of LWD would occur along unconstrained meandering reaches if trees were adjacent to the bank, with little bank cutting occurring in bedrock-constrained reaches (Swanson 1994). In small, low gradient streams in Washington, Grette (1985) found that bank cutting of live trees was the most important delivery mechanism in second growth stands, while mortality was more important in old-growth stands.

Movements and Losses of Large Woody Debris

Primary LWD loss mechanisms within streams largely depend on stream characteristics. LWD may be lost from a reach by decomposition, floatation, or debris torrents (Swanson et al. 1976). Past harvesting has resulted in losses of LWD through stream cleaning, although the 1994 Water Protection Rules require that trees that have fallen over the stream channel be left. In small streams, most wood would expected to be lost through decomposition, while large streams would tend to float more wood downstream. Steep terrain would be expected to have more wood lost through debris torrents or flows. Large streams with floodplains tend to store debris on the sides of channels and in larger accumulations; few trees are large enough to span wide rivers and remain stable at high flows (Bisson et al. 1987). Debris flows in the Oregon Coast and Cascade Ranges have been most commonly found in steep second- and third-order streams and often stop at tributary junctions or alluvial fans (Swanson and Lienkaemper 1978, Swanson et al. 1987). Some research has estimated loss rates based on observed decomposition levels. Grette (1985) estimated the loss of LWD in second-growth sites at 0.5 pieces per 100 m of stream channel, or less than one percent per year. Murphy and Koski (1989) estimated losses of LWD in Southeast Alaska from 1 percent per year in old-growth to 3 percent per year with smaller diameter material in harvested stands.

The variation in streams' abilities to transport debris is perhaps best quantified by the observed levels of LWD among stream orders. Long (1987) saw the greatest quantity of debris in second-order streams (55 pieces/100m, 25 kg/m^2), with gradual declines in debris for third-order (41 pieces/100m, 14 kg/m^2) and fourth-order streams (36 pieces/100m, 12 kg/m^2).

Future Sources of LWD in Managed Stands

Streams in harvested or second-growth stands have been found to have less debris volume and frequency than undisturbed stands (Ursitti 1990, Bilby and Ward 1991, Ralph et al. 1994). Small streams (<10 m width) did not show this trend (Bilby and Ward 1991). Earlier studies showed some occasions where logging had added substantial amounts of cut and broken logs (Summers 1982). However, large additions of wood to streams during logging are rarely seen in recent harvests; regulations call for directional felling away from the stream in most cases.

Wood from the previous stand can be important in streams in harvested stands (Grette 1985, Long 1987, Andrus and Froehlich 1988). Wood from the new forest is more likely to be alder and of smaller diameter (Grette 1985). Significant inputs from the new forest occurred only after 50 to 60 years on the Olympic Peninsula of Washington (Grette 1985). Snags greater than 12 inches were present only in stands over 80 years of age in the Oregon Coast Range (Andrus and Froehlich 1988). Rainville et al. (1986) estimated that trees greater than 11 inches diameter would be essentially absent in stands less than 40 to 45 years old in Northern Idaho, and unable to provide stable LWD. These ages are equal to or less than some of the rotations in Western Oregon, so the stands beyond the riparian zone are unlikely to provide much LWD under typical management.

Wood from the post-harvest stand depends on the nature of the surrounding new forest. Andrus and Froehlich (1988) found that alders dominated terrace riparian sites, while a mix of conifers and alder grew on the slopes in the Oregon Coast Range. Minore and Weatherly (1994) found that conifer basal area increased with greater elevation, steeper streams, older stands, and distance from the stream. Wider streams were also found to have less conifer basal area (Minore and Weatherly 1994), a result expected because wide streams are more likely to have terraces and floodplains. Different areas clearly have varying potential to grow conifers, so not all riparian areas would be expected to develop plentiful conifers for woody debris sources over time.

RESEARCH METHODS

Multimethod Approach: Opinions of Forest Practice Rules

Opinions and experiences were sought using written questionnaires and informal interviews. There are limitations to both written and personal interview approaches; the combination of methods attempts to offset disadvantages and increase the strength of conclusions. Written surveys were designed to give a large sample, cover a broad geographic area, and allow comparisons of responses (Frey 1989). Personal interviews were designed to explore issues in a more unstructured and individual manner, a basis for insight unavailable from written instruments. The issues of land use regulation and land ownership are complex, and some of the questions may be unfamiliar to the respondents; both these qualities encourage a role for personal interviews. For both methods, the study will necessarily be limited to its window in time, and perceptions of rules may be changing throughout this time.

Sampling Design

The goal of this research centers on how the Forest Practice Rules are implemented, so the sample frame for the written survey focused on those people who have implemented the rules. The intent was to solicit people whose opinions and judgments have been formed by direct experience, not just hearsay or supposition. Only those landowners and operators who had cut timber along riparian areas after September 1, 1994 were included in the study. This focus excludes forest landowners who have not harvested and may not be interested in harvesting. The focus is appropriate for evaluating response from the group currently most directly affected and actively implementing the Forest Practice Rules, even though it does not represent all forest landowners.

The mailing list for survey participants was developed from the ODF database of harvest notifications between September 1 and December 31, 1994, just after the Water Protection Rules took effect. Harvest notification forms are required for commercial forest harvesting in Oregon, creating a relatively precise and complete survey frame; in 1988, 98.4% of the operations filed notifications properly (ODF 1989). From the ODF database of all notifications during Fall 1994, items were screened to identify harvest activities (clearcut, partial cut, or thin) on greater than ½ acre with water on the property. Where only company names were listed for operators or landowners, the regional ODF field offices were contacted for the names of the people involved with harvest operations. Individuals were assigned to one of three groups:

-Industry foresters (employees of corporations or businesses that own land)

-Logging operators (those who were listed only under operator, not landowner)

-Nonindustrial private forest owners (individual, family, or noncorporate owners, including those who listed themselves as both operator and landowner).

The distinctions among the groups generally were clear because most corporate ownerships and individual ownerships were easily identifiable. However, some entries could have been classified into a couple of the categories. Landowners who listed themselves as both logger and landowner were sometimes logging contractors who in this instance had filed a notification for cutting on their own property, and so were classified as NIPF owners. If they had filed a notification for someone else's property, they would have been classified as loggers. Some landowners were logging their own land but had no other connections to the logging industry, and were unequivocally classified as NIPF owners. State and county agencies were included in the industry category, comprising less than five percent of the category. The industry category was used because state and county lands that are harvested often have situations more similar to industry than to NIPF owners, with management mandates to produce income (e.g., for schools) and full-time professional foresters are hired to manage the land. The industry forester category was generally assumed to include professionals trained in the field of forestry, with most having at least a 4-year degree in forestry. However 12 percent of the people in this category indicated that they did not have a 2-year or 4-year degree, so the term "forester" is used more loosely here than in contexts such as certified forester or registered professional forester.

Questionnaire Development

The written surveys were developed and conducted according to the Total Design Method of Dillman (1978). A draft survey was developed to query the level of acceptance and relative importance of issues to timber harvesters. This draft was based on library research on the Forest Practices Act, related opinion surveys, and literature and conferences and training sessions on the 1994 Water Protection Rules. Surveys posed questions on 1) the response to the new water protection rules, including the process of creating them, 2) attitude towards land use regulation in general, and 3) attributes of the respondent and the harvested tract. There were three slightly different versions of the survey for the three groups. For example, NIPF owners were asked why they owned land, and the other groups were not. Operators were not asked why they harvested. The remaining questions were kept consistent to facilitate summaries and comparisons between groups.

The draft survey was reviewed by the Oregon State University Survey Research Center to improve question structure for data analysis, format, and wording. To obtain review for content, clarity, and bias, the draft was sent to all Forest Practice Foresters (ODF field staff who enforce the rules), the ODF Water Protection Rule Development Advisory Committee, the ODF Incentives Committee, OSU Extension Foresters throughout the state, the ODF Monitoring Coordinator, and the ODF Board of Forestry Chairperson. Of the more than 100 people sent drafts, about thirty percent returned comments, and the draft was revised to address the comments and expanded list of issues. The approved questionnaire was blind pretested on 30 people from the identified population. Pretest participants were contacted to determine need for further changes to the questionnaire, prompting some minor wording and format changes.

Survey Administration

Surveys were mailed to 848 individuals with a personally addressed hand-signed cover letter on Department of Forest Engineering letterhead and postage-paid return envelope. The cover letter outlined the principles of informed consent: identifying the purpose of the study, stating that it was confidential and voluntary, and offering contact for more information. Study participants were offered a summary of results from the study, which they could receive by mailing a separate postage-paid card with their name and address. Thirty-nine percent of the respondents returned the postcards and were sent results summaries.

The first mailing was sent to all individuals in late July 1995, followed three weeks later by a reminder postcard. Twenty-one addresses were not deliverable, leaving a total of 827 surveys successfully mailed. Follow-up mailings including a new cover letter, survey, and return envelope were mailed to nonrespondents in mid-August and late November. Return rates are listed in Table 3.

Table 3: Return rate by group and mailing date, Stream Rules Survey 1995

		Number of Returns				
Group	Mailed	July	August	November	Total	Percent
Industry	172	106	25	14	145	84%
Operators	394	115	68	55	238	60%
NIPF	261	98	55	19	172	66%
Total	827	319	148	88	555	67%

Because the November mailing was substantially later than the previous mailings, chi-square tests were performed comparing results of the third mailing with the first two mailings. For most questions, no significant differences were detected. There was a significant increase in the level of acceptance for the later mailing. This may have been due to increases in familiarity of the rules to the respondents or ODF staff who had helped them implement the rules. It also may reflect the middle-of-the-road position; the earlier returns could have had more people with strongly held opinions at either extreme, leaving for the later returns a greater proportion of moderate respondents who chose the median response of general support. There were reasons to suspect that acceptance ratings might have dropped over the fall; many runs of salmon were being proposed for listing as threatened species, a potential regulatory increase that could increase dislike for other newly expanded regulations. However, this result was not seen.

Because there was no reason to suspect that the increased level of acceptance was due to events occuring between July and November, and most other variables did not differ significantly, all the mailings were pooled for further analysis. The level of education was also detected as significantly different between mailings, showing more people responding high school or some college in the later mailing. The Operator category had the lowest response rate, so they made up a larger proportion of nonrespondents, the only ones receiving the third mailing of the survey. Operators also tended to have a typical education of high school or some college, so that this difference reflected the nonrespondent population, again not a sufficient reason to treat the results separately from earlier responses.

Personal Interviews

Personal interviews and investigations of riparian conditions were carried out on 24 sites, about 5% of the written survey respondents. Two-thirds were industry foresters and one third were NIPF owners. Sites were selected from respondents whose harvests were in the five regions used by the 1993 ODF Riparian Rule Effectiveness Study (Mormon, 1993): Tillamook, Forest Grove, Lane and Douglas Counties, Coos Bay, and Central Oregon. Sampling was randomized if more than five contacts were available for the area and category (industry or NIPF). Landowners were telephoned and asked if they were willing to cooperate with the field study. Two refusals were received from nonindustrial private forest owners and none from industry representatives. Interviews were conducted in person before or during the visit to the streamside site. Field notes were used to record responses and issues raised. An interview guide was developed to help focus on several important issues not readily addressed through the written survey, and to maintain some consistency among interviews. The questions were:

1) When did the harvest take place? (Season, month, weather)

2) What harvest method and equipment was used?

3) How did this harvest fit into your overall management picture for your land?

4) Have the Stream Rules affected the planning or harvest operations? How so?

5) Did you use any of the options for cutting in the RMA? Did you place logs or do other instream work that would allow additional basal area to be cut?

6) Should there be laws (regulations) for forest management or should we be using other options?

7) What would you consider to be your biggest concern with the Stream Rules (or the Forest Practice Rules in general)?

8) What do you think the Stream Rules are trying to do?

9) Do you think the Stream Rules should be trying to do something different?

10) Do you think that there are better ways of achieving these results?

The last three questions were not always asked, especially if conversation had been flowing in other relevant directions.

Riparian Conditions

The questionnaires and interviews were aimed at assessing how the Water Protection Rules functioned from the rule user perspective; the field research looked at how implementation of the Rules affected riparian area resources after harvest. The riparian condition assessment focused on the streamside stand as a source of large woody debris (LWD) as fish habitat. Stream temperature, litter inputs, and infiltration of runoff are related and are important concerns of the Water Protection Rules, but were not closely evaluated here for two reasons. Apparent major goals of the 1994 changes were to ensure sufficient future conifer LWD from streamside areas and to encourage active placement of LWD for stream restoration. This followed the finding by Mormon (1993) that previous rules resulted in the loss of much of the conifer from streamside areas. The LWD focus also avoids duplicating recent ODF monitoring efforts, which focus initially on stream temperature monitoring.

Riparian condition assessments were conducted in conjunction with the personal interviews, sharing the site selection process described above for the personal interviews. In the few situations where more than one harvested streamside site was available, smaller streams were chosen because these streams would have been most affected by the 1994 rules. Where available, fish-bearing streams and streams cut on both sides were used. Because many of the NIPF owners had not harvested and there were relatively few NIPF harvests within the identified regions, three NIPF sites that turned out to have been harvested under the previous rules were sampled. These three sites were not included in summaries of results for sites harvested using the 1994 Rules. The standard length of stream measured was 600 feet, varying from 350 feet where a powerline right-of-way precluded trees on the remainder to 1200 feet for some one-sided harvests. Site descriptions and results for each stream are listed in Appendix A. Forms for data collection in the streams and riparian areas are included in Appendix B.

Instream Measurements and Shade

Instream measurements were intended to gather information about stream condition and geomorphic setting that could be used to evaluate the role of LWD in the stream. Stream length was measured with a loggers tape, beginning at least 50 feet in from the harvest edge and including major stream meanders. Instream measurements were collected at a cross-section every 50 feet. Stream gradient was measured to the nearest percent with a clinometer, sighting on a partner, 5-foot stick, or flagging tied at 5 feet. Active channel width was measured to the nearest foot with a loggers tape, or estimated if the bank was inaccessible (e.g., blocked by piles of woody debris). Where multiple channels were present, the active width of each channel was recorded. At each cross-section, the dominant habitat unit (pool, riffle, glide) and substrate (fine, gravel, cobble, boulder, bedrock) were visually assessed and recorded. Substrate categories were based on the following particle diameters in inches: fines <0.08, gravel 0.08-2.5, cobble 2.5-10, boulder >10. Degree of stream confinement was recorded as C- confined on both sides, I- intermediate confinement such as on one side, or U-unconfined on both sides.

Stream canopy cover was measured with a convex spherical densiometer (Lemmon 1956) at the same cross-sections as instream measurements. Shade or cover from the entire canopy was measured in four directions relative to the stream: upstream, left bank, downstream, and right bank. If cover was provided by the bank or large stable woody debris, this topographic shade was recorded separately. A single angular canopy cover reading was taken by orienting the densiometer towards the southwest (210 degrees on the compass) and using the center band of 48 squares rather than the full 96 squares, which approximated the summer solar path. Topographic cover was also noted for the angular cover measurement. Cover measurements were taken midstream, except where streams were over 20 feet wide. Because shading varies greatly over wider streams, streams over 20 feet wide had measurements taken at three locations on the cross-section: by each bank and in the center. Low cover, shrub or herbaceous cover, that would not be affected by tree removal, was visually estimated for the 50 feet of streambank back to the previous cross-section.

Bank Slope Condition

Bank transects were extended from the stream cross-section every 50 feet, perpendicular to the stream for the width of the Riparian Management Area (RMA). For fish-bearing streams, RMAs are 50 feet for small streams, 70 feet for medium streams, and 100 feet for large streams. Stream size is based on average annual flow, estimated from watershed area and local precipitation maps (OAR 629-635-200, Dec. 1, 1994).

For streams harvested on both sides, transects alternated left and right banks every 50 feet. For streams cut on one side, transects were run every 100 feet on the bank where harvesting had occured. Slope distances along the transect were measured with a loggers tape or 5-foot stick and distances were flagged at 25, 50, and, where applicable, 75 and 100 feet. Distance to harvest-related disturbance was recorded, including disturbances such as fire trails. Seedlings and trees less than eight inches DBH were tallied by hardwood or conifer species using five-foot fixed radius plots at 5, 15, 35, 55, and, where applicable, 75 and 100 foot distances along the transects. Area in plots was divided into area of streamside surveyed to calculate the expansion factor for trees/acre.

Large Woody Debris

A quick assessment of relative levels of instream woody debris was taken as a basis for identifying the potential need for new LWD to improve aquatic habitat. Number of pieces in the bankfull channel were tallied along 600 feet of stream, within the following diameter classes: 1-5 inches, 5-10 inches, 10-19 inches, and greater than 20 inches. Pieces were classified as functional (affecting stream flow at bankful height or less) or nonfunctional (not affecting streamflow, suspended above channel), and as solid (relatively undecayed wood recently added to channel) or soft (showing evident decay or bark sloughing). If some smaller pieces were accumulated into a stable and indistinguishable mass, the obstruction size was tallied for the mass, not the individual pieces. No minimum piece length was used.

Trees, Stumps, and Snags

The riparian forest stand was inventoried in detail because it forms the basis for future sources of LWD. For the entire length and width of the RMA sampled, all live trees over eight inches diameter breast height (DBH) were tallied, recording species.

DBH was measured or estimated to the nearest inch. Two to ten trees per site were measured with a clinometer and tape to obtain reference heights to the nearest foot. Heights on remaining trees were visually estimated to the nearest five feet. Slope distance to the stream was visually estimated to the nearest five feet, using the measured and flagged distances for reference. Several other attributes that could affect likelihood of mortality or direction of fall were collected. As a measure of canopy dominance, trees were visually categorized as competing (codominant), dominant and above crown competition, or suppressed (overtopped). Tree lean was visually estimated to the nearest degree, checked with a compass, and lean direction was recorded as towards, away, upstream, or downstream. Trees on poorly drained terraces can be more susceptible to windthrow due to limited rooting area. Consequently, the landform of each tree's location was recorded as terrace or slope. For this context, terraces were considered to be poorly drained landforms adjacent to the stream, intended to reflect areas where water limits rooting depth. The occurrence of defects such as a cavity, logging damage, split top, broken top, insects, mistletoe, or reduced vigor were also recorded for each tree.

Stump data was collected to be able to estimate trees removed from the RMA in the current harvest, and gather information about location of conifers cut in past harvests. Diameters of new and old stumps were measured or estimated to the nearest inch over the entire length and width of the RMA sampled. Stumps were classified as hardwood or conifer and identified by species where possible. Distance to the stream was estimated to the nearest five feet. Distances flagged on transects served as points of reference for estimating distances. Minimum diameter tallied was eight inches.

Snags are an important feature for some wildlife habitat, and can also be potential sources of LWD. For snags, DBHs were estimated to the nearest inch and heights were estimated to the nearest five feet. Snags were classified as hardwood or conifer and identified by species where possible. Distance to the stream was estimated to the nearest five feet. Decay class was assigned as follows: 1-bark intact, mostly solid; 2-some bark absent, wood generally sound; 3-moderate decay, most or all bark gone, wood beginning to rot; 4-wood soft with holes, bark gone. Minimum DBH was six inches.

DATA ANALYSIS

Survey Data Analysis

Survey responses were coded as categorical data. Question 5 (what resources are the Stream Rules meant to protect) was an open-ended question, so answers were classified by whether they mentioned goals related to any of five categories: fish, water quality or flow, wildlife, values related to riparian stands or banks (including biodiversity), or negative comments (including beaureaucrats, enviros, no one). Frequency analysis was used to summarize responses by rule user group and geographic region. Chi-square tests were used to test for significant differences among response categories ($p<0.05$). Chi-square tests rely on a minimum count in the response categories being compared to maintain validity in the computations. Where categories did not have sufficient counts for valid tests, related categories such as "support" and "strongly support" were combined for chi-square testing. If the "don't know" response was infrequently chosen, this category was omitted in the analysis to allow the remainder of the response categories to be tested for significant differences.

Riparian Condition Analysis

Instream Characteristics, Large Woody Debris, and Shade

Instream parameters were assessed to build a context for evaluating the potential utility of LWD in the reach. Stream width and gradient measurements for all cross-sections were averaged for each site. Where streams had multiple channels, the stream width was the sum of the bankful channel widths, and the number of occurrences of multiple channels was summed for the site as an indication of habitat complexity. The occurence of pool, riffles, and glides was tallied and converted to percent occurrence over the stations. This approach is useful for conveying a sense of relative proportions of habitat units over the site. Assessment of actual habitat functions would require more detailed data on pool dimensions, habitat unit adjacency and complexity, and other limiting factors such as water temperature or food base. The simple assessment used here was considered sufficient background information for evaluating the potential utility of more woody debris in the stream, the purpose for collecting this information.

Percent occurrence was similarly calculated for stream substrate (fine, gravel, cobble, boulder, and bedrock). Where multiple substrates were listed for a station, the substrate was assigned a fractional number, in an attempt to accurately represent the observed proportions. Percent occurrence was also calculated for the three levels of stream channel confinement: unconfined, intermediate, and confined.

Large woody debris was summarized by diameter classes, proportion of solid (fresh) and soft wood, and whether functional (within bankfull channel) or nonfunctional (above or outside bankfull channel). For shade, densiometer counts were converted to percent cover by dividing the counts by the potential maximums, 96 for canopy cover and 48 for angular canopy cover. The four readings of overhead canopy cover were averaged for each station, then further averaged over the length of the stream. Angular cover and low cover were also averaged for sites.

Bank Transects

Averages were calculated for percent slash, percent exposed mineral soil, percent slope, and distance to harvest-related disturbance. Percent slope was also averaged for just the first 55 feet to be comparable to the ODF data set of slope from 0-50 feet. Proportion of exposed mineral soil due to harvest activity was tallied separately and averaged. Wildlife, cattle, and windthrow were other major contributors to exposed mineral soil in the riparian area, and were noted as well. Seedlings and trees less than eight inches DBH were summarized by conifer and hardwood, then the 5-foot fixed radius plots were converted to number per acre based on the ratio of area of RMA to area of plots.

Forest Stand Analysis

Tree and Potential Large Woody Debris Analysis

Tree counts were summarized by conifer and hardwood. Basal area (ft^2/acre) was calculated from DBH in inches by multiplying by $0.005454*DBH^2$ (Bell et al. 1984), and summarized by conifer and hardwood. Counts and basal area (BA) were standardized for the different lengths and areas of RMAs by converting to a per-thousand-feet basis and a per-acre basis (multiplying count or BA by size of RMA and dividing by thousand feet or acre). RMA acreages were corrected from slope distance of RMA widths to horizontal distance using average bank slopes. The thousand-foot basis was used because Forest Practice Rule requirements use this measure, and the slope-corrected per-acre basis was used for comparison of results from the ODF Assessment (Mormon 1993). Averages were calculated by conifer and hardwood for DBH, distance to stream, and tree lean. Conifer and hardwood were calculated separately because they have different qualities as instream LWD.

A major goal of this study was to explore the potential for trees left in the RMA to contribute future LWD. A taper equation by Kozak et al. (1969) for Pacific Northwest conifers and hardwoods was used to calculate an effective tree height to 6-, 8-, and 10-inch top diameter. The top diameters represent the minimum LWD diameter of interest, and five feet was subtracted from effective height to represent a minimum length of pieces delivered to the channel. Where the effective height was greater than slope distance to the stream, trees were tallied to find the number of conifers and hardwoods physically able to contribute future LWD to the stream. Tallies of trees potentially contributing LWD were converted to number of trees per thousand feet and percentages of total trees in the RMA.

The equations in Kozak et al. (1969) were developed in British Columbia, but unlike many of the equations developed in Oregon, included coefficients for most of the species encountered in this study, and did not require crown ratio or iterative solutions for effective height. Bias could be present from use of equations developed further north, but would be most likely to underestimate effective height, and would not be large relative to the precision of height estimates (5 feet). Results are thus likely to be conservative estimates of potential LWD.

The simple comparison of slope distance and effective height implies that trees will fall directly towards the stream and not move downslope, as would happen with windthrow and no stem breakage or sliding. Lienkaemper and Swanson (1987), working in old-growth coniferous forests in the Cascade Mountains, concluded that windthrow was a major agent for entry of wood into streams. In more localized situations, other mechanisms can be dominant, such as bank cutting, important in larger streams which can rework their floodplain, and earthflows or landslides, important in steep areas with unstable slopes (Swanson et al. 1976). Entrainment during floods can also bring large amounts of debris to streams (Bisson et al. 1987). Inputs from wind tend to be the most chronic and random, while many of the other mechanisms are episodic (Bisson et al. 1987). Episodic events such as floods, large windstorms, and debris slides may contribute significant amounts of debris over the long term, but windthrow seems to be the most likely to occur in any short interval over a wide range of regions.

Reported rates of windthrow were used to estimate LWD input to streams because a relatively short time period, 10 years, was being evaluated, and windthrow seems to be the most common and widely applicable of the input mechanisms. Bank cutting was not estimated separately because it was considered to contribute a minor proportion of the added debris on the sites visited, similar to results from McDade et al. (1990), Long (1987), and Lienkaemper and Swanson (1987). Bank cutting is important usually in a small area close to the stream and most active on larger streams with floodplains, while most of the streams visited in this study were small- or medium-sized. Average windthrow rates were considered to be the best available and applicable estimates of LWD input, with the understanding that observed input rates are likely to be quite variable in space and time. If rates from bank-cutting and debris slides are much greater than the windthrow rates found, estimates would be conservative. Episodic events could be factored in as longer periods of time were being estimated and as long-term estimates of rates became available.

Sliding and breakage were not specifically considered in this analysis, but could be expected to increase the number of pieces in the stream by up to around 30 percent and decrease piece length. McDade (1987) found that 70 percent of the LWD added to Cascades streams were boles rather than broken tops or branches. Broken tops and branches could be from trees that were close enough to contribute the entire bole. Breakage was more prevalent on steep slopes, seen in different average LWD piece sizes added to streams, 15 m for slopes over 25° (47%) compared to 21 m for flatter slopes (McDade et al. 1990). Sliding was also more prevalent on steep slopes, with 52 percent of pieces having moved from the source on slopes over 25° and 33 percent of pieces having moved on flatter slopes (McDade et al. 1990). Despite the frequency of piece movement, 83 percent of the pieces were from trees less than 25 m from the stream, so most pieces would have reached the stream even without considering sliding (McDade et al. 1990). If a quarter of the 52 percent of the pieces that moved from the source were from trees that otherwise would not have reached the stream, another 13 percent of pieces could be expected. Sliding and breakage thus are likely to expand the number of pieces and perhaps increase the length that is in the streambed, but they seem to have more limited effects on expanding the source of trees contributing LWD. Based on the data from McDade et al. (1990) from the Oregon Cascades, about 10 to 30 percent additional pieces could be expected by adding in sliding and breakage.

The numbers of trees identified as potential LWD contributors can be sensitive to the minimum piece size selected, especially where tree diameters are close to the limits of the diameter range of interest. The 1993 Riparian Rules Effectivenes Study (Mormon, 1993) used an 8-inch minimum diameter and 10-foot minimum length for LWD. Other studies on woody debris have used a range of minimum diameters: 10 cm (4") in Bilby and Ward (1991), 2.5 cm (1") in Harmon et al. (1987), and 10 inches in Rainville et al. (1986). Various minimum lengths have been used as well: 2 m (6.6 ft) in Bilby and

Ward (1991), 1 m (3.3 ft) in Harmon and Hua (1991), and 8 feet in Rainville et al. (1986). Length is most important relative to stream width, with the pieces exceeding stream width being more stable in the stream (Lienkaemper and Swanson 1987).

The information collected can be used to calculate potential utility using a range of diameters and lengths of interest. Six and ten inches were chosen here to bracket common ranges of sizes of interest, and eight inches was selected to be able to compare results to ODF LWD data. A length of five feet was chosen because some streams in the study were as small as three feet wide, where five-foot pieces might be stable. Also, five feet within the bankfull channel would in most cases be connected to a much longer piece on the bank, and possibly to a root wad.

Estimates of potential LWD were developed to determine the effects of different assumptions of direction and timing of tree fall on LWD input rates at the range of visited sites (Table 4). Input rates were estimated over 10 year intervals, during which average growth rates would not drastically change height and diameter of potentially available trees. LWD input rates (number of trees over time) were estimated for five different sets of assumptions. The first two cases make assumptions about direction and rate of tree fall that are applied generally to all sites, and these are used where different assumptions are not specified in the Site Influences cases. The Site Influences cases alter the initial assumptions using tree- or site-specific factors measured on the individual trees and sites. The approach is essentially a sensitivity analysis to determine the likely effect of various site-level influences on LWD loading rates. The average rates of LWD input using the different assumptions are calculated from the 21 harvest sites from 1995, using the site-specific and tree-specific measures where applicable.

General Assumption 1: Random direction of fall

Direction of fall was initially assumed to be random, and was calculated from the geometry of slope distance to stream and effective tree height, a method described in

Table 4: Assumptions for calculations of potential large woody debris, streamside stands harvested using 1994 Water Protection Rules

Assumptions for all Cases:	* No breakage or sliding of boles * Trees fall to ground without hanging up on trees or stream banks
General Assumption 1: Random Direction of Tree Fall	* All trees present in RMA fall * Trees fall in any direction with equal probability
General Assumption 2: Windthrow Rate of 30% over 10 years	* Random direction of fall * Rate of windthrow 7% for first three years, 2% for last seven years, reflecting higher windthrow rates after cutting the adjacent stand * Windthrow occurs in a chronic fashion (neglects episodic probability) at same rate for all sites
Site Influence A: More Trees Fall Downhill on Steep Slopes	* Slope effects the same in all regions of state * No effect on slopes less than 20% * 20-29% average bank slopes, direction of fall probability calculated out of 324° instead of 360°; similarly 30-39% slopes with 315°, 40-49% slopes with 306°, greater than 50% slopes with 297°.
Site Influence B: Trees with Severe Lean Fall Towards the Lean	* Random direction of fall for trees with less than 35° lean * Trees with greater than 35° lean fall in direction of lean if towards or away from the stream, no change if lean upstream or downstream
Site Influence C: Higher Windthrow Rates on Poorly Drained Terraces	* Trees on poorly drained terraces (limited rooting depth) fall at a rate of 44% while trees on slopes fall at a rate of 30% over 10 years * Random direction of fall * Ratio of frequency (#/10 years) of windthrow for terraces/slopes proportional to ratio of basal area loss after 1-6 years seen by Andrus and Froehlich (unpublished data) in the Oregon Coast Range

Van Sickle and Gregory (1990), Robison and Beschta (1990b), and McDade et al. (1990). Probability of a tree randomly falling into the channel is given by :

$P = (2(\cos^{-1} x/h))/360°$, where

P is the probability of the tree reaching the channel,

x is slope distance to stream, and

h is the effective tree height.

Effective tree height is the height to top diameter of interest, less five feet to assure that this minimum piece length would be in the channel. The closer the tree, the greater the arc over which randomly the tree could fall and reach the stream, and the higher the probability of contribution as instream LWD. Probability of tree fall in the stream was calculated for each potentially available LWD tree, and the probabilities were summed to estimate the total number of trees likely to be added over the reach. Estimates were standardized for RMA length to give number of trees per 1000 feet of RMA.

Adding probability of direction of fall yields only a static number, not a rate over time. Estimated windthrow rates for riparian areas were used to calculate probable LWD input rates to streams, as described above. Windthrow rates in newly exposed buffers are thought to be higher than during later years (Steinblums et al. 1984, Andrus and Froehlich 1992). Estimates from buffers in the Oregon Coast Range showed an average 21 percent loss of basal area to windthrow over an average of 3 years, giving roughly a 7 percent annual basal area loss for recently exposed buffers (Andrus and Froehlich, unpublished manuscript). Visual estimates of blowdown after 1 or 2 years on 91 buffers in Washington State clearcuts also averaged 7 percent loss, with the median category of loss estimates being 1-10 percent of the buffer blown down (TFW Field Implementation Committee 1994). Windthrow rates over longer periods of time and in older stands were lower than estimates from newly exposed buffers. Data from Steinblums et al. (1984) shows about a 2 percent annual volume loss in buffers from 1 to 15 years old in the Oregon Cascades. Van Sickle and Gregory (1990) estimated the probability of tree fall to be 0.13 over 10 years, based on observed inputs from a riparian stand in the Oregon Cascades. Direct estimates of LWD inputs, rather than just windthrow rates, were also reviewed to develop input over time. Estimates of LWD input include an average 2 percent/year in 20-140-year-old stands in the Oregon Coast Range (Heimann 1988), an average 2 percent/year (range 1-3%) in old-growth stands of Southeast Alaska streams (Murphy and Koski 1989), and an average 3.2 percent/year of LWD volume added in old-growth stands of the Oregon Cascades (Lienkaemper and Swanson 1987).

General Assumption 2: Windthrow Rate of 30% over 10 years

Estimates of windthrow and LWD inputs were quite variable from site to site, and many different measurements, such as tree density, volume, and basal area, were used to report these rates. Despite these variations, average rates seemed similar enough to form the basis of an estimated rate of LWD input. LWD inputs were calculated over the 10 year period of analysis using a 7 percent rate of tree input for the first three years and a lower 2 percent rate for the next seven years, giving an average of 3.5 percent/year input. The cumulative rate, estimated in one-year intervals, was 30 percent of tree density over 10 years. LWD input is directly related to probability of tree fall (Van Sickle and Gregory 1990), so any increase in rate of tree fall would be seen as a proportionate increase in LWD added to the stream, if other assumptions or conditions remain constant.

The last three scenarios involved site- and tree-specific data on side slopes, landform position, and severe lean, which intuitively could be expected to modify observed LWD input. These factors were used to change LWD input estimates to reflect the probably direction and scope of effect. Data on crown position (similar to dominant, codominant, suppressed) and tree defect (such as cavity, broken top, mistletoe, reduced vigor) were also collected, but were not used at this level of analysis because they would be unlikely to modify either direction of fall or short-term probability of windthrow. These two variables would be useful if the tree lists were used in a growth model over longer periods of analysis, because they could be expected to modify growth rates and likelihood of mortality.

Site Influence A: More trees fall downhill on steep slopes

On steep slopes, trees are more likely to fall downslope than randomly (R. L. Beschta, personal communication). This effect was observed in the Oregon Cascades over a range of slopes, the lowest of which was 20 percent. Over 75 percent of the trees on sites with slopes over 20 percent fell in the two downhill quadrants, compared to the 50 percent expected from random fall models. Effects below 20 percent slope are unknown. This evidence suggests that trees are unlikely to fall in some of the uphill portions, so the 360° area of potential random fall was reduced proportionally to the expected percentage not falling uphill. Probability of direction of tree fall was modified to account for steep slopes as follows. For 20-29% average slopes on a site, 70% of the trees were assumed to fall in the downhill quadrants, leaving 30% of the trees that would fall in the uphill 180°. To mimic this effect arithmetically, 20% of the degrees were deleted from 360°, representing the difference between 50% (random) and 30% (the slope case). Fall direction was calculated out of 324°, resulting in a higher probability figure than out of 360°. Similarly, on 30-39% slopes, 75% of the trees were assumed to fall downhill, using 315°; on 40-49% slopes, 80% of the trees were assumed to fall downhill, using 306°, and on greater than 50% slopes, 85% of the trees were assumed to fall downhill, using 297°. The data for these assumptions was collected in conifer stands in one area of the Oregon Cascades over a range of slopes and aspects. Information from a broader geographic area would be preferred to give a more robust estimate of effects of slope, and hopefully will become available in the future.

Site Influence B: Trees with severe lean fall towards the lean

Leaning trees are encouraged by gravity to fall in the direction of lean. Bustos-Letelier (1994) did not find any significant effect from tree lean on fall direction for windthrow, looking at conifers leaning from 0 to 34 degrees in foothills of the Oregon Coast Range, but concluded that more severe lean might affect direction of tree fall. Wind forces apparently overpower effects of lean in the range observed, or variability was too great to detect significant effects with the sample size of 200 trees. The effect of tree lean was explored in a very hypothetical manner, given the lack of data to focus the range of probable effects. The data available indicated that less than 35° lean did not have significant effects on windthrow direction, so only trees with 35° or greater lean were modified for direction of fall. Trees leaning towards the stream were given a probability of 1 that they would fall towards the stream, and trees leaning away from the stream were given a probability of 0. This approach was designed to look at the maximum possible effect of lean, within the assumption of no effect from lean less than 35°.

Site Influence C: Higher windthrow rates on poorly drained terraces

Trees growing on poorly drained terraces develop shallow roots, which are more susceptible to windthrow (Miller 1985). Vegetative indicators of poor drainage, such as skunk cabbage and sphagnum moss, are commonly associated with high-hazard windthrow areas (Moore 1977). Data on windthrow from 10 sites in the Oregon Coast Range showed an average 45% basal area loss on poorly drained terraces, compared to an average 31% basal area loss on slopes (Andrus and Froehlich, unpublished manuscript). The large variability of the data, limited number of sites, and lack of information from other regions of Oregon make the data a limited base on which to make assumptions about effects of poorly drained terraces on windthrow. The importance of shallow rooting in increasing susceptibility to windthrow was frequently acknowledged but infrequently estimated in the literature. In the windthrow hazard classification system for the United Kingdom, shallow soils could account for up to a quarter of the windthrow hazard, suggesting that a 25 percent increase could be expected, but no data were presented to corroborate that assumption (Miller 1985). Consequently the average 10-year windthrow rate of 30% was increased proportionately to the specific data of Andrus and Froehlich in Oregon, yielding a windthrow rate of 44% for poorly drained terraces. Trees listed as growing on terraces were assigned the 44% probability of windthrow, while trees on slopes remained at 30% windthrow, and LWD input rates were calculated by cumulating those probabilities.

Stump and Snag Analysis

Stump diameters were converted to DBH's using prediction equations by Demaerschalk and Omule (1982), developed for use in British Columbia. These equations were used because they had a wide range of species similar to that encountered in this study, and used outside-bark measurements. There were two major sources of possible bias with this approach: estimates for stump height and use of equations developed outside Oregon.

Stump height was not measured, but is used as an input for the prediction equations. A sample of 20 stump heights of Douglas-fir, western redcedar, and bigleaf maple was collected to determine a range of typical stump heights. Stump heights ranged from 0.5 feet to 2 feet, so DBH's and basal areas were calculated for this range of stump heights, giving the probable range of removed diameters and basal areas. For more concise summaries, an average stump height of one foot was selected. High-value Douglas-fir stumps tended to be closer to 0.5 feet, so are more likely to be overestimated (more actual taper than would be predicted). Redcedars, prone to buttswell, and clumped hardwoods tended to have stumps greater than one foot, so would be underestimated by the equations. Relative to measurement precision, the range in DBHs for the different stump heights was not large. The range of DBHs was less than 2 inches from 0.5 feet to 2 feet, and less than 1 inch from 0.5 feet to 1 foot.

To test the accuracy of the DBH prediction equations of Demaerschalk and Omule (1982) for Oregon, 20 standing trees were measured for diameter every one-half foot of height from 0.5 to 4.5 feet. The sample included Douglas-fir, western redcedar, and red alder, the most commonly encountered species in the study. No bias was detected at the 0.5-foot stump height or for alder predictions. At stump heights of 1 foot and above, predicted DBHs of Douglas-fir were significantly smaller than those measured; British Columbian Douglas-firs apparently have more taper. However, the bias was within the one-inch measurement precision of the stumps, and would counteract any overprediction due to stump heights for Douglas-fir being lower than the one-foot stump height used as an average. While this balancing of bias is inferior to precise data and perfectly accurate prediction equations, it does build estimates that are reasonably accurate relative to measurement precision (nearest inch) and possibly inclined to give conservative estimates (lower rather than inflated basal area). The possibility of undiscovered stumps would also contribute to conservative estimates.

The basal area predicted from stump predicted DBH and number of removed trees were added to retained basal area to predict preharvest stocking for conifers and hardwoods. To normalize effects of site differences and stream sizes, the preharvest/postharvest ratio for trees/1000 feet was calculated and compared to the 1993 ODF study. Average distance to stream was also calculated for stumps.

Snag counts were summarized for each site and converted to a per-acre basis for conifer and hardwoods. The 1993 study used an eight-inch minimum DBH and 10-foot minimum height, so the snag dataset was trimmed to these standards to create comparable data. Average counts/acre, DBH, and height were calculated for conifers and hardwoods. Distance to stream and level of decay were averaged for each site.

Comparison of 1993 and 1995 Data

The Riparian Rules Effectiveness Study (Mormon 1993) was used as the baseline for riparian conditions after harvest under the previous rules for streamside harvesting. Data for that study, collected by Oregon Department of Forestry Staff, was summarized for each site in the Study report and appendices. They visited 37 sites in three regions: Northwest, South, and Eastern Oregon. The regional and site averages were extracted from the report.

Few of the variables for either 1993 or 1995 data were normally distributed, so nonparametric tests such as the Kruskal-Wallis Chi-square Approximation were used to test for significant differences between the two datasets. Stream width was significantly wider for the 1993 streams ($p<0.01$), so the 1993 dataset was trimmed to only those streams 35 feet or less in average width. This maximum width was close to the maximum width for 1995 streams, but stream widths were still significantly different with the trimmed dataset ($p<0.05$). The 1994 Rules affected harvesting along smaller streams more than the previous rules, so the 1995 dataset included streams smaller than those considered in 1993, the probable basis for the continued differences in stream width. No significant differences ($p<0.05$) in stream gradient, LWD loading, or preharvest stocking were evident. Kruskall-Wallis tests were used to compare of conifer and tree stocking after harvest (counts/1000 feet and slope-adjusted basal area per acre), angular shade, distance to harvest-related disturbance, snags per acre, average snag diameter, small conifer trees, and exposed mineral soil.

RULE USER OPINIONS OF THE WATER PROTECTION RULES

Overall, responses varied more among groups (industry, operators, and NIPF) than among regions (East, Southwest, and Northwest Oregon). Important factors for support of the Water Protection by the rule users ranged from tangible, economic factors to more abstract factors like ability to control management activities. Although compensation was high profile on the political agenda during the period of the survey, alteration of tax policies to reward provision of public benefits was seen as more effective than and almost as desirable as compensation by industry foresters and a large minority of operators and NIPF owners. Appendix C summarizes the frequency analysis for the entire questionnaire for reference to total and group-level percentage responses. Appendix D contains all of the written comments from the questionnaire. Appendix E contains the two-page summaries of the Stream Rules Survey and the riparian assessments that were offered to participants.

Response Rate and Likelihood of Harvest

Differences among the groups of rule users were apparent even in the response rates. The overall response rate was 67%, with 555 of the 827 successfully mailed surveys being returned (Figure 1). Industry foresters had the highest response rate (84%), suggesting that the survey topic was very salient to them. Operators had the lowest response rate (60%), still high enough to conclude that the topic was salient; perhaps seasonal work schedules and dislike of paperwork by woodsworkers had some impact. A greater proportion of operators responded in November compared to the other groups. Because operators had been slowest to respond to the first two mailings, they comprised more of the potential respondents for the third mailing, so greater response in November is not surprising.

Sixty-six percent of NIPF owners responded, but a substantial portion of those (43%) said that they had not harvested under the new Rules, even though they had filed

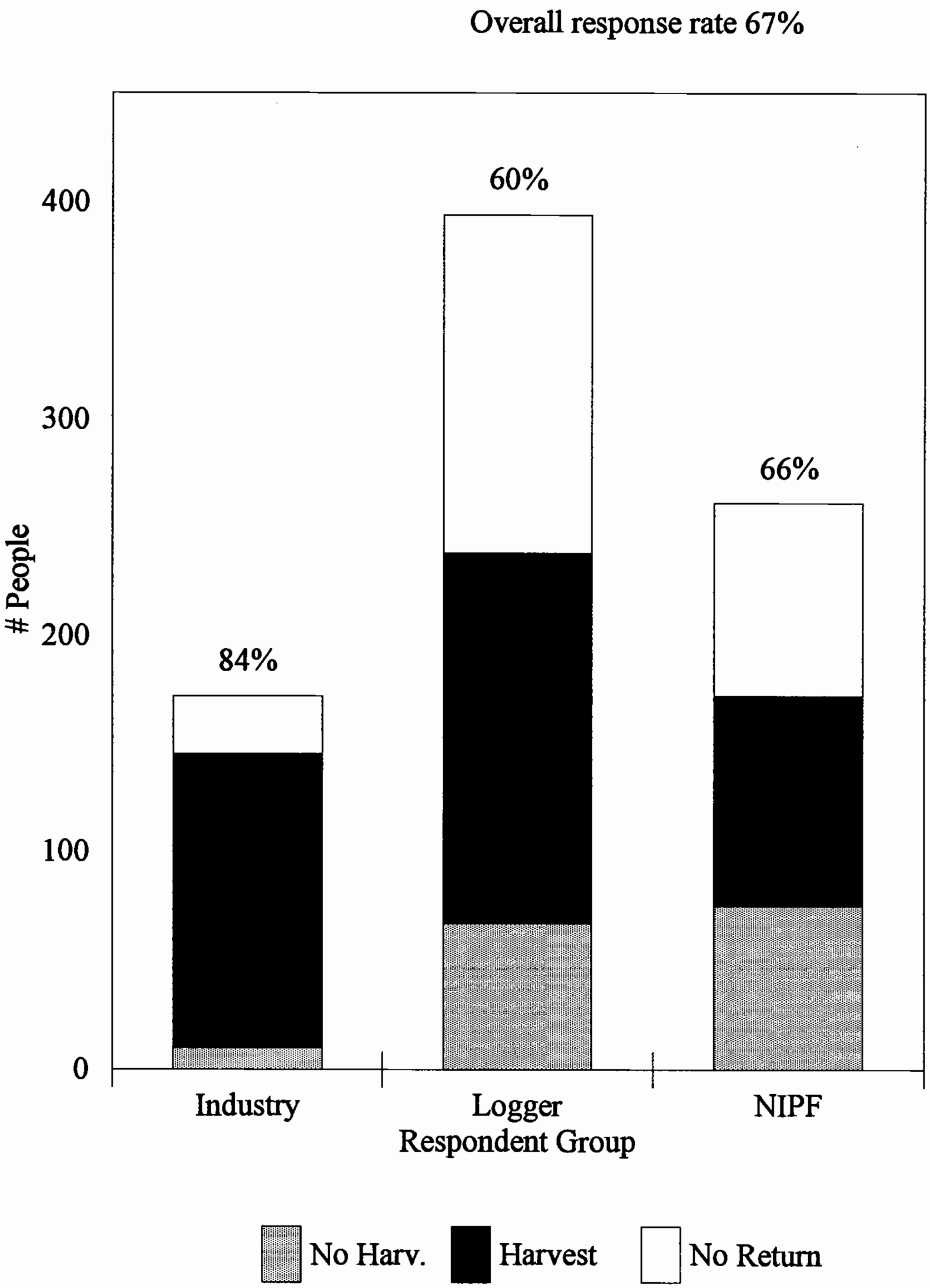


Figure 1: Numbers of survey respondents by Rule User Group (Return rate is listed above bars)

the harvest notification. The topic seemed highly salient to some NIPFs and not to others, who noted that they had left rule requirements to the logging operators. Some operators (28 %) had not harvested under the new Rules either. Based on interviews and pretest follow-ups, reasons for not harvesting included: they had used the old rules for harvests prior to September 1994 and the notification was an amendment to a prior plan; they had decided not to harvest; or they didn't harvest near enough to a stream to consider the rules. The variability of NIPF harvesting patterns was corroborated by interviews. Most of the NIPF owners interviewed had modified their harvest because of expectations of upcoming state rules or fear of federal rules: clearcutting instead of partial cutting, cutting before the rules took effect, or concentrating cutting near streams. The industry foresters, who need continued harvests for regular timber or income supply, did not often report these actions. NIPF owners, who seldom harvest every year, were more likely to temporarily avoid the Rules if possible, while industry foresters in pursuit of a relatively steady timber supply were more likely to start learning the Rules as soon as possible.

The results that follow are based on respondents who had harvested and filled out the rest of the survey. The intent was to examine opinions that had been formed by direct experience with the rules. The sample was not a general cross-section of NIPF landowners; it targeted harvesters, probably representing the more active managers and larger landowners (Bennett 1993).

Respondents had a median age of 47 and most frequently earned between $40,000 and $59,000. Most logging operators had a high school education or some college, most industry foresters had 4-year degrees, and NIPF owners had a wide variety of education levels. Race and gender were not asked on the survey, but information on the ODF harvest notifications showed that most were white males. NIPF owners had a median of 43 acres, owned by themselves or their family for a median of 30 years. As a comparison to estimates for all Western Oregon and Washington, Johnson et al. (in review) reported a median ownership size of 30 acres, average tenure of 27 years, average income of $61,000, and 41 percent of owners over 60 years old. Thus, for the harvesters in this survey, ownership size seems to be greater, tenure of ownership slightly longer, and age somewhat lower than the general NIPF population in the region.

Level of Support

What level of support exists for the Stream Rules? Figure 2 shows that a majority of people support the rules in all three groups, 61% overall. Industry foresters clearly have the highest support (73% supported or strongly supported). Operators (54%) and NIPFs (55%) have similar smaller majorities that support or strongly support the rules. It is a comment on the diversity of the NIPF group that they have the largest percentage of both strong support (18%) and strong opposition (17%). Despite the visible trend, differences in support among groups were not significant in chi-square tests at the standard 95% confidence level ($p=0.07$). Support or strong support was highest in Southwest Oregon (67%) and lowest in Eastern Oregon (58%), but these relatively narrow differences were not significant ($p=0.14$).

Majority support for the Water Protection Rules was not the case for all types of landowners. NIPF owners who chose timber income as one of the top three reasons that they owned land were more likely to oppose the Rules (56%) than support them (39%) ($p=0.03$). Harvesters who reported over 20 percent of the harvest value lost due to the Rules were more likely to oppose the Rules than harvesters who estimated lower lost values (significantly different at $p<0.01$). NIPF owners over 60 years were just as likely to oppose as to support the Rules (38% each), differing significantly from younger owners who more often expressed support ($p=0.02$). Support from NIPFs did not differ significantly based on tenure ($p=0.48$) or size of ownership ($p=0.14$), income levels ($p=0.76$), or education ($p=0.65$).

Is this support because people think the Rules are on target? Figure 3 suggests that much of the support is based on a sense that the Rules are "about right" (45%), but enough people feel that the Rules have gone "too far"(45%) that some of them necessarily are supporting the Rules despite that feeling. The difference between the

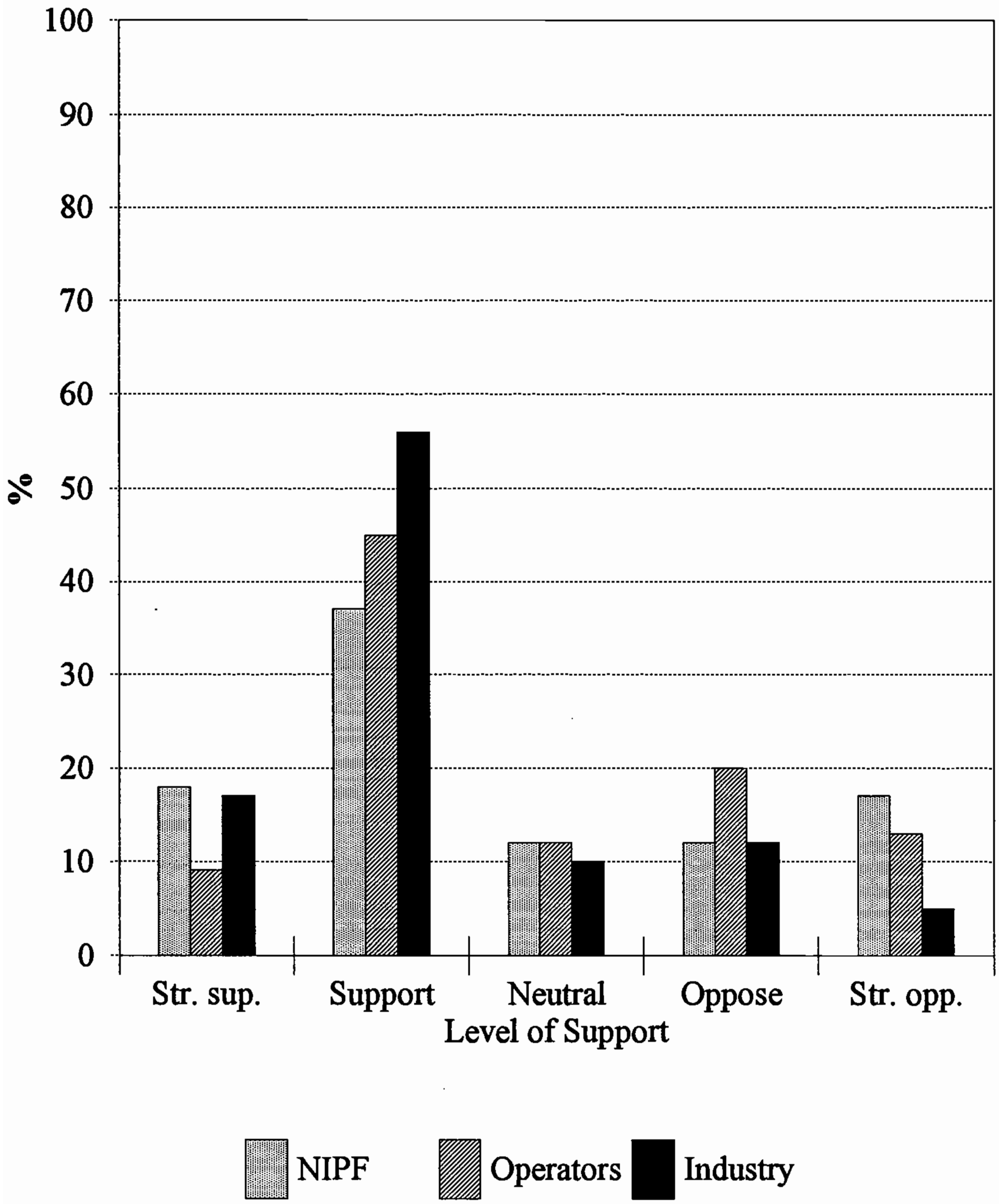


Figure 2: Response by Rule User Group to the question,"How much do you support or oppose the Stream Rules?"

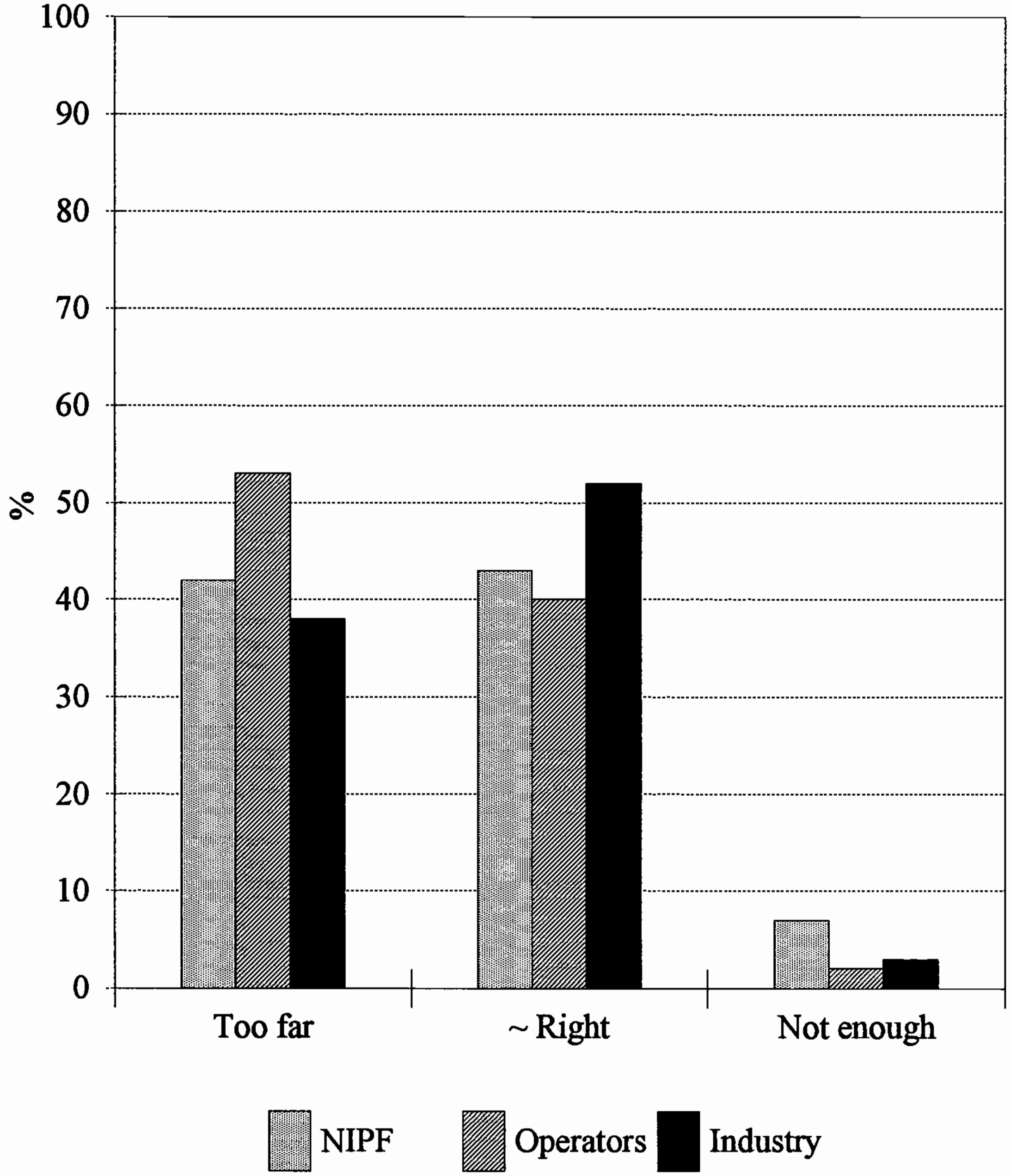


Figure 3: Response by Rule User Group to the question, "Compared to your idea of what the Stream Rules should do, which statement most closely expresses your view of where the rules are now in terms of protecting streams?"

number who support for Rules and those who feel the Rules are about right is highest for industry foresters (21%), and lower for operators (14%) and NIPFs (13%). These differences are not statistically significant among groups (p=0.26) or regions (p=0.52). A comment worth noting from interviews is that some view the Rules as the best of bad alternatives, and feel that they should be supported to avoid future more restrictive requirements such as the buffers of 300 feet or more used on federal forest land in Oregon. Written comments on the surveys distinguished between the small streams, where respondents noted that the Rules were overprotective, and medium and large streams, where Rules were more often considered about right.

More people supported the Rules (61%) than thought they were very or mostly effective (52%). Regional differences in Rule support were not significant (p=0.46), but opinions of Rule effectiveness differed significantly among groups (p=0.01). Industry foresters rated the Rules as very or mostly effective most often (44%), while fewer operators (25%) and NIPF owners (19%) did so (Figure 4).

In discussions among foresters, some are quick to say how strict forestry rules in Oregon are, while farmers and ranchers operate with fewer regulations and greater impacts. Would a situation where all land uses were "doing their part" to protect streams affect support of the forest rules? Figure 5 shows that, for the majority, raising the burden equally for all land uses would not affect support. Fairness, at least if it involved more rules for other uses and not fewer for forestry, did not seem to be a controlling factor for support. Twenty-three percent of NIPF owners and operators thought that equivalent rules for other uses would decrease support for forestry rules, compared to 10% for industry foresters, differences significant at p<0.01. NIPF landowners may be more likely to have multiple uses on their land, and so would not welcome additional rules that restrict cattle grazing or raising crops. There is evidence that a principle or norm for fair sharing of burdens for public resources exists (Lind and Tyler 1988), but it does not appear to be an important factor in support for the Rules.

Harvesters were asked to express their level of support for several of the major goals behind the Forest Practices Rules: water quality, fish habitat, and wildlife habitat. Compared to 61 percent for the Water Protection Rules, 82 percent generally or strongly

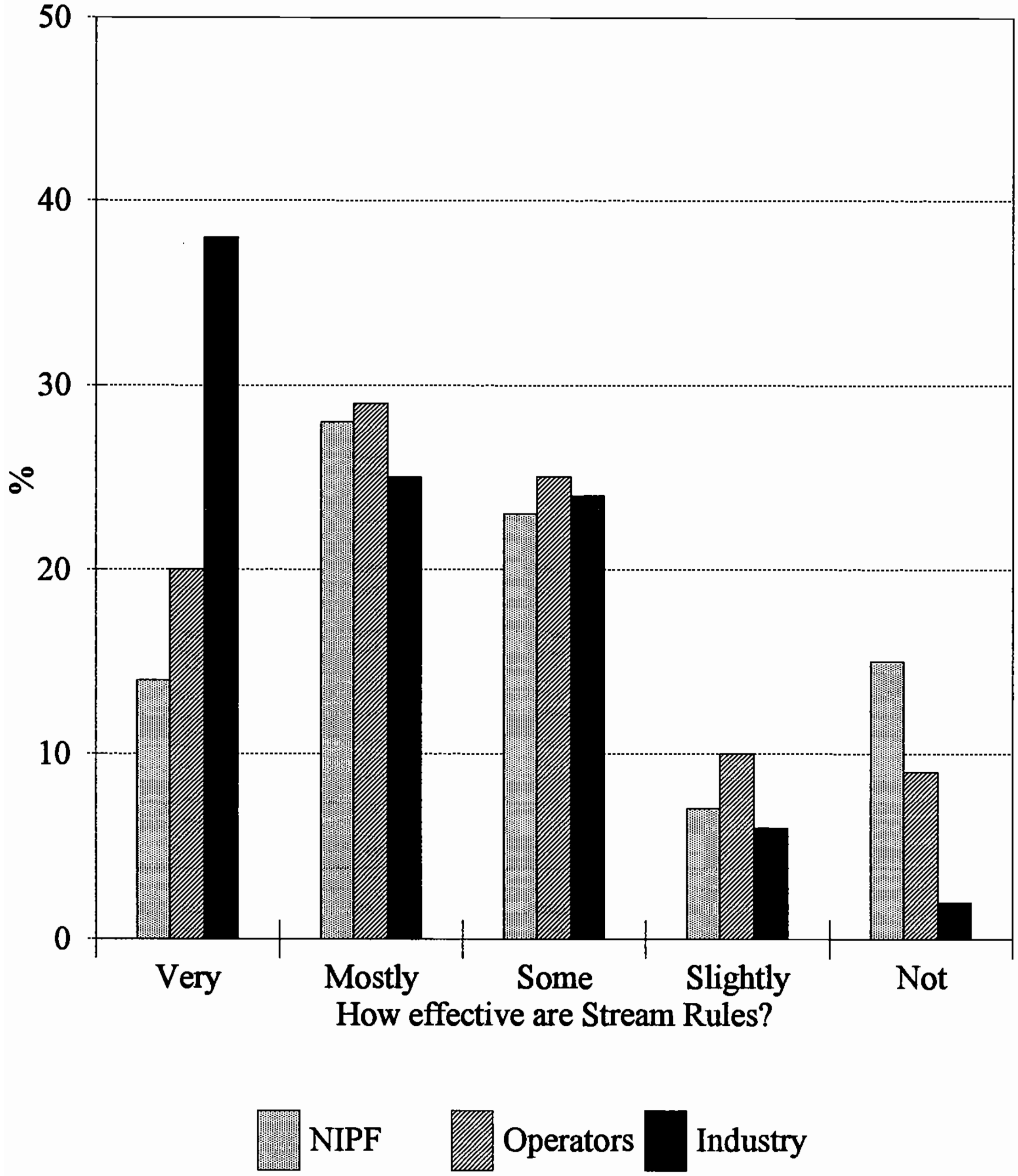


Figure 4: Response by Rule User Group to the question, "How effective do you think the Stream Rules are in protecting the resources you listed in Question 4 (open-ended)?"

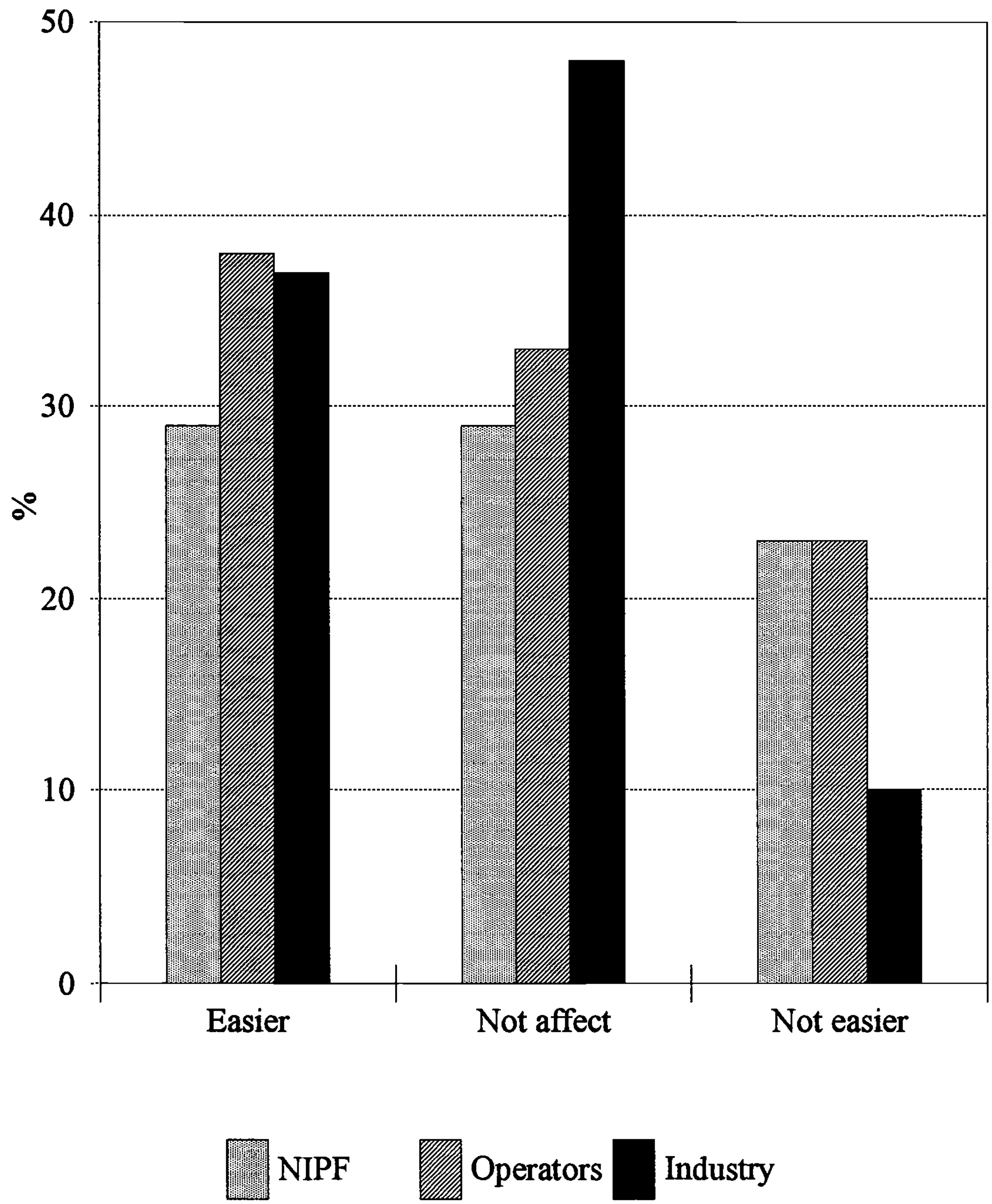


Figure 5: Response by Rule User Group to the question, "If rules for nonforest uses required similar protection of streamside areas, how would it affect your support for the Stream Rules?"

supported rules on private land for water quality, with 76 percent for fish habitat and 64 percent for wildlife habitat. Support for these goals was significantly correlated to support for the Rules ($p<0.01$), but explained only a relatively small portion of the variation ($r=0.39$ for water quality and wildlife habitat, $r=0.43$ for fish habitat). Other surveys have found greater agreement with broad ideals than with more specific examples where the costs as well as general benefit are evident (Barkley and Flinchbaugh 1990). Thus, stronger support for broad goals is not surprising, and suggests that much of the support for the Water Protection Rules comes from belief in the desirability of the goals. In the interviews, all but two of the 24 people expressed general understanding of and agreement with the major goals of the Rules, even though many were skeptical about the need or effectiveness of specific provisions.

To summarize, there is majority support for the Rules among harvesters, some of it even despite individual perceptions of excessive regulation. This generalization is not true for those NIPF owning land for timber income, however, where less than half support the Rules. The support for the Water Protection Rules seems related to support for its broad ideals, such as protecting water quality and fish habitat. Creating comparable burdens for other land uses besides forestry is a consideration, but not a dominant factor, in support for the Rules.

Importance of Awareness and Process

Not everyone will agree with outcomes of regulations or other public policy decisions. However, the field of procedural justice claims that people are more likely to support outcomes that might not be personally preferred if they thought the process was fair and open (Alexander and Ruderman 1987, Thibaut and Walker 1975). The ability of perceptions of a fair process to improve satisfaction with results has been documented primarily with those who were dissatisfied with the outcome, since most people who liked the outcome were already pleased (Lind and Tyler 1988). Inclusion of a wide variety of interest groups and backgrounds is considered a desirable part of a fair process. If the process is not inclusive, responses to public input may satisfy a small vocal minority at the expense of a larger affected group (Freudenberg 1983).

The process for creating the Water Protection Rules was lengthy, occurring over four years, and included the traditional public hearings for both sets of draft regulations. The advisory committee used to help develop the second draft was a new approach, and included representatives from state forestry, fish, and water agencies, forest industry, loggers, water suppliers, small landowners, and environmental groups. This group involved a broader spectrum of people than historically had been directly involved in rule drafting. How the use of the advisory committee might have affected support for the Rules thus was of considerable interest.

Information on the level of training and familiarity with the Rule development process for the different rule user groups was used to help evaluate opinions of the process. Ninety-three percent of the industry foresters and 59 percent of the logging operators said that they had attended the ODF Water Protection Rule training sessions in Summer 1994, compared to 22 percent of the NIPF owners. The ODF Landowner/Operator Training Manual explains that the Water Protection Rules were designed to achieve mature forest conditions (e.g., 80- to 120-year old forests) along streams and other waters. A majority in all groups of the harvesters reported that they were aware of the goal, but industry foresters again were most familiar (89%), compared to operators (60%) and NIPF owners (53%). Industry foresters were significantly more aware (p=0.03) of the Rule development process; 41 percent said they knew a lot about the process, compared to 7 percent of operators and 5 percent of NIPF owners (Figure 6). Twenty-nine percent of NIPFs said they were not aware of the process, compared to 1% of industry foresters. Although representatives of both forest industry and the small woodlands associations were included in the process, the forest industry at large clearly received more information during rule-making. This trend is present even though the NIPF respondents here are likely to be more active harvesters than the general population of NIPFs, and may be more informed than average. The forest industry association networks and roles as full-time professionals probably support this trend and enhance their ability to follow and participate in policy development.

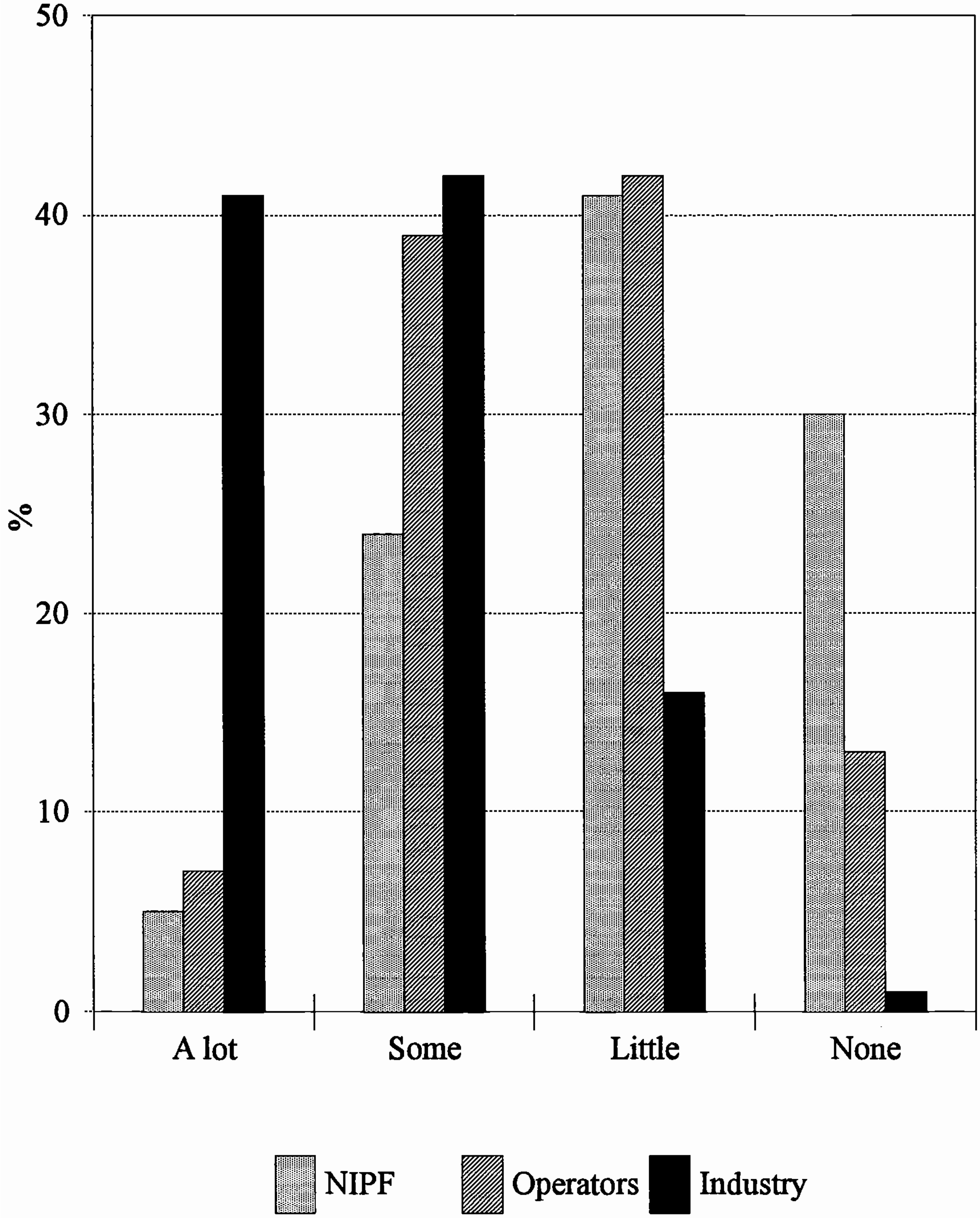


Figure 6: Response by Rule User Group to the question, "How much did you know about the process used to create the rules?"

The person or people making the streamside harvesting decisions also could have a bearing on awareness and relationship of the respondent with the Rule development process. Industry foresters indicated that the forest manager was important in streamside harvest decisions most of the time (72%), with the landowner, layout crew, and Forest Practices Forester (FPF) being important at least a third of the time. Logging operators indicated that the FPF was important in harvest decisions over half the time (58%), with the landowner, operator, and forest manager also frequently being important (47, 43, and 37%, respectively). NIPF owners thought that the landowner was important the majority of the time (58%), with the FPF (38%) and logging operator (33%) also being frequently mentioned. These results reflect some differences among groups, such as industry timber often being marked by the company forester or crew, compared to greater discretion for logging operators in streamside areas on NIPF land. Respondents from all groups generally see themselves as important in the decisions, with FPFs the most common outside influential player.

Knowledge or awareness by themselves were not clearly related to support of the Rules. Support did not differ significantly based on awareness of the goal of mature streamside forests ($p=0.44$) or level of knowledge about the Rule development process (Figure 6, $p=0.16$). Support differed significantly by self-reported levels of knowledge about riparian ecology ($p=0.02$), but those reporting high knowledge had the greatest proportions for both strong support and strong opposition, so no clear correlation was apparent ($p=0.28$). Despite the large disparity in training session attendance by the different groups report above, support did not differ significantly based on attendance ($p=0.39$).

Although support did not vary significantly with awareness and training, agreement with aspects of the Rules goals and development process showed stronger relationships to support. Opinion of suitability of the mature forest goal and the use of a diverse advisory committee differed among groups ($p=0.01$, $p=0.03$, respectively) but not regions ($p=0.15$, $p=0.74$, respectively). Support or opposition for the rules differed significantly ($p<0.01$) based on opinion of goal suitability and use of the diverse committee. For those who thought the mature forest goal was not at all suitable for their property, 4 percent strongly supported the Rules, 28 percent opposed, and 18 percent strongly opposed the Rules. Some respondents wrote comments about unsuitability in salvage areas, where trees had all died, and in alder areas, where ages over 80 years were not expected. However, despite the clear disagreement about the goal, 32 percent of those choosing "not suitable" still generally supported the Rules.

Respondents were asked directly, "Did including diverse representatives when developing the rules increase, not affect, or decrease your support for the new rules?". Most people (49% overall) did not think that it affected their support (Figure 7). An inclusive process apparently was not a key issue for them. There was some evidence that the inclusive process was increasing support, especially among industry foresters, 40% of whom said that it increased support. However, among NIPFs where process affected support, slightly more reported decreased (20%) rather than increased (17%) support.

Comments on surveys indicated that the inclusion of environmental groups was the biggest source of discontent. In three out of 24 interviews, there were unsolicited comments about the importance of a participatory process, rather than top-down development of regulations. The qualitative evidence suggests that process matters, but additional written survey results indicate that, for the general population of harvesters, other aspects such as economics and management autonomy matter more.

Importance of Rule Attributes

People were asked if they agreed or disagreed with a variety of statements about the rules, dealing with whether the rules: are too complex, are flexible enough, need too much interpretation by ODF staff, are backed by good scientific reasoning, leave too much value in uncut timber, take too long to lay out buffers, take too long to get written plans or approvals, help take care of land, include compensation or incentives, were helped by ODF staff, and caused uncertainty about future harvests. They were then asked which factors most affected their level of support.

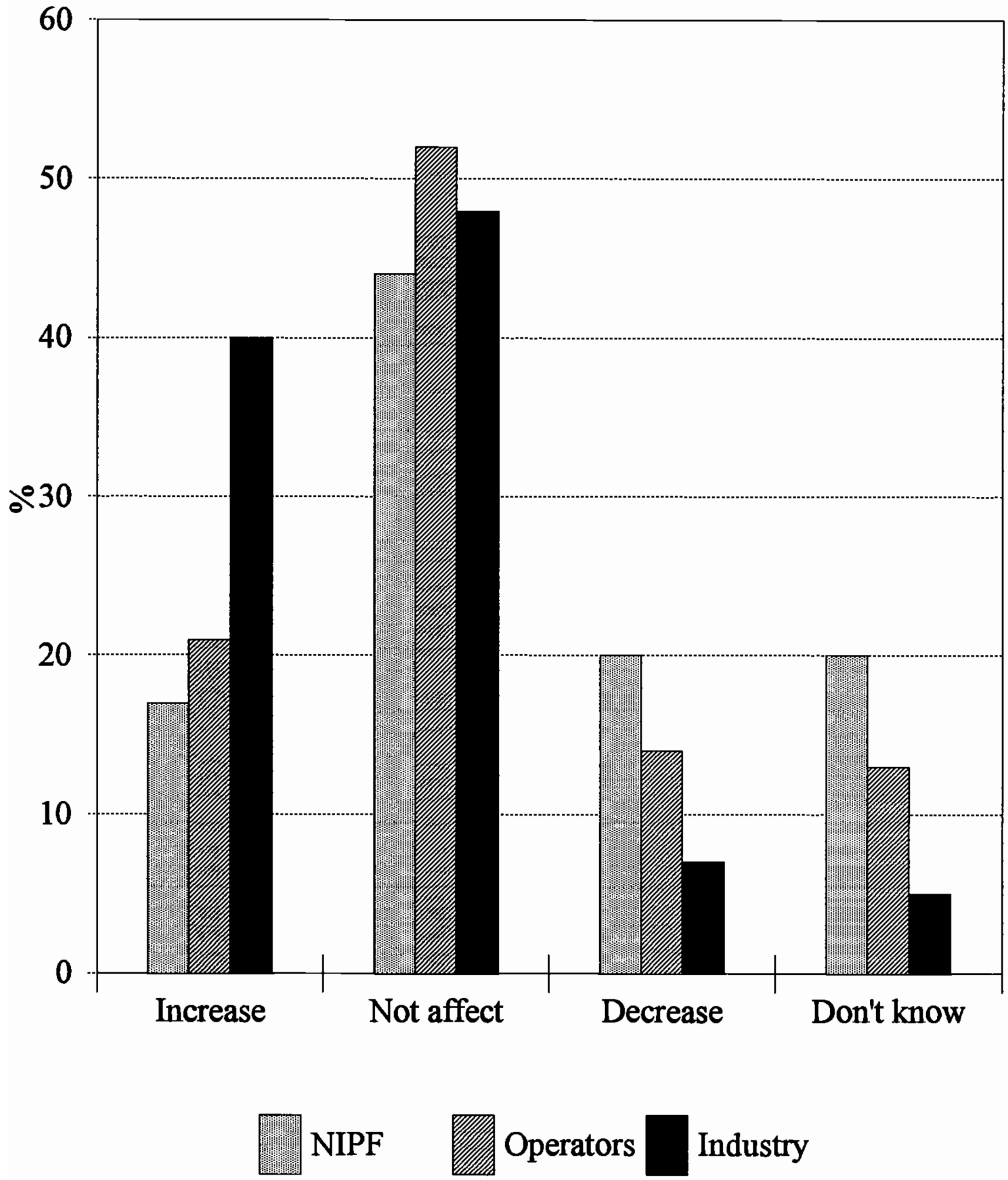


Figure 7: Response by Rule User Group to the question, "Did including diverse representatives when developing the rules increase, not affect, or decrease your support for the new rules?"

Which factors were seen as most important? Out of the eleven statements, the four most frequently chosen factors were:

1. "The rules have the flexibility I need for site-specific management." Fourteen percent chose the statement. Overall, people tended to disagree with the statement (42%), but industry foresters were more likely to agree with it (44%).
2. "The rules are backed by good scientific reasoning." Thirteen percent chose this statement, with a greater proportion of them being industry foresters. More people disagreed (40%) than agreed (24%) with the statement.
3. "Rules don't include compensation or incentives for timber owners." Thirteen percent chose this as important, with 82 percent agreeing with the statement, the clearest point of consensus in the entire survey.
4. "Rules help me take better care of the land." Twelve percent chose this. More disagreed (43%) than agreed (32%).

These factors center around several issues: ability to control land management decisions, norms for public policy, and financial impact. The more complicated and time-consuming nature of buffer layout under the new rules was frequently mentioned by industry foresters in the interviews, suggesting that it affects the daily lives of field personnel. However, when that factor was one of an array of other factors in the written survey, the fact that buffers take longer to lay out was seldom rated as important as the broader scale factors like money and control. Only 6 percent chose complexity as one of the two most important factors, and 5 percent chose the buffer taking too long to lay out, half the rate of the top four factors listed above.

Forest Practices Foresters (FPFs) are the ODF staff that implement and enforce the Water Protection Rules, and as the primary contact between harvesters and ODF, they are in a position to influence experiences and opinions. Almost half of the respondents (46%) indicated that FPFs were important in deciding how to harvest their streamside stand, with 57 percent of the operators saying so. Sixty-nine percent of the respondents agreed that ODF staff had helped them use the Rules, and only 11 percent disagreed. Eleven percent of the operators even chose that factor as one of the two most important factors for support of the Rules, one of the four most frequently chosen factors for operators. The majority of harvesters interviewed mentioned FPFs without prompting, further indicating that the role of the FPF is quite important in implementation. Quite a few industry foresters thought they had a pretty good relationship with the FPF, and NIPF owners looked to the FPF to substantially help them figure out how to apply the Rules. Other harvesters thought that the FPFs were too legalistic, took an unnecessarily threatening approach, or were too busy anymore to help out in the field.

There were also mixed perception regarding the FPFs' role as interpreters of the Rules to specific harvests. Harvesters were asked to agree or disagree with the statement, "The rules need too much interpretation by the FPFs". Overall, more agreed (43%) than disagreed (25%) with the statement, especially operators and NIPF owners. Industry foresters, on the other hand, had more respondents disagreeing (42%) than agreeing (33%) with the statement, similar to the disparity among groups for perceptions about Rule flexibility. Written comments covered a spectrum of concerns, ranging from dissatisfaction about widely differing interpretations among FPFs, to feelings that the FPFs went by the book too much and hopes that the FPFs would be given more flexibility for interpretation.

Given the importance placed on financial impact noted above, it is worth looking at people's impressions of lost harvest value. People were asked, "For your most recent harvest, about how much was the value of the total harvest lowered because of meeting the Stream Rules, in percent?". The most frequent responses for NIPFs were:

- None (some comments said "I wouldn't have harvested down there anyway"),
- 10 to 19% , and
- Don't know.

Compare this broad range of responses with industry foresters, who most commonly chose less than 5% value loss (45%) or 5 to 9% value loss (28%), about half of what NIPFs estimated for those who perceived a value loss (Figure 8). This disparity in perceived value loss could be related to differences in information about the stand, different perceptions, or different characteristics of the land owned; NIPF land is more commonly in settled valleys and lower elevations with the larger streams, where there would be larger buffers.

Use of Rule Options and Incentives

The Water Protection Rules have provisions designed to encourage management that would supply wood to the stream more quickly while allowing increased timber removal, considered incentives for landowners to undertake desired activities. The option to just leave the specified Riparian Management Area (RMA) width is the simplest, requiring no measurement other than distance for RMA boundaries. Another option is to measure the conifers and eligible hardwoods or snags in the RMA and determine the number and basal area of trees above the minimum diameter, from which the trees allowed to be cut can be determined. Options for stream habitat management include conversion units, where hardwood buffers are cut for conversion to conifers for future LWD, and basal area credit, where logs are placed directly in the stream, in return for being able to cut proportionately more basal area in the RMA.

Given the different levels of complexity and effort required to undertake the various options, different rates of use among forest industry, logging operators, and NIPF owners could be expected. In fact, about twice as many industry foresters as operators or NIPF owners said that they had used this option on their most recent harvest, 10 percent compared to 4 and 5 percent, respectively. Rates of use of stream habitat management would probably be higher if all harvests, not just the most recent, were considered. In the interviews, 17 percent, 4 industry foresters out of 24 harvesters (2/3 industry), had placed logs or done conversion units. An additional 21 percent had cut to minimum basal area, again all industry foresters. Although the additional time and paperwork required to remove trees from the RMA are considered a burden, and many

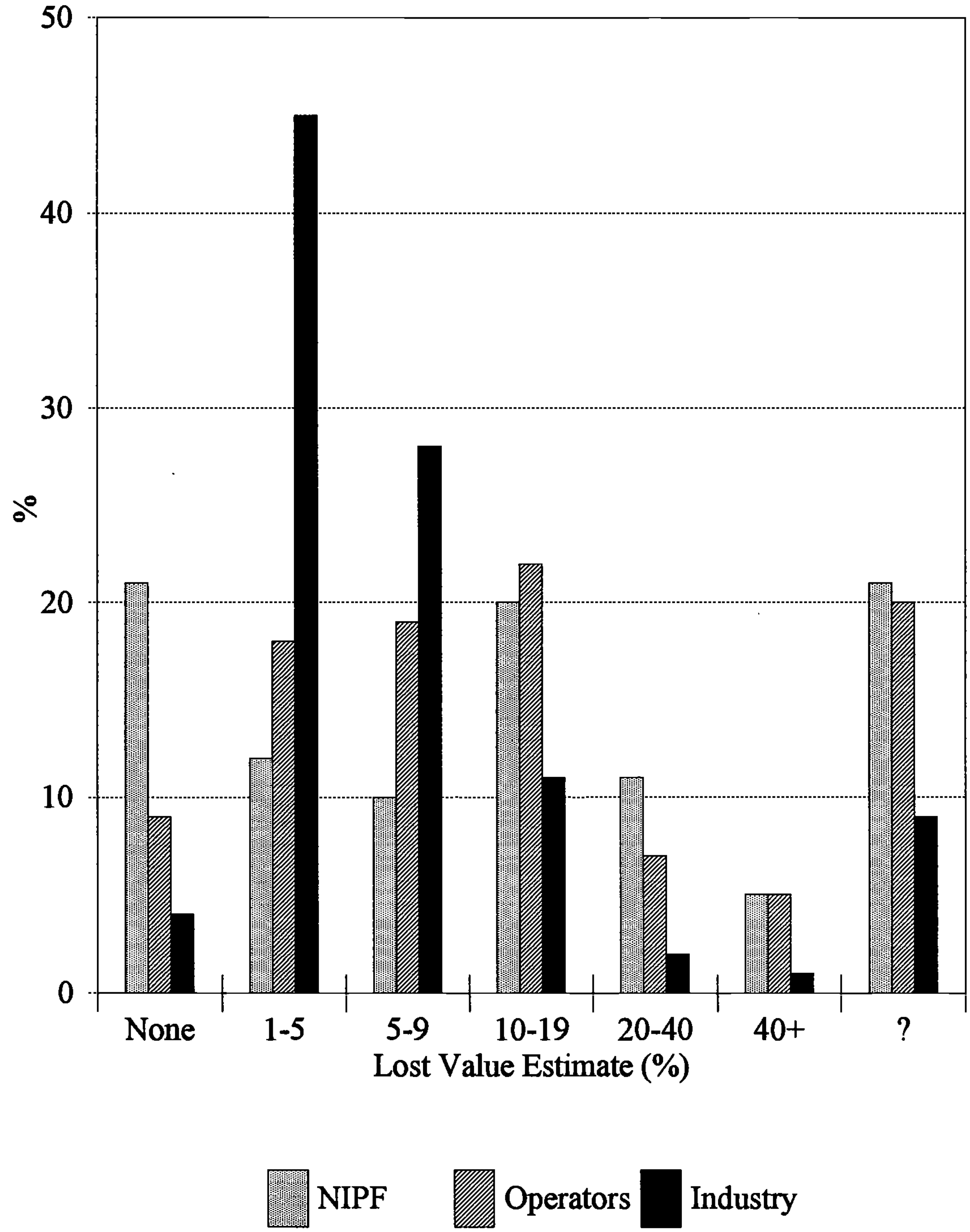


Figure 8: Response by Rule User Group to the question, "For your most recent harvest, about how much was the value of the total harvest lowered because of meeting the Stream Rules?"

do not have the staff to handle the new tasks, industry foresters are exploring all of the options more so than NIPF owners. Most of the NIPF owners interviewed were on larger streams where conifer basal area was too low for the various options to be used. Industry foresters are better positioned to take advantage of the RMA management options by virtue of more formal forestry training, managing forests as a full-time job, and characteristics of some of the land (higher elevation land where streamside conifers are more likely). Considering this, the fact that industry foresters thought the Rules were flexible more often than other harvesters is not so surprising.

More respondents in the Eastern Region (14%) said they had used stream habitat management options on their most recent harvest than in the Northwest (6%) and Southwest (5%). These differences are based on low numbers of respondents because the Eastern Region had about half as many harvesters as the other regions, so these results should be viewed with caution. The low numbers also mean that chi-square tests are not appropriate instruments to test for significant differences.

What were the motivations or barriers to using stream habitat management? Of those who did or could have used stream habitat management options, the factor most frequently chosen (22%) as important by all groups was that stream habitat management "let me increase timber volume or value removed". Other factors frequently chosen were: "let me better manage streamside stands" (15%), "took too much time for written plans" (13%), and "let me improve fish habitat" (13%). Industry foresters also frequently chose "took too long to physically apply" (16%), and logging operators were more concerned than other groups about creating ".... a liability during floods" (12%). It should be noted that landowners and operators are generally absolved from legal liability when an approved stream habitat project is implemented. Those fearing liability may not be aware of this provision in the law.

The motivation for stream habitat management seemed to be the ability to remove some of the volume in the RMA otherwise off-limits, with the desire to improve fish habitat being less compelling but operative. Barriers seemed to be the level of field work and written plans. The technical feasibility or availability of appropriately skilled workers or equipment did not seem to be a barrier for many. A majority (57%)

disagreed that stream habitat management wasn't feasible because of a lack of equipment or workers, while only 10 percent agreed with the statement. Similar results were seen for the question about feasibility due to lack of expertise in placing logs. Support for the Rules did not differ significantly ($p<0.05$) based on opinions about these factors related to stream habitat management.

Another Rule option allows harvesters to count, in some situations, trees left in excess of the required basal area in the RMA towards other harvest regulations, the wildlife trees required to be left in adjacent harvest units. Most people (72%) thought that this provision encouraged more trees to be left near streams. However, few seem to consider any of the provisions considered incentives by ODF as real incentives for landowners, witnessed by the overwhelming 82 percent agreement with the statement "Rules don't include compensation or incentives for timber owners". The structure of the Rules can motivate, or be incentives for, some behavior such as grouping leave trees by streams or undertaking stream habitat management projects. However, these provisions were added within the context of increasing restrictions, so that landowners seem to perceive a net loss in value. The "incentives" may be allowing harvest of a fraction of the value that could have been realized previously. Few consider this situation a reward (or incentive in the traditional sense) to comply with the Rules or pursue public-minded management. The incentives in fact are to encourage streamside management in directions considered useful by those creating the Rules, not incentives like cost-share payments for reforesting that directly supplement income to landowners.

Classification of Streams

The survey was distributed during the first year of the Rules being in effect, when implementation challenges could be expected. The Rules were based on a new stream classification system keyed to stream size and the presence of fish or registered drinking water intakes. Current information on fish use was not available for many streams in the state, so fish use was often presumed by ODF unless shown to be otherwise. Fish use during higher winter and spring flows is of particular concern, so determination of fish use has a limited window of time, especially for smaller streams where most questions arose. ODF initially estimated that new stream surveys statewide would take up to three years. Guidelines for conducting local fish use surveys were issued for use by landowners, operators, and others.

Respondents were questioned about whether finding the classification of streams had been a problem. A majority (69%) did not report a problem, although more industry foresters (41%) than operators (14%) and NIPF owners (23%) reported a problem with classification. Open-ended comments about the nature of the problem were solicited. As expected, quite a few said that maps or fish use surveys were not available, requiring time and expense to those who conducted their own surveys. Many commented that too many small streams were assumed to have fish use, such as seasonal streams that dry up in the summer. In interviews, some people also expressed the opinion that streams were classified as larger than they actually were or they were unlikely to actually have fish use but were classified as such. However, some of those who had been out with agency personnel to determine fish use expressed surprise at the small size of streams where young salmonids could be found.

Policy Ratings

Attitudes about particular regulations are likely to be part of larger perceptions about general policies. Respondents were asked, "How effective do you think the following methods are for government to influence forest practices on private land?". The options with the highest effectiveness ratings were clearly the financial tools: compensation, tax credits and more favorable capital gains treatment; over 60% rated them highly or mostly effective (Figure 9). Cost-sharing did not receive as much support; about 45% rated it highly or mostly effective, similar to education. The rating for regulation was slightly lower than cost-share and education, and that for technical assistance was a little higher. Easements, such as donating development or harvest rights

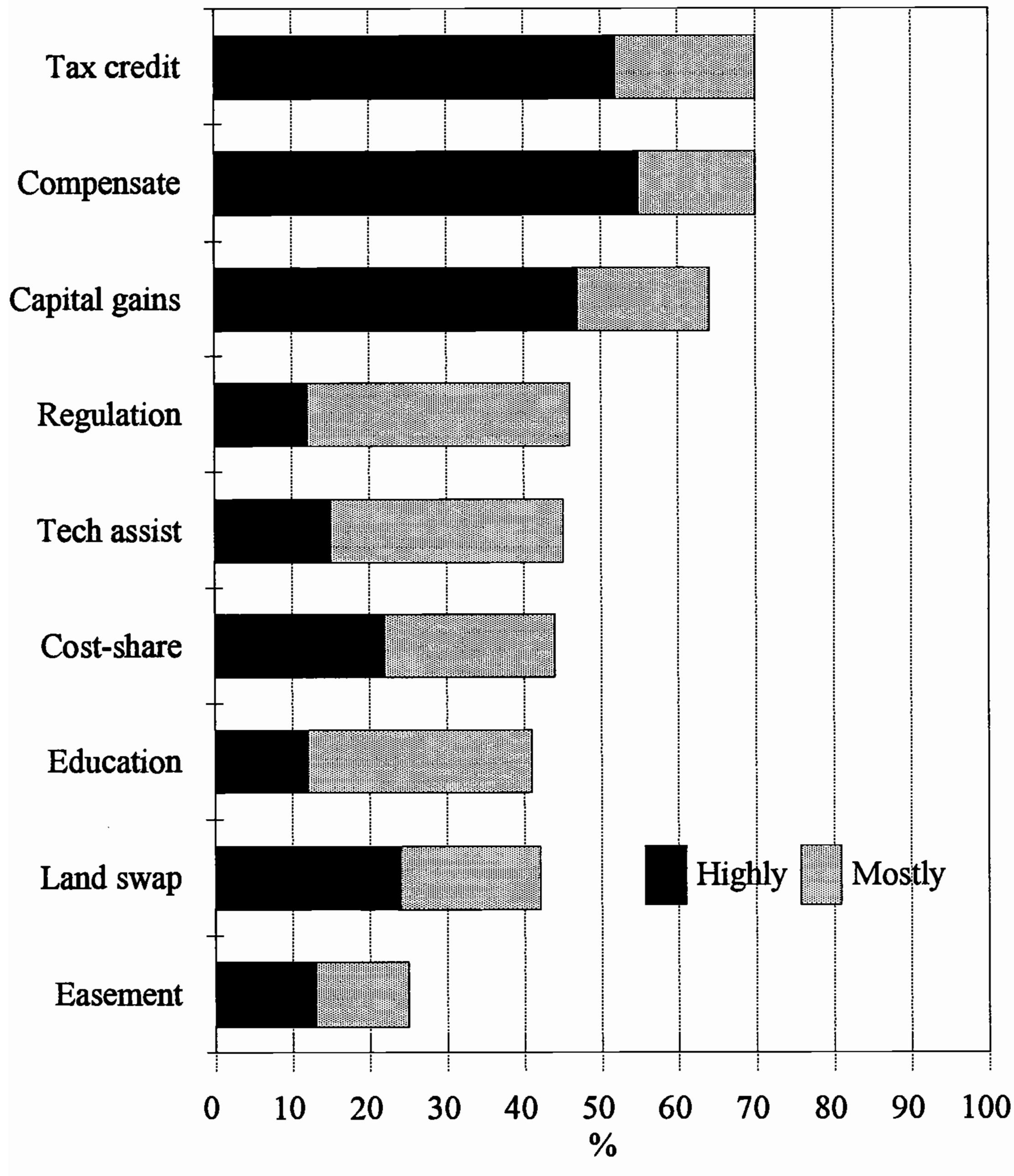


Figure 9: Responses of all Rule Users to the question, "How effective do you think the following methods are for government to influence forest practices on private land?"

to relieve estate taxes, received the lowest ratings, but many had chosen “don’t know”, suggesting that this option is not well understood. Land swaps were not quite as low (about 40% rated it mostly or highly effective), but NIPFs gave this option lower ratings than did the other groups. It is likely that NIPFs identify personally with their particular property, not merely an equivalent asset value.

Opinions on the effectiveness of regulation was one of the few places where significant regional differences were found. Significantly fewer ($p=0.04$) harvesters in Eastern Oregon than in Western Oregon thought that forest practices regulations were highly or mostly effective, although those believing regulations effective still outnumbered those choosing slight or no effectiveness.

Compensation for regulatory takings on private property was an active state and federal issue in legislatures both during and after Rule development, so respondents were questioned about their views on compensation. The most popular choice (47%) was clearly that “compensation should be offered if income or property value is reduced at all by complying with the rules”, a resounding vote for economic self-interest (Appendix C, Question 25). The option similar to most of the compensation legislation being considered in 1995, “compensation should be offered after a certain loss of value on a piece of property (e.g., 10-20%)”, was the third most popular choice at 18 percent. The other option that was frequently considered close to respondent’s own views was the tax incentive option, “changing tax incentives or credits to encourage landowners to manage and invest in forests would be better than compensation payments”. This choice received 29 percent overall; slightly more forest industry employees chose the tax incentive option than chose the full compensation option, but about half as many operators and NIPF owners did so. Those choosing the full compensation option were more likely than others to oppose the Rules ($p<0.01$), but supporters still outnumbered opposers for this category.

When asked where the relative responsibility lies for protecting and not harming public resources lies, with the landowner or the public, respondents most frequently (20%) chose the middle ground of 5 on a scale of 1 to 10. However, 58 percent chose a mix with greater responsibility for the public (6 to 10), and only 22 percent chose greater responsibility to the landowner (1 to 4). Some written comments indicated that this question was confusing or poorly written, so responses may not clearly express views in all cases. One comment said, "Landowner is responsible for 'on-the-ground management, however public is responsible for any compensation due"; from this perspective, the question would make little sense.

Discussion and Conclusions for the Stream Rules Survey

Support for the Water Protection Rules seems to be from a broad-based majority of harvesters surveyed. NIPF owners who had timber income as an important reason for owning land were more likely to oppose the Rules, and a larger minority of those over 60 years old opposed the Rules. These categories may be most like the Washington Farm Forestry Association members surveyed by Elway Research (Northwest Renewable Resource Center 1995), who demonstrated widespread concern about regulations. Most harvesters are probably more similar the general population of Pacific Northwest NIPF owners (Johnson et al., in review), who express some concern about regulatory restrictions but are also willing to contribute to environmental concerns within some bounds. Most harvesters are interested in balancing environmental protection and costs, much like the general public (e.g., Shindler et al. 1996). Despite the general broad support for environmental objectives like water quality and fish habitat, there is also a clear sentiment that limits are being approached or have been passed for what the Oregon landowner can afford to do or should have to do.

The aspects of regulation that seem to be most important to the people harvesting are: 1) control of management decisions, 2) financial impact, 3) norms of good science in policy. There is some evidence that other social norms like an open and inclusive process, or comparable regulatory burdens for all land uses, are at work, but they do not seem to be primary factors for support of a policy. Research in other disciplines has found a similar mix of motivations from altruism or social norms and direct self-interest. Holmes (1990) concluded that altruism had a real, but small, impact on voting behavior for environmental initiatives. Looking at Canadian waterfowl habitat, van Kooten and Schmitz (1992) concluded that a positive attitude towards habitat conservation could not substitute for adequate monetary incentives, although both played a role. After failing to find significant change in tax compliance from an education program, McGraw and Scholz (1991) noted the importance of appealing to norms that are consistent with an individual's values in trying to influence behavior. People are often willing to support a social good, but actually changing behavior seems to be greatly promoted by the existence of economic rewards in addition to intangible personal benefits.

As a policy approach, most harvesters seem to prefer the idea of compensation over tax credits. Nonetheless, these results also suggest that tax credits could be an effective route to expand support for forest rules, particularly among industry foresters. The Rules essentially convert some streamside areas into land that will produce little or no timber and income, and many feel that the reduced income potential should be recognized more widely in tax policies.

What are some limitations to the tax policy approach? Forest policy makers usually don't have complete control over tax policy. State and local government leaders may have different priorities than forestry policy makers for tax breaks. Cubbage (1994) noted that tax policies are often difficult to change because they are part of an intricate tax system and can affect government revenues. Tax code changes can still be pursued as an effective way to increase support for forestry rules and good practices, but there are few reasons to expect rapid changes. The debate over who pays for environmental protection is not new and not likely to be easily resolved.

Because the new Rules were considerably more complex than previous Rules, it was hypothesized that complexity would be an important factor for support. While some expressed concern about the intricacy of the Rules, survey results indicated that flexibility was a more important consideration overall. This lends credibility to the Stream Rules approach of having a less complex initial option, with other management options that can be explored if time is available and conditions are appropriate. Inclusion of options for flexibility was particularly important for industry foresters who by virtue of expertise and employment focus are in the best position to take advantage of the options.

Existing options that provide flexibility, such as the site-specific plan in the Stream Rules, are used by relatively few harvesters. Many see the site-specific plan as an uncertain route, where approval depends on the judgment of an agency forester, and they don't take the extra time and effort to pursue it. These options also require significant mutual trust (between harvester and ODF forester, and between ODF and public). More flexible options may also raise questions about consistent enforcement of the Rules.

Allocating and limiting costs and degree of individual control of forest management decisions are important long-term issues to pursue, although these must be pursued in complex, broad policy arenas. What might these results suggest that forest policy makers consider more immediately? Productive paths that may now be within the control of forest policy makers are training of FPFs and harvester education or technical assistance.

The issue of trust and relationships needed for site-specific plans points out the importance of the role of the FPFs. Harvesters' perceptions of inflexibility of or inconsistency among FPFs could be addressed through ODF training programs, and could be one route to improve opinions. Training has been found to be an issue and a potentially significant source of improvement elsewhere. When the Forest Practices Act was being evaluated a few years after initial implementation for its ability to meet water quality laws, a need for improved technical training of ODF staff was a major conclusion (Brown et al. 1978). Looking at the California forest practices rules, Green and Gallez (1982) found that training of state forestry employees, particularly in logging systems, would be considered a great improvement by harvesters.

Clear differences in policy knowledge, training, and involvement in process between industry foresters and NIPFs were evident. There were also noticeable differences in perceptions of cost and flexibility of the rules, which may have been affected by these different levels of knowledge and involvement. Industry foresters and NIPF owners usually have very different situations and goals for their management, and we would not expect similar policy involvement in most cases. However, there is clearly significant room for additional education of NIPF owners about the options that exist in the Rules through expanding training or assistance. If the lack of awareness or knowledge that prevent NIPF owners from pursuing these options could be reduced, their impressions of cost or flexibility might also be altered.

NIPF owners in Oregon are inherently diverse, a quality revealed in almost every question on the survey. The situations of industry foresters and logging operators vary distinctly from many NIPFs, and among themselves. The constraints and opportunities of a small company can differ dramatically from those of a large company. A variety of approaches for education and technical assistance are likely to be needed, in different formats (e.g., written, video, tape, field demonstrations), timing (e.g., initial training and follow-ups) and sources (e.g., government, industry, associations, nonprofits). Increased opportunities for learning about options is likely to help out some people, but effectiveness can be constrained by individual circumstances and resources, including time, available for education or assistance. This may be reflected in the limited number of people rating education as highly or mostly effective. Despite such obstacles, programs for education and assistance, such as service and extension forestry, are already in place and targeted efforts could reduce harvesters' concerns and increase use of management options. Given existing constraints on funding economic incentives, education may be one of the few available avenues for attempting to influence harvester behavior.

SELF-INTEREST AND SOCIAL NORMS IN RESPONSES TO THE OREGON WATER PROTECTION RULES

Natural resources policy has traditionally relied on economic theories of motivation to influence forest landowners' behavior. The behavior of private landowners affects goals considered beneficial to the public such as clean water or productive new forests. Policies have ranged from laws and fines for water pollution to technical assistance for timber stand improvement and cost-share programs for replanting forests (Cubbage 1994). Despite the potential benefits of the assistance programs to forest owners, many programs have not found the expected scale of response. In a 1989 survey of Oregon nonindustrial private forest owners (NIPF), only 27 percent were aware of federal cost-share programs, and less than half of those aware had used the program (OSU Survey Research Center 1989). NIPF research has shown some increases in reforestation from cost-share, technical assistance, and tax incentive programs, but other studies have not found any conclusive relationship (Alig et al. 1990). Oregon Department of Fish and Wildlife offers a riparian tax incentive program for landowners with approved riparian management plans, but participation is low. Substantial room remains for improvement in affecting or predicting landowner response to natural resource policies. While economic theory can explain the use of financial incentives such as cost-sharing, it does not account for the many factors such as noneconomic motivations for owning land, availability of information, and social context that can affect program participation and land use behavior.

Integrated Behavior Model

This chapter uses a conceptual model developed by Dr. Steve Daniels at Oregon State University to investigate the relationship between policies and peoples' responses to the policies. Daniels' model, the Integrated Behavior Model, merges the traditional economic model relied upon by game theory research with behavioral elements from social psychology research (Daniels 1996). The traditional economic theory assumes that individuals will evaluate the costs and benefits of a situation and adopt the behavior that maximizes their present net value or utility (Alig et al. 1990). Economic models have been developed to evaluate the impact of forest management regulations, based on assessing costs and benefits of physical consequences of the regulations (Gregory et al. 1989). These approaches assume rational decision-making based on all the information available, an assumption that is not met perfectly in many situations.

Behavioral research has revealed the existence of ingrained biases and heuristics, shortcuts for processing information (Bazerman 1994). Factors such as saving face or strengthening relationships have been found to be important in decisions and behavior (Kramer and Messick 1995). Daniels' model incorporates elements of both economic and behavioral theory to create a more robust basis for exploration of reactions to policies (Figure 10). The model starts with a forum or situation, which includes rules of interaction such as laws or regulations, parties involved, institutions involved, and other elements of the structure of the situation. People react to the external motivations and incentives provided by the forum, can formulate a rational response, and also can bring in influences from known behavioral factors. Behavioral factors include cognitive heuristics, personality traits (e.g., aggressive, retiring, thorough, spontaneous), social context (e.g., culture, norms, important relationships), and self-esteem or identity protection.

The model was used to evaluate the responses of harvesters to the 1994 Water Protection Rules, a case study of a particular forum. A written survey was distributed to people filing harvest notifications in Fall 1994, just after the Water Protection Rules were implemented. Analysis focused on the interplay of self-interest, the underpinning of the rational economic model, and social norms, basic elements of behavioral research. Group relationships and concepts of distributive and procedural justice were explored as facets of behavioral research that are relevant to the situation of harvesting using the Water Protection Rules.

Daniels' model is structured to predict individual behavior in a certain forum. This case study of the Stream Rules Survey of harvesters measured attitudes and beliefs

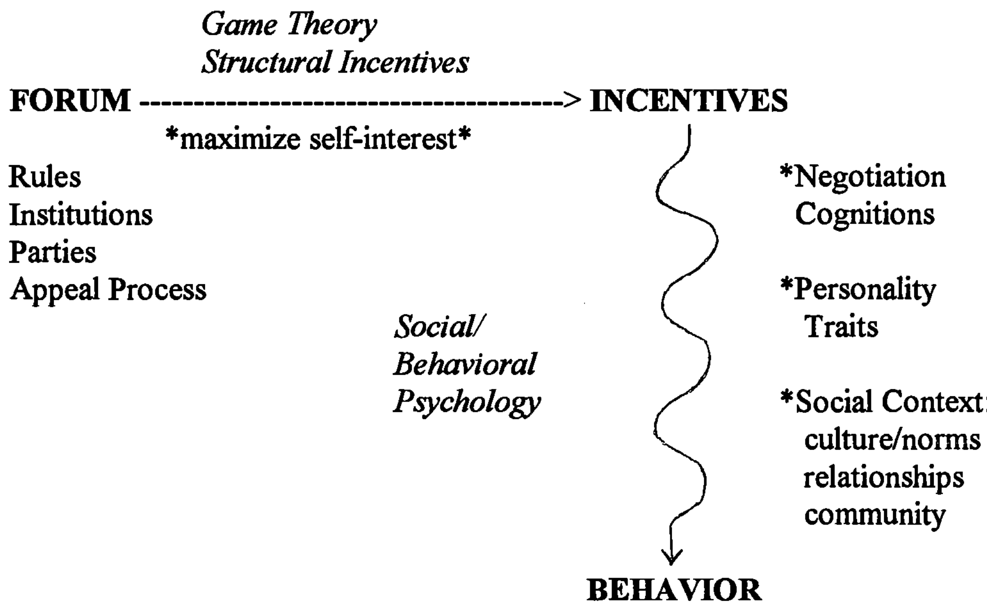


Figure 10: Dr. Steve Daniels' Integrated Behavior Model combining rational self-interest and behavioral psychology

about the Water Protection Rules, rather than behaviors of interest such as compliance or voluntary cooperation. Intuitively, beliefs, attitudes, intentions, and behaviors seem connected, and social science research has confirmed relationships among them (Ajzen and Fishbein 1980, Crano 1995). Attitudes clearly affect behavior, but they do not predict any particular behavior. Attitudes are thought to be more useful in predicting general patterns of behavior (Ajzen and Fishbein 1980).

Harvesters' attitudes after using the Rules can be expected, at best, to only approximate probable behavior. There are several areas where an assumed relationship can break down between survey responses and actual behaviors. Some researchers are skeptical of the reported links between attitude, intention, and behavior and propose that more complex models are needed (Bagozzi 1992). Reported beliefs and practices have been found to differ from facts; Nowak (1985) found that farmers reported that they had adopted conservation tillage when many had only adopted some of the equipment and did not practice techniques that provided the conservation benefits of interest in the survey. Reported beliefs and attitudes may be based on narrow personal experiences instead of thorough, thoughtful analysis of an entire situation (deHaven-Smith 1988). They may be developed as a spontaneous response to a question, instead of reporting a stable, previously formulated belief (Schkade and Payne 1994). An experiment which successfully altered beliefs and attitudes of individuals about tax compliance failed to see any behavioral (compliance) changes based on the altered beliefs (McGraw and Scholz 1991).

Despite pitfalls such as those outlined above, there are reasons to expect reasonable relationships between the surveyed attitudes and behaviors related to the Water Protection Rules. For forest landowners, rules affecting how and how much can be harvested are likely to be important. The harvesting experience of survey respondents was relatively recent, which is likely to reinforce its personal importance or salience. The experience should have important personal consequences in management of and profit from their or their organization's land, so the experience should be both quite salient and related to financial self-interest. Topics that are salient to respondents are more likely to elicit previously formed opinions and also more likely to have associated strong attitudes, which typically are much more stable than weak attitudes (Crano 1995). Strong attitudes also are more likely to be acted upon than weak attitudes (Crano 1995). Surveyed attitudes were related (r=0.75) to intentions to harvest for NIPF owners (Young and Reichenbach 1987). Because of the probable salience of the issue for the survey respondents, the survey measures of attitudes and preferences should provide some useful insight into behavioral issues.

Self-interest and Norms

Role of Self-interest

Research has found evidence supporting important roles for both self-interest and various social norms such as contributing to the public good (Kerr and Kaufman-Gilliland 1994). More research has been done in the agricultural community than in the forestry community, but both are rural resource-dependent communities and may relate to public policy in similar ways. Self-interest was found to be a controlling factor for farmers' opinions of agricultural policy in Kansas (Barkley and Flinchbaugh 1990). An evaluation of a voluntary program with minimal payments for habitat conservation in Canada concluded that sufficient payments were necessary to trigger participation, and the positive attitudes of farmers towards habitat conservation were insufficient motivation to overcome economic costs (van Kooten and Schmitz 1992). Another study on agricultural nonpoint source pollution control programs in Wisconsin also stressed the limits of a voluntary program to garner sufficient participation for meaningful improvement in water quality (Wolf 1995). Napier et al. (1984) found that farmers' adoption of conservation tillage in Ohio was related to economic factors such as farm size, and not related to social factors such as education or attitudes. Napier (1987) noted that farmers often seem unwilling to adopt socially and ecologically beneficial farming practices unless the economic paybacks are clear. A survey of farmers in Indiana found that farmers favored government support for conservation at the same time that they retained personal responsibility (and control) for the problem (Parent and Lovejoy 1982).

Numerous studies on the general public have also found a clear role for self-interest in reactions to public policies (O'Brien and Zoumbaris 1993, Boninger et al. 1995). As an example in land use policy, a nationwide survey on preferences of the general public for soil conservation policies found strongest support for regulation, the approach that individually cost them the least and seemed most likely to assure the public benefits of soil conservation (Jordan and Elnagheeb 1992). Bollens et al. (1988) found that property owners who bought houses in a floodplain were more likely to pursue political action to limit personal risk than to adopt individual on-site mitigation.

The strength of self-interest seen in survey responses has been related to the specificity of the question and degree of personal impact. Responses to survey questions on very broad tax policy preferences were not found to be related to self-interest at all, while questions that clarified expected costs or benefits to individuals had strongly self-interested responses (Fisher 1985). Barkley and Flinchbaugh (1990) observed the same trend, with farmers supporting broad concepts of free trade but opposing loss of trade limits or price supports for their particular crop. Nowak (1983) described a similar phenomenon, the proximity effect, where farmers were less likely to admit that their actions would harm public interests in response to questions with the greatest relevance to their own costs. A survey of Florida park users found links between environmentalist attitudes and preferences for broad programs, but much less association between environmental leanings and support for environmentally beneficial limits on their favored activity (Noe and Hammitt 1992). The greater the personal impact, the less likely that people would judge their actions as having negative effects.

Role of Norms

Some research has found greater effects from social and normative factors than from obvious self-interest on attitudes or policy preferences. Gillespie and Buttel (1989) found that farmer ideology was important in predicting opposition to government regulation in rural New York while economic factors were not. In group experiments, Ancok and Chertkoff (1983) concluded that people allocated rewards based more on individuals' abilities and membership in a favored group than on personal gain. Dawes et al. (1988) researched cooperation in social dilemmas and rejected not only an undue focus on self-interest but also any focus related to self; group identity was posited as an important behavioral influence. Kerr and Kaufman-Gilliland (1994) also observed greater cooperation in social dilemma situations after group discussion and promises to cooperate, but concluded that personal norms for keeping promises were more important than group identity or benefit. Despite their focus on the effect of psychological factors in decision-making, Kerr and Kaufman-Gilliland (1994) also acknowledged the important role of game-theory predictions of behavior based on self-interest.

Much more research has found that attitudes, preferences, and behaviors are affected by both self-interest and social factors. Holmes (1990) concluded that altruism played a small but important role in determining voter behavior on an environmental (human health) referendum, but also confirmed the importance of self-interest criteria. Surveys of voters on a gas-tax referendum found altruistic motivations common, along with strong connections to self-interest (Brodsky and Thompson 1993). NIPF harvest intentions were affected by attitudes of family and peers as well as economic benefits of harvesting (Young and Reichenbach 1987). Judgments about procedural justice were found to be explained best by considering both self-interest and identity (e.g., self-esteem) effects (Conlon 1993). Investigators of procedural justice issues have found evidence for self-interested outcome motivations as well as normative ego- or group-based motivations (Lind and Tyler 1988, Tyler 1994, Lawrence et al. in press). DiMento (1989) endorsed a multivariate approach to predicting compliance with environmental regulations, because various parties and organizations can have a range of situations and motivations for compliance.

The continued debate and lack of conclusiveness about which items are the controlling influence for decisions probably carry their own message, that both are likely to be important. The question then becomes, “In which situations would you expect the various motivations to have stronger influences?”.

Stream Rule Survey Results Related to Self-interest and Social Norms

Several questions on the survey of harvesters offered respondents a chance to express self-interest or altruistic norms. Respondents were asked, “From the list in Question 12 above, what would you say were the two factors that most affected your level of support for the Stream Rules?” (Question 13, Appendix C). Question 12 listed eleven statements describing factors likely to influence harvest experience and rule opinion, and asked whether respondents agreed or disagreed with the statements. Statements included references to complexity, flexibility, need for interpretation (vagueness), good science, timber value, lengthy buffer layout times, written plans, stewardship, compensation/ incentives, ODF staff assistance, and uncertainty (Question 12, Appendix C). From among this litany of factors, the most frequently chosen items were flexibility (14%), good science (13%), lack of compensation or incentives (13%), and whether the Rules help take care of land (stewardship) (12%). The word “stewardship” was not used in the question to avoid the tendency of people to choose socially desirable items, but the wording of taking care of the land was intended to tap those impulses without introducing a loaded word.

The results indicate a mix of self-interest and norms. The desire for flexibility may relate to self-interest because it implies that harvesters can carry out their preferred actions, but also may tap psychological motivations because it grants a greater sense of control over management. Good science was a norm expressed most strongly by the industry foresters. Industry foresters, who typically have at least 4-year forestry degrees, may feel better equipped to judge what “good science” is than many logging operators or NIPF owners. Also, foresters may regard science as a standard for evaluating forest policy more highly because of values instilled during training. Responses of logging operators were highest for financial self-interest issues, the issues of compensation and timber value left uncut.

Stewardship, or taking care of the land, was chosen more often by NIPF owners, who typically own land for a diversity of reasons including pride of ownership and aesthetics (Bennett 1993). Desire for rules that promote stewardship may be tapping altruistic feelings supporting environmental benefits. However, it also may represent a belief that the landowner can best take care of the land, and rules that take better care of the land would be fewer rules and would give more control to landowners. Either way, the connection of stewardship to financial self-interest is indirect and connection to behavioral psychology is more direct (e.g., either norms supporting public goods or identity-related control issues).

The obvious attention paid to financial self-interest by all groups justifies the central placement of economic rationality in Daniels' model. However, the variety of other important factors affecting support for the Rules that were related to social psychology argues for the importance of including that element in modifying attitudes and behaviors.

Another question (Question 25, Appendix C) solicited views on compensation, an ideal medium for strong expression of financial self-interest. Respondents did not disappoint, overwhelming (93%) choosing some comprehensive compensation scheme or tax incentives/credits. Few chose options in which compensation would be targeted to a few severely affected owners, or would be available for those exceeding the standards of the Rules (2 and 3 %, respectively). Few (1%) considered the landowners' responsibility to protect the land sufficient justification to forego assistance from the public sector, despite the importance of stewardship noted above.

Responses to another question on allocation of responsibility for public resources provide some perspective on the self-interested responses of Question 25. Question 24 asked, "Public resources such as fisheries, water supplies, and wildlife often are on private land. On a scale from 1 to 10, where 1 gives all responsibility to the landowner for protecting and not harming public resources and 10 gives all responsibility to the public, where do you think the responsibility for public resources should be?". The most common choice was 5, and 57 percent of the respondents chose answers from 5 to 8. Only 15 percent chose 10, that the public was entirely responsible for paying to protect public resources or goods on private property. This is in contrast to the 47 percent on the next question who considered that compensation should be paid if income or property value is reduced at all by complying with the Rules. This demonstrates the effect described above, where people respond with greater self-interest to the more specific question. Comments from the written survey offer additional perspective on the seemingly incongruous responses. "Landowner is responsible for "on-the-ground" management, however public is responsible for any compensation due!" "Landowners as a whole rely on the land and tend to take care of it." Landowners may consider the contribution that they make through their own management efforts to be their share, so additional costs or limits for protection seen as unneeded should from this perspective be paid by the public.

Question 24 was more complex and abstract than most of the questions on the survey and may not have been well understood. Results should be viewed cautiously, but the pattern of response showing willingness to accept a nontrivial share of the burden for public resources seems reliable. Results to this set of questions are consistent with results on agricultural policy from Napier (1987) and Parent and Lovejoy (1982), where positive attitudes towards soil conservation and personal responsibility were combined with an unwillingness to bear additional costs for practices most beneficial to the public.

Respondents were asked about effectiveness of a range of policies for regulating private land (Figure 9). The highest ratings for effectiveness went to the financial instruments: tax credits, compensation, and capital gains taxes, as would be expected with a strong expression of financial self-interest. Considering the range of questions, the role of rational self-interest as used by economists (maximizing either present net value or personal utility) seems to be clearly influential in affecting stated preferences, attitudes and beliefs. Self-interested responses to a specific, salient situation can be expected based on these results. However, the second leg of Daniels' model, the social psychology factors, also offers important understanding for responses, most obviously on Question 13 which included the broadest range of factors. Norms for stewardship and identity concerns about having control of the management of property were clearly expressed in question responses and written comments. The different motivations seem likely to apply in different proportions based on the individuals and their situations.

Effects of Judgments of Justice

Distributive and Procedural Justice

Public policy is typically expected to meet certain standards of fairness and justice. Justice issues can be thought of in terms of fairness of the outcome, distributive justice, and in fairness of the process, procedural justice (Thibaut and Walker 1975, Tyler 1994). The theories behind why people value these justice issues also reflect the interplay of self-interest and normative elements. Distributive justice, with its focus on outcomes and allocations of resources, is clearly related to self-interest. Procedural justice can express self-interest based on the belief that a fair process leads to a fair outcome (instrumental motives), or it can express values such as affirmation of self-worth or status, identity-based relational concerns (noninstrumental motives) (Lind et al. 1990). Tyler (1994) concluded that judgments about both distributive and procedural justice were used to evaluate the fairness of legal and managerial decisions.

Research has shown the importance of justice and equality considerations in decision-making, with some finding strong roles only for distributive justice (Aquino et al. 1992) and others showing the value of procedural justice (Lind and Tyler 1988). The quality of procedural justice has been found to be of greater importance when participation in the situation is involuntary (Gordon and Fryxwell 1989), as is the case with regulations.

Justice Judgments in Survey Results

A couple of the questions concerned the effect of process and fairness on harvesters' support for the Water Protection Rules. Responses to these questions offer some insight into importance of these issues in attitudes about forest harvesting regulations, although questions were not designed to directly address the theoretical concerns. One question addressed an issue basically related to distributive justice, whether forestry regulations for streamside areas imposed greater burdens to landowners than did regulations for other land uses. Respondents were first stratified by those that thought forestry regulations were stricter than other land use regulations for streamside areas (Question 21, Appendix C). Industry foresters commonly thought forestry rules were stricter (91%), as did a large majority of logging operators (72%). A lower proportion of NIPF owners (49%) thought that forest rules for streamside harvesting were stricter, with 33 percent unsure about this comparison.

Those who considered forestry rules stricter were asked to answer the question, "If rules for nonforest uses required similar protection of streamside areas, how would it affect your support for the Stream Rules?". Imposing similar burdens on all land use to protect water quality and aquatic habitat would in theory improve the distributive justice of the situation. The question does not ask directly about how important distributive justice is to respondents, but relies on an assumption that a perception of greater fairness plus importance placed on the issue would translate into making the forestry rules easier to support.

Responses were mostly split, with the largest number saying that it would not affect support, and almost as many saying that it would be easier to support the forest rules (Figure 5). Few industry foresters thought that stricter rules for other land uses would make forestry rules "not easier to support", while over 20 percent of logging operators and NIPF owners thought so. NIPF owners especially are likely to have more than one land use on their property, combining tree-growing with cattle ranching and residential use. For these owners, the condition in the question would represent an increase in rules overall, and the question of distributive justice would not have been relevant to them. Respondents to the other categories, "easier" and not affect", probably perceive the justice issue, but differ in the importance they place on the issue. Results suggest that a fairly imposed regulatory burden is important to many, but not a majority, at least to the extent that it would alter attitudes.

Other questions asked about perceptions and influence of the process used for developing the Water Protection Rules, and can be used to make inferences about importance of procedural justice. Questions focused on one element of the process, use of a diverse advisory committee in developing the draft Rules that included environmental groups in addition to traditional members such as state forestry staff, forest industry and forest owners. Respondents were asked, "Did including diverse representatives when developing the rules increase, not affect, or decrease your support for the new rules?" (Question 11, Appendix C). This question assumes that procedural justice would be enhanced by considering and deeming valid a wider range of views and issues during rule development. It asks about inclusiveness rather than fairness, but these norms or values seem interrelated in this situation. The question again relates to justice effects through two steps, perception of improved procedural justice and having that perception be important in affecting support for Rules.

A close majority said that the diverse committee used in the new process would not affect their judgment of support (Figure 7). A higher proportion of industry foresters than other groups said that it had increased support for the Rules, while a higher proportion of NIPF owners than other groups said that it had decreased support (Figure 7). These responses seem related to attributes revealed in the previous question, which asked how much they knew about the process used to create the rules (Question 10, Appendix C). Industry foresters were dramatically more aware of the rule development process than both logging operators and NIPF owners, with almost a third of NIPF owners relating that they had not known about the process (Figure 6). The group that seemed most included in the rule development process, industry foresters, were more likely to say that the process had increased support, presumably because it was fairer and more inclusive.

Effects of Group Differences

The variations seen among responses for the three groups delineated for the survey, industry foresters, logging operators and NIPF owners, calls for consideration of how and why these differences might be seen. An understanding of different types of rule users can be potentially useful for evaluating different responses to policies for the range of individuals and situations encountered.

Research on Group Allegiance

Group membership and interactions have been found to play an important role in attitudes, cognition, and behavior. In a study contrasting enforcement by state and federal surface mining regulators, Hedge et al. (1988) found that culture of the agency consistently affected behavior. People perceive and process information about and from groups differently depending on whether they believe that they belong to the group (Ostrom et al. 1993). Information from one's own group (in-group) is generally viewed as more persuasive than information from other groups (out-groups) (McGarty et al. 1994). For policy and decision-making this effect alone could be important, as information sources believed credible are thought to greatly influence individuals' policy preferences (Soden et al. 1992).

The importance of group affiliation has been related to the procedural justice concerns discussed above. The group value theory of Lind and Tyler (1988) suggests that procedural justice is viewed as important because of the information it imparts about status within a group or system. That is, one is a valued group member if one's views are sought for important decisions and treated fairly and with respect. Tyler and Lind (1990) found that those of intermediate status in a group, those not clearly leaders or on the fringe, care most about justice, suggesting that gaining information about group status is a relevant mechanism.

The focus of people's attention relative to group membership could affect perceptions and judgments about impacts of regulations. Smith et al. (1994) found that within a group subjected to a deprivation (of a cash reward), those who ended up with more than members of their group felt less deprived, even though everyone in that group had received less than members of another group. The results show a tendency to focus within a relevant group for making judgments about burdens or deprivations. Smith et al. (1994) also noted the power of reward in shaping individual perceptions, suggesting that a participant's focus was mostly individualistic rather than considerate of group well-being.

What would this narrow focus of evaluation suggest for how the effects of regulations are assessed? Regulatory effects might be judged relative to others in one's own group (peers), with little attention to relative advantage or disadvantage of the entire regulated community. If this phenomenon were applied to the Water Protection Rules, it could mean that industry foresters would be satisfied with the operation of regulations if their particular company's goals could be met, with less concern about other companies or greater difficulties for NIPF owners or logging operators. Outside of simple experimental manipulations, the effect may not be commonly manifested. For example, in the forestry situation, many companies rely on wood supply from NIPF land as well as their own and employ the services of loggers, so the real situation has interdependence among groups that generates, at a minimum, ties of self-interest within the forestry community.

People's perceptions of the strength of their group can affect which policy or decision-making options they prefer, and how they would interact with a decision-making process. In a study of development issues in a rural Vermont community, people with minority viewpoints were found to commonly overestimate the percent of agreement with their opinion, sometimes to the extent of believing themselves a majority (Miller 1993). Likewise, people with majority viewpoints were likely to underestimate agreement with their position. For disputes, this meant that those perceiving a large consensus, even if a false one, were more likely to support majority rule and not support compromise positions (Miller 1993).

The level of communication within a group can influence members' assessments of a situation. Individuals who discuss issues within one of their groups are likely to have had a chance to form opinions and crystallize intended behaviors and reasoning. Communication within a group about action in a social dilemma (individually best decisions lead to a collectively worse outcome) was found to increase cooperating behavior, regardless of whether or not the behavior could be observed by fellow group members (Kerr and Kaufman-Gilliland 1994). Many land use situations are structured similarly to a social dilemma, implying that more active communication regarding the dilemma could result in more publicly beneficial behavior.

Kerr and Kaufman-Gilliland (1994) attributed the increased cooperative behavior after group discussion to norms of personal integrity (people not wanting to break promises made about voluntary cooperation), because the effect was seen whether or not there was any opportunity for checking compliance. Dawes et al. (1988) similarly found increased cooperation after group communication, but observed it only when benefits of cooperative behavior accrued to that group (not to another group), causing them to conclude that the effect was related to concern for group well-being rather than personal norms of integrity. Research outside of social dilemma scenarios has found that people's compliance with requests depended more on public image (e.g., opinion of a companion) than on self-image (e.g., self-perception of generosity) (Rind and Benjamin 1994). The variation in motives consistent with results for similar trends in behavior suggests that causes of cooperation or compliance are complex.

Research on Groups Related to Forest Management

Different attributes for the groups delineated for the harvesting rule users survey were evident in the question responses, such as industry foresters being more aware of the Rule development process than NIPF owners. Existing research, such as that on NIPF owners, can offer information about common characteristics of the group relevant to the discussion here.

The behavior of industry or other professional foresters in adopting new management techniques was found to be related to employer, sources of information used, professional membership and perceived management requirements for the region (Hodges and Cubbage 1990). The size of company landholdings and policy structure were related to adoption of integrated forest management, and land tenure patterns were related to perceptions of costs and benefits of the management approach (Kreutzwiser and Wright 1990). Forest industry shares a clear interest in and need for profit from their operations. Still, company philosophies and culture can vary greatly, which may be reflected in employees' attitudes and behavior, as was found for state versus federal surface mining regulators (Hedge et al. 1988).

NIPF owners are characteristically diverse, much like the general public (Bliss et al. 1994). Ownership goals are typically more complex than those of forest industry, combining multiple interests in recreation, green space, aesthetics, income, estates to pass on, and outlets for stewardship and pride of ownership (Bennett 1993). Cleaves and Bennett (1995) found several major variables that contributed to diversity in NIPF harvesting behavior: ownership size, tenure, residence on property, form of organization, method of acquisition, occupation, age, and income. Differences in goals among NIPF owners can translate into different responses to public policies. Max (1983) modeled economic benefits for landowners under various tax alternatives and found that the same tax would motivate different harvesting behavior depending on the owner's level of interest in recreation versus timber.

Logging operators may be affiliated with a company or work more independently with multiple companies or NIPF owners. Some companies mark the harvests, RMA boundaries, and trees to cut or leave, essentially leaving little discretion to the logger for harvest decisions. In other situations, the logger may make most of the specific harvest decisions. Thus, the level of involvement with the Water Protection Rules is likely to vary greatly. A study of California foresters and logging operators found that operators seemed to have been affected by state rules more than the foresters, in terms of degree of change in practices and cost estimates of the changes (Green and Gallez 1982). California operators thought that the state rules were more responsible for improvement in resource protection compared to ratings by foresters. Green and Gallez (1982) concluded that operators were more concerned about the protection of non-timber resources, while foresters were more concerned about future timber production.

Group Effects in Responses to the Stream Rules Survey

In general, responses on the survey from industry foresters were more consistent or clearly grouped to a favored category than for the other two groups, especially NIPF owners (e.g., Figures 2,4,5,8). Many of the industry foresters share a similar educational background; over 80 percent reported that they had an undergraduate or graduate degree, probably forestry (Question 33, Appendix C). Educational background was more variable for logging operators, with 49 percent having a high school education and others having technical, undergraduate or graduate degrees. NIPF owner education was most variable, with less than 25 percent in any category and ranging from grade school to graduate degrees. Job situations were not queried in the survey, but industry foresters are most likely to have salaried jobs working full-time in forest management or harvesting. Logging operators may work consistently with a particular company or from contract to contract with a range of landowners, and usually are involved full-time with forest harvesting, at least seasonally. NIPF owners most often have occupations other than forest management, coming from a diversity of professions and backgrounds as noted above.

These broad generalizations do not convey the ranges of experiences in each group, but are sufficient to illustrate common situational differences for the groups. Given the general similarity in education and job responsibilities for industry foresters, the observed relative consistency in responses is not surprising. The other groups, logging operators and NIPF owners, have more diversity in situations, and more variability would be expected. Of interest is how and to what extent group characteristics affect attitudes and behavior in response to policy.

Some responses to questions appear to reveal differences that could be relevant to policy. Daniels' model allows a strong role for economic self-interest, and much of the research discussed above suggests that economic motives are important. Estimates for percentage increase in cost of harvest from complying with the Water Protection Rules were higher for most logging operators and NIPFowners (those who could estimate them) than for industry foresters (Figure 8). The perception of higher relative costs suggests that loggers or NIPF owners may have more incentive to avoid the Rules. This research cannot confirm the accuracy of the self-reported costs. They may be based on different land ownership patterns or contract structures and reflect real costs, or they may be potentially biased guesses made without much tree inventory or cost information. Regardless of the accuracy of cost estimates, the perceptions or beliefs about costliness of the Rules will be the information on which the landowner or operator acts.

Perceptions about effectiveness of the Rules for protecting resources differed noticeably between industry foresters and NIPF owners, with a greater proportion of NIPF owners considering the Rules less effective (Figure 4). The combination of perceptions of lower effectiveness and relatively higher cost among some NIPFs seems designed to encourage noncompliance or avoidance of streamside harvesting. Experiences in the efforts to find harvested stands to visit corroborates this pattern; several NIPF owners contacted said that they had harvested before the Rules took effect and a logging operator/landowner said he generally tried to avoid streamside areas because harvesting was too much trouble (too many people to coordinate with for approvals). Many other NIPF owners with similar perceptions may not have been surveyed because they had harvested before the Rules or had avoided harvesting, at least near the stream. Logging operators would seem to have less opportunity to avoid harvesting near streams because they would be more frequently involved with harvests than NIPF owners. However, at the time of the survey, shortly after the Rules were implemented, relatively few harvests under the 1994 Rules had been completed, so many operators very well could have not used the Rules or avoided areas affected by the Rules.

Some group-related differences are less easily explained by economic self-interest and more easily explained by social psychology. Why do industry foresters choose good science as an important factor influencing support more frequently than logging operators or NIPF owners? Social psychology would suggest that common training had helped develop that norm more strongly for the group. Why would a greater proportion of one group view diverse representatives during Rule develop more positively or negatively than another when representatives from each of their groups was included in the process? Combining the level of participation and involvement with in-group/out-group theory offers some insight. Economic motives are unclear; the inclusion of environmental groups, suggesting stricter regulations, should be viewed negatively by all harvesters from an economic perspective. Attitudes of industry foresters may be influenced by company culture valuing diversity and good public relations, while NIPF owners may be looking at self-interested economic motives or reflecting aspects of rural culture which distrust typically urban-based environmental groups.

Relationship of Rational Self-interest and Behavioral Traits

Daniels' model combining the traditional economic rationality of policy analysis with behavioral elements from social psychology is useful because it spurs consideration of a broader evaluation in policy design. The research reviewed here supports that approach. Some studies have concluded that the economic model is not sufficient by itself to accurately predict policy response, but most work has seen an important and often strong influence for self-interest compared to social norms (Young and Reichenbach 1987, Barkley and Flinchbaugh 1990, Holmes 1990, Conlon 1993). The combination of motives based on self-interest and social norms seems like a more robust approach than relying on either one alone.

The mixed-motive approach can explain the variety of responses on the Stream Rules Survey. The strong desire apparent for compensation and tax incentives easily relates to self-interest, while the desires for flexibility and control over management options are probably related more strongly to identity or self-esteem motives. Control is an issue frequently seen in social psychology research (e.g., Gordon and Fryxell 1989, Lind et al. 1990).

Based on the results and analysis presented above, policy for streamside harvesting should consider both types of motives, and not rely entirely on either. This approach has already been used to some extent, reflecting intuitive understanding of the range of human motivations. Programs exist to reward good stewardship by private owners and exemplary logging jobs by operators. The Forest Practice Rules contain fines as economic disincentives for violating rules, and state and federal programs offer economic assistance for tree planting and increasing productivity of forest land. What could be done more explicitly is understanding under which circumstances the different motives may be operating most strongly.

The Stream Rule Survey questions were not crafted to distinguish behavioral motivations specifically, rather to judge influence of various factors on attitudes towards the Rules. Other research has been directed at motivation more directly, and can offer some insight on relative strength of motives in different circumstances.

Strongly operating motives are likely to depend on level and type of **group identification**. Tyler (1989) found that those with most invested in the group with the authorities (decision-makers) paid the most attention to process issues. Industry foresters had more awareness of and have usually had more involvement in the rule-making process, and more in that group seemed to place importance on the process as well as the outcome. Motives related to group welfare or group norms are only likely to operate where groups are developed and communicate frequently. Forest industry has more frequent interaction than the other groups through professional meetings, trade shows, and a strong state association. Logging operators and NIPF owners also have active state associations, but not as many other avenues that would be likely to develop group relationships related to forest management issues. The Associated Oregon Loggers (AOL) has developed a logger certification program, the Professional Logger Program, that may motivate loggers to more actively participate in AOL events and relevant training sessions. New programs such as this may increase the level of interaction among loggers, creating a possible avenue for forming or strengthening group norms. The level of participation in Oregon Small Woodland Association constitutes less than 15 percent of the NIPF owners. Proportionally low membership alone suggests that its activities, even if well-designed and effective in influencing policy, would have limited effectiveness in developing group-based motives for the broad spectrum of NIPF owners.

Relevant motives are also likely to depend on **expected length of interaction** or relationship. Group-value or identity concerns such as standing, trust, and group harmony operate most in a situation that is expected to have long-term interactions or relationships (Tyler 1989). If a policy approach relies on these type of motivations, attention should be paid to stability of the relationships and the personnel involved. To ODF with the Water Protection Rules, this could mean greater efforts to promote tenure of Forest Practice Foresters or creating a mechanism for transferring information about relationship histories.

Relative strength of motives depends on the **specificity and magnitude** of the action and its impact. Public goods or social norms seem to be supported in a general way if the costs are not specified or affect everyone similarly, but reactions to situations with large and obvious costs are more strongly self-interested (Barkley and Flinchbaugh 1990). A related phenomenon that is challenging for policy design is the tendency of people to not perceive negative impacts of their own actions, even though they may be harming resources they value (Noe and Hammitt 1992). Informing people about large public benefits from refraining from an activity may increase awareness of the problem without greatly changing behavior because an individual's action seems unlikely to have any effect. Messages that could show improvements based on cumulative action and the magnitude of use of the resources might help counter this tendency.

Importance of motives can depend on the **setting**. Tyler (1994) found that trustworthiness was more important in legal disputes, while neutrality and standing were more important in management decision processes. The Water Protection Rules are likely to be more like the legal setting, where decisions are made by the state agency or Board of Forestry, than the managerial setting with employee/supervisor relationships.

Appropriate policy can vary depending on the **complexity** of a task. Studying barriers to adoption of conservation techniques in farming, Nowak (1987) found that information and education were the most important assistance to offer if a new method was complex, while strategies to reduce economic risk were more important if it involved high financial risk. Those who perceive the Water Protection Rules as complex might be assisted by better information, while those who are most concerned with the cost might be aided by assistance with marketing or existing cost-share or tax programs.

As regulation has increased over the last couple of decades, many calls have gone out to broaden the use of policy approaches outside regulation, particularly economic approaches. The Oregon Department of Forestry convened a Forest Incentives Group to develop options for incentives to encourage forest stewardship, the results of which are summarized in a recent report (Schroeder 1996). That committee developed options related to educational assistance, financial assistance, recognition, technical assistance, and using cooperative approaches to streamline programs, a mix that reflects a variety of expected motivations for stewardship.

Educational assistance may tap either economic motives, helping owners to manage more profitably, or altruistic motives, helping owners to achieve valued non-market goals. Research on "diffusion of innovations" theory (e.g., Muth and Hendee 1980) might help target efficient ways to pursue education or technical assistance. People identified as early adopters and opinion leaders in the community would be approached initially, and their experiences with the new information or methods could be used to inform other potentially interested owners. This approach relies on information about relationships within the community, which suggests that attention to group values and norms is important.

Financial assistance in the past has focused on cost-share and tax policy. The Forest Incentives Group Report (Schroeder 1996) included less-used concepts including forest trust accounts (like an Individual Retirement Account that shelters harvest income from taxation and can be used for long-term forest management), land exchanges, and voluntary conservation easements. Based on rational self-interest alone, all of these programs would be useful for a number of situations and in people's financial self-interest. However, other programs like the Oregon Forest Trust that set up a revolving loan fund for NIPF owners to reduce financial risk in improving productivity of underproductive forest land have not been widely used. A riparian tax incentive program for landowners with approved riparian management plans also has not been widely used, a result attributed both to limited funding and distrust of the implementing agency, Oregon Department of Fisheries and Wildlife. Factors such as diverse ownership goals, effective implementation paths, and limited time for learning about or managing forests for NIPF owners should be addressed in carrying out programs for unfamiliar incentives. As another caution, Freedman et al. (1992) described the "reverse-incentive effect", where people inferred that an activity was more or less distasteful or dangerous based only on the size of the reward offered to undertake the activity. While large financial awards from public funds for forest management are quite unlikely, such research suggests that relying largely on financial assistance to motivate landowners may not be the best long-term approach to encouraging public-minded management.

Cooperative approaches, combining programs or coordinating different sets of regulations, have been suggested to reduce owners' tasks in learning about, understanding, and using the programs or rules (Cubbage 1994, Schroeder 1996). These approaches would require careful attention to relational issues, such as organizational culture and face, as well as legal issues with different mandated responsibilities and authority. Cooperative and educational approaches to encourage voluntary compliance can be useful where enforcement cannot be extensive (Curtis et al. 1991).

Predicting and influencing people's behaviors through public policies such as the Water Protection Rules and associated programs can be enhanced by broadening the range of motives and considerations as suggested by Daniels' model. However, Daniels' model provides few specifics about or examples of how the combination would play out in any particular policy scenario, leaving the identification of important motives to the individual situation or analyst. It increases the complexity of factors to consider by orders of magnitude, much as the trend for ecosystem management has done for forest management. Regardless of the complexity, a broader approach seems likely to improve ability to design and carry out effective policies.

POST-HARVEST RIPARIAN STAND ASSESSMENTS

Post-Harvest Riparian Stand Characteristics

Results presented here are from 21 stands within Riparian Management Areas (RMAs) required by the Oregon Forest Practices Act. The stands were along streams that had an overall average gradient of 7 percent, with site averages ranging from 1 to 25 percent. Overall, average stream width was 12 feet, with site averages from 4 to 30 feet. Sites were on harvests that had used the 1994 Water Protection Rules from around Oregon, including Coast and Cascade Ranges and Central and Northeast Oregon. Sites were grouped into three regions, Northwest (NW), Southwest (SW), and Eastern (E), like the regions used for the Oregon Forest Practices Rules.

On average, 82 percent of the pre-harvest RMA trees remained after harvesting, with a range from 53 to 100 percent of the 21 sites visited. Conifers are of particular interest in riparian areas as sources of larger, longer-lived woody debris for streams. Retention of conifers was somewhat lower than for all trees; 75 percent of the pre-harvest conifers remained on the visited sites, ranging from 12 to 100 percent for individual sites.

Nonparametric Kruskal-Wallis tests were used to test for significance because many variables did not seem to meet assumptions of normal distribution and constant variance. Regional differences in trees retained after harvest were not statistically significant with this sample size (Table 5). The Eastern Oregon sites had few riparian hardwoods and tended to have both lower numbers of trees and total basal area (BA), although conifer BA was similar among the regions (Table 5). Pre-harvest stocking did not differ significantly among the regions for the sites visited, although sites in Eastern Oregon had fewer trees, lower basal area and very few hardwoods compared to sites in Western Oregon regions (Table 5).

After harvest, riparian stands on the visited sites averaged 104 stems/1000 feet of Riparian Management Area (RMA), using a minimum DBH of 8 inches (Table 5). Although Eastern Oregon sites had lower tree densities and few hardwoods, differences

Table 5: Average pre- and post-harvest riparian stand stocking and trees removed by region for sites harvested using the 1994 Oregon water protection rules

	Average All Sites	Eastern Oregon	North west Oregon	South west Oregon	Kruskal Wallis Test (p)
Pre-harvest Stocking	n=21	n=5	n=7	n=9	
Total trees/1000 ft RMA	127	108	135	131	NS
Conifers/1000 ft RMA	66	102	49	58	NS
Hardwood/1000 ft RMA	71	6	86	72	NS
Total BA (sq. ft./acre)	131	85	171	124	NS
Conifer BA (sq. ft./acre)	79	81	85	74	NS
Hardwood (sq. ft./acre)	51	4	86	50	NS
Post-harvest Stocking					
Total trees/1000 ft RMA	104	78	113	111	NS
Conifers/1000 ft RMA	48	73	34	45	NS
Hardwood/1000 ft RMA	56	6	79	67	NS
Total BA (sq. ft./acre)	100	58	134	98	0.01
Conifer BA (sq. ft./acre)	54	54	57	52	NS
Hardwood (sq. ft./acre)	57	(1 site)	77	46	na
Trees Harvested					
Total trees/1000 ft RMA	23	30	22	19	NS
Conifers/1000 ft RMA	18	29	15	14	NS
Hardwood/1000 ft RMA	5	<1	7	6	NS
Total BA (sq. ft./acre)	30	27	37	27	NS
Conifer BA (sq. ft./acre)	25	27	28	22	NS
Hardwood (sq. ft./acre)	5	<1	9	5	NS

Notes: NS- Not Significant at p<0.05; na- not applicable (only 1 site);
BA-basal area/horizontal acre; 1-foot high stump assumed for BA of harvested trees

among sites in the regions were not significant. However, looking at basal area per acre, which takes into account tree diameter and RMA width, differences among post-harvest basal area (ft^2/ac) for sites in the regions were significant ($p=0.01$). Post-harvest conifer basal areas were similar among sites in the different regions, so differences are apparently related to the variation in hardwood stocking. Only one site in the Eastern Oregon region had post-harvest hardwood stocking, precluding statistical tests for regional differences. The sites in Eastern Oregon had more trees removed, mostly conifers, but similar or lower basal area (smaller trees) compared to Western Oregon sites. However, these differences in removed density and BA among regions were not significant ($p<0.05$) (Table 5). Stump basal area was estimated from taper equations from British Columbia, and may be underestimating BA for Oregon trees. Comparing relative differences of removed BA among regions should be valid, even if there is underestimation in the absolute magnitude.

The BA/acre of post-harvest conifers was positively related to stream gradient ($r=0.62$, $p<0.01$), similar to the relationship found by Minore and Weatherly (1994). Conifer density also differed significantly ($p<0.05$) among sites along different stream sizes, averaging 82 trees/1000 feet of RMA on large streams (n=2), 64 trees/1000 feet on medium streams (n=8), and 30 trees/1000 feet on small streams (n=11). Differences were not significant for total tree numbers/1000 feet of RMA or hardwoods/1000 feet.

Number of trees/1000 ft of RMA represents areas of different size because the various streams have different widths for RMAs. To look at density on an area basis, measurements were examined as basal area per acre of RMA. Average total basal area/acre increased from large (86 ft^2/ac) and medium (99 ft^2/ac) to small streams (104 ft^2/ac), but these differences were not statistically significant at $p<0.05$. Average conifer BA/ac was similar and not significantly different for sites by large (58 ft^2/ac), medium (59 ft^2/ac), and small (50 ft^2/ac) streams. Thus, although larger streams tend to have lower gradients and larger floodplains that can favor hardwood development, the wider RMAs and greater conifer BA requirements as stream size increases apparently result in more conifer retention overall on the sites visited. If streams larger than 30 feet wide were included in the sample, a different result might have been found. Larger streams tend to have more well-developed terraces, a location favored in Oregon by hardwoods such as red alder (e.g., Andrus et al. 1988). Fewer conifer might be found within 100 feet of these larger streams instead of more, as seen on the "large" streams in this study.

Potential and Existing Large Woody Debris

On average, 51 percent of the trees retained after harvest would have the capability to fall directly into the stream with a minimum 8-inch diameter and 5-foot length in the channel (Table 6). The remainder of the trees were too small for now or too far away to fall directly towards the stream and be potential contributors for instream LWD. For the sites visited, estimates of potentially available LWD ranged from 3 to 88 percent of the trees retained in the RMA. The lowest proportions of potential contributors were at Eastern Oregon sites, where trees tended to be farther away from the stream than at Western Oregon sites.

Different minimum sizes for LWD may be of interest because stability and function of LWD depends on length relative to stream width and mass relative to the stream's ability to transport debris (Bilby and Ward 1989). ODF guidelines for placement of LWD recommend using pieces with lengths at least twice the stream width. Although smaller pieces of debris are likely to be capable of altering stream morphology and to remain stable in small streams, they probably would be transported in large streams. For larger streams, large pieces would be needed to affect stream morphology or serve as a base for debris accumulations in ways that could provide stable aquatic habitat.

The number of trees potentially able to contribute is affected by the minimum size of LWD pieces considered to be of interest. The potential availability of trees with a 6-inch minimum diameter was 67 trees/1000 ft RMA (65% of total density), which dropped to 52 trees/1000 ft RMA (51%) for an 8-inch diameter and 38 trees/1000 ft RMA (37%) for a 10-inch diameter (Table 6). If the 10-inch piece was the minimum size considered sufficient to meet aquatic habitat needs, the capacity of most of the

Table 6: Potential future large woody debris from riparian stands after harvest using the 1994 Oregon Water Protection Rules, by region, stream size, and minimum diameter of debris

	Average potential LWD/ 1000 ft RMA	Percent of total trees/ 1000 ft RMA	Range of Site Averages (#/1000 ft RMA)
Average, all sites (n=21) 8" minimum diameter	52	51%	3-158
By Region (8" min. D)			
Eastern Oregon (n=5)	33	36%	3-82
Northwest Oregon (n=7)	57	53%	39-75
Southwest Oregon (n=9)	60	60%	25-158
By Stream Size (8" min. D)			
Large (n=2)	80	39%	3-158
Medium (n=8)	57	49%	10-82
Small (n=11)	44	56%	3-75
Using Different Minimum Diameters (5' min. length)			
6-inch min. diameter	67	65%	3-178
8-inch min. diameter	52	51%	3-158
10-inch min. diameter	38	37%	0-117

visited sites to provide suitable LWD would drop to almost half that if the 6-inch minimum diameter is thought sufficient. In managed stands where diameters may be close to the minimum size of interest, this effect should be common. In old stands with diameters greatly in excess of the minimum size of interest, this effect probably would not be apparent.

The initial calculations of potential ability of trees to fall into the channel assume that trees fall directly towards the channel, do not break into smaller pieces, and do not slide downslope. Breakage and sliding could be expected to add between 10 and 30 percent more pieces over time than the assumed potentially available trees, based on observations from McDade et al. (1990) from streamside stands in Western Oregon and Washington. The initial calculations of trees potentially contributing LWD do not specify a time period, so the numbers represent a capacity, not a rate. Five calculations using different assumptions about direction and rate of tree fall were developed to test what factors could affect LWD loading rates over the range of visited sites (Table 4). The five sets of assumptions are described by two categories, General Assumptions and Site Influences. General Assumptions specify default parameters for direction and timing of tree fall, and they were used to initially estimate possible LWD input rates. Site Influences represent alterations of the general assumptions using tree- and site-specific information measured on the 21 individual sites.

General Assumption 1 calculates the number of probable boles reaching the stream for LWD assuming a **random direction of tree fall** for the trees measured on each site. Because not all trees would fall straight downhill, the first calculation assumed a random direction of fall for the potentially contributing trees, reducing probable future LWD. The probability of a tree reaching the stream with a random direction of fall was calculated from the geometry of distance to stream and the radius of effective height (e.g., VanSickle and Gregory 1990). With this assumption of random direction of fall, ranges of rates for potential LWD are one third of the initial potential number (Table 7). Ranges of potential LWD inputs vary substantially among the sites visited (Table 7), reflecting a typically wide variation in RMA conditions that make efforts to predict LWD input difficult.

Table 7: Trees and estimated potential instream large woody debris (8-inch diameter, 5-ft length), number per thousand feet of Riparian Management Area, with varying assumptions for sites harvested using the 1994 Oregon Water Protection Rules

Site	RMA width (ft)	Avg. Tree DBH(")	Avg. bank slope (%)	All trees/ 1000 ft	Potential LWD	Assump.1 Random Fall	Assump.2 30% fall	Influence A: Steep slopes	Influence B: Severe lean	Influence C: Wet terraces
1	50	11	21	14	3	1	<1	<1	<1	<1
2	100	13	25	91	3	<1	<1	<1	<1	<1
3	50	11	43	162	82	31	9	11	9	11
4	70	16	27	95	70	28	9	9	9	12
5	70	17	7	28	10	3	1	1	1	1
6	70	13	39	134	58	22	7	8	7	9
7	50	13	52	127	69	25	8	9	8	9
8	50	12	50	120	39	12	4	4	4	4
9	50	22	31	57	47	17	5	6	5	6
10	50	14	68	98	43	15	4	5	4	5
11	50	14	23	102	65	23	7	8	7	7
12	50	14	49	155	75	26	8	9	8	8
13	70	16	41	115	68	25	8	9	8	9
14	70	16	56	63	40	15	5	6	5	6
15	50	12	22	54	40	14	4	5	4	5
16	50	19	32	93	38	13	4	5	4	5
17	50	15	18	28	25	11	3	3	3	4
18	100	15	30	212	158	62	19	21	19	27
19	50	14	38	147	60	19	6	7	6	7
20	70	11	55	228	67	24	7	9	7	9
21	50	14	51	63	42	14	4	5	4	4
Avg(sd)	60 (16)	14 (3)	37 (15)	104 (57)	52 (33)	19.1(13.1)	5.7(3.9)	6.6 (4.5)	5.8 (4.0)	7.1(5.5)

General Assumption 2 adds an assumed **windthrow rate of 30 percent over 10 years**. Assigning direction of fall gives another static number, a potential that does not consider of rates of LWD addition over time. The second round of calculations assumed an average windthrow rate of 30 percent over 10 years as the mechanism for LWD input to streams. This estimate was based on several observed riparian windthrow and LWD input rates, detailed in the Methods section. Van Sickle and Gregory (1990) demonstrated mathematically that probability of tree fall is directly related to LWD input rates. Thus, further calculations with different rates of windthrow or other tree fall mechanisms would yield proportional changes in LWD input rates. The 30% windthrow rate therefore gave a LWD input load of about a third of the potential with random fall, duplicating the relationship shown by the model of VanSickle and Gregory (1990). This number was about 10% of the original estimate for trees left in the RMA that were physically capable of reaching the stream with a minimum 8-inch diameter, 5-foot long piece (Table 7). Rates of tree fall are quite variable in space and time, from episodic and chronic windthrow as well as the several other common mechanisms for LWD input such as bank-cutting, debris slides, and flooding. Actual LWD loading seems very dependent on these delivery processes and rates; more information on observed input rates and patterns could much improve our ability to predict LWD input.

The other sets of calculations, Site Influences, estimated likely effects from the presence of steep side slopes, poorly drained terraces, and severe tree lean given the information collected on the individual trees at each site. The predicted effects are based on limited information about scope and direction of effect on windthrow rate and direction of fall (detailed in the methods), so these cases should be evaluated as hypothetical situations applied to a range of real riparian areas. Relative effects of the factors probably offer a more reliable judgment than absolute magnitudes.

Site Influence A calculations assumed that **more trees fall downhill on steep slopes**. On sites in the Oregon Cascades, more than 75 percent of trees on slopes greater than 20 percent were observed to fall downhill, compared to the expected ratio of one-half for random fall (R. L. Beschta, personal communication). This evidence suggests that trees are unlikely to fall in some of the uphill portions, so the 360° area of potential random fall was reduced proportionally to the expected percentage not falling uphill. For 20-29% average slopes on a site, fall direction was calculated out of 324°. Similarly, 30-39% slopes used 315°, 40-49% slopes used 306°, and greater than 50% slopes used 297°. Simulating a greater probability of fall increased the number of boles/1000 ft of RMA likely to be contributed by 16 percent on average compared to the number with the initial assumptions of 30% windthrow and random direction of fall. The mean boles/1000 ft of RMA were significantly different for these two cases, using a paired t-test ($p<0.01$). Effects ranged from none on flat slopes up to 21 percent on slopes over 50% (Table 7). The magnitude of the observed effects is related to the use of the increased rate on every potential LWD tree on a sloping site, and the fact that most of the visited sites had average slopes over 20 percent. More information on effects of steep slopes on tree fall direction would be needed to confirm these estimated results, and the potential size of the effects argues for pursuing that information.

Site Influence B calculations assumed that **trees with severe lean would fall towards the lean**. Tree lean had less potential influence on LWD loading than did steep slopes. Leans less than 35° were not considered to affect direction of fall, an assumption based on a study of tree lean and windthrow in Oregon Coast Range foothills that found no significant effect from tree lean up to 34° (Bustos-Letelier 1994). Assuming that trees leaning 35° or more would definitely fall in the direction of lean towards or away from the stream resulted in average increase in trees/1000 ft of less than 2 percent, with the maximum effect on any of the measured RMAs being 7 percent (Table 7). For most RMAs, adding these assumptions for direction of fall had no effects on LWD inputs. Lean had such a minimal effect because relatively few trees were severely leaning, and not all of the leaning trees were close enough to reach the stream. These estimates suggest that the practical influence of lean on LWD loading is limited, but they were based on insufficient information to conclude that lean would have little effect on LWD loading. The Water Protection Rules call for leaving any trees that lean over the stream (OAR 629-400-100(2)(c)), a simple approach that seems to appropriately target trees that are likely to contribute LWD due to lean.

Site Influence C calculations assumed **higher windthrow rates on poorly drained terraces**. Trees growing on poorly drained areas such as streamside terraces have rooting depth limited by the water level, reducing their ability to withstand high winds. Investigation of windthrow in the Oregon Coast Range found 45 percent basal area loss on poorly drained terraces, compared to 31 percent loss on slopes (Andrus and Froehlich, unpublished manuscript). Applying this ratio to the 30 percent average windthrow estimate, any tree noted as growing on a terrace was given a windthrow rate of 44 percent over 10 years. Increasing windthrow probability for trees growing on poorly drained terraces increased average potential LWD loading by 25%, from 5.7 trees/1000 ft RMA to 7.1 trees/1000 ft RMA (Table 7). Means were significantly different using a paired two-sample t-test (p=0.001), despite substantial variability from site to site. Some sites had few trees on terraces while other sites had much larger terraces over which tree fall probability would have been increased with this assumption. Effects of poorly drained terraces were greater than those of bank slope and tree lean, probably because the assumption for the terrace case was applied to many of the trees closest to the stream, the ones most easily capable of reaching the stream as LWD.

The LWD already existing in the streams was measured on the visited sites to help evaluate need for future debris. Existing instream LWD loadings were generally within ranges seen for streams in mature and old-growth stands: 31-186 pieces/1000 ft (10-61 pieces/100 m) for stands over 80 years, and 24-137 pieces/ 1000 ft (8-45 pieces/100 m) for older stands (Table 2, Table 1). The overall average of existing instream LWD loading was 139 pieces/1000 ft of stream, using a 5-inch minimum diameter and no minimum piece length, with site totals ranging from 10 to 272 pieces/1000 ft. Eastern Oregon sites averaged the lowest frequency, 68/1000', compared to 164/1000' for Northwest Oregon sites and 193/1000' for Southwest Oregon sites. Most of the data on LWD loading in Tables 1 and 2 was collected in humid systems, not dry interior climates like Eastern Oregon, where slower tree growth might frequently result in lower loadings. On the average, existing instream LWD did not seem to be generally lacking, although certain sites had very little.

Many of the large pieces had some level of decay, possibly originating in the previous stand, and a couple of sites had no solid (fresh) debris over 5 inches, raising some question about sufficiency of wood inputs for maintaining LWD. Debris with little or no signs of decay, probably added in the last few years, constituted an average of 14 percent of the total pieces over five inches, ranging from 0 to 55 percent on the different sites. The average proportion of fresh debris could be sufficient if debris lasted the possible 100+ years noted by Swanson et al. (1976). However, the majority (88%) of the existing debris is less than 20 inches in diameter, and hardwood debris was common, so shorter longevities would be expected (Grette 1985). Like total loading, concerns about current debris input appear to be warranted in certain areas and on some streams, but not as a broad conclusion for a region or class of streams. Harvesting using current forest practices and rules did not appear to add substantial logging debris (cut pieces) to streams based on field observations, unlike some results obtained in earlier studies (e.g., Long 1987). Small slash in cable corridors was common, but most fresh pieces in the streams were not cut, suggesting that buffers in managed stands currently receive wood through windthrow or similar mechanisms, and not during logging. Placement of woody debris appears to have a potentially important role in increasing LWD in some debris-poor stream systems, but this data suggests that existing LWD levels and stream characteristics should be examined to determine need and project design constraints on individual sites.

Stream Bank Conditions

Riparian management areas (RMAs) are a streamside management zone and not an inviolate buffer, and in many cases, some tree removal can occur. Trees may also be left beyond the RMA, in some cases to meet requirements for wildlife leave trees in clearcuts (Sec. 5, Chap. 919, Oregon Laws 1991). The Water Protection Rules include some motivation to leave extra trees in the RMA because trees in excess of RMA basal area requirements may be counted towards the live tree retention required in clearcuts

(OAR 629-640-100(11), 200(12), Dec. 1, 1994). Consequently, the width of the RMA often is not equivalent to the distance from the streambank to the harvest disturbance, but may be lesser or greater.

RMA widths vary from 50 feet for small fish-bearing streams to 100 feet for large streams, so distance to harvest disturbance was examined relative to the required RMA width. The average ratio was 0.97, suggesting that on the average, unharvested widths were slightly less than the RMA, and some harvesting commonly occurred in the RMA (Table 8). Regional differences were not statistically significant, but harvesting in the RMA seemed to occur more on the sites in Western Oregon, where the average ratios were 0.9, rather than on Eastern Oregon sites, where the average ratio was over 1, indicating that trees were left beyond the required RMA (Table 8). The greater distance in Eastern Oregon may be related to the tendency in this region to partial harvest, which often results in a less distinct harvest boundary.

There are various sources of disturbance, including harvest of adjacent stands, that may expose mineral soil in the riparian area. Exposed soil indicates the potential to generate unwanted sources of sediment in the stream, although exposure does not automatically translate into stream sediment. Not all exposed soil will be eroded (detached and transported), nor will all eroded sediment reach water before being redeposited. Despite a lack of information about these steps, exposed mineral soil is a quick comparative measure for potential erosion and sediment in streams.

Visual estimates of percent of the area within unharvested portions of the RMA that had exposed mineral soil showed that, on these sites, less than 10 percent of the area had exposed mineral soil. The average for all the sites was 7 percent mineral soil, with high variability on individual sites ranging from none to 23 average percent mineral soil (Table 8). Disturbances such as game trails, animal burrows, and windthrow were common sources of exposed mineral soil. Looking only at mineral soil disturbed by a harvest-related activity, including fire trails and cable corridors, the overall average was 3 percent soil disturbance, less than half of the total soil exposed (Table 8). These percentages give estimates of exposed soil for the entire bank in the RMA, not just areas adjacent to streams. Percentages summarize scattered areas of mineral soil, not

Table 8: Distance to harvest and percent disturbance in unharvested portions of Riparian Management Areas (RMAs) harvested using the 1994 Oregon Water Protection Rules

	Average for All Sites (range of site averages) (n=21)	Eastern Oregon (range of site averages) (n=5)	Northwest Oregon (range of site averages) (n=7)	Southwest Oregon (range of site averages) (n=9)
Distance to Disturbance/ RMA width (Ft/ft)	0.97	1.2	0.92	0.91
Disturbance in unharvested portions of the RMA				
Total % Exposed Mineral Soil	7 (0-23)	8 (0-23)	9 (3-20)	5 (1-12)
% Exposed Mineral Soil, Harvest-Related	3 (0-16)	2 (0-9)	5 (1-16)	1 (0-7)

contiguous exposed soil, so that some of the exposed soil would have opportunity to redeposit in the RMA before reaching a stream. Sites in the Northwest region seemed to represent the high end of exposed mineral soil, and may reflect the small streams and steep banks on the sites sampled in the region. To summarize average conditions, some harvesting often took place in the RMA (distance to harvest/RMA width < 1), but relatively little soil (<10%) was exposed in the remainder of the RMA, with less than half of that related to harvest activities. Some harvest-related activities such as fire trail construction and site preparation create continuous areas of exposed soil, but these are usually in the parts of the RMA furthest from the stream.

Riparian Reproduction

Seedlings and young trees are the source for future riparian trees. The presence or absence of conifer reproduction can determine the likelihood of riparian conifers in the foreseeable future. Tree reproduction was highly variable, both for species present and abundance. Some areas, such as the Sitka spruce zone along the coast, tended to have abundant spruce or hemlock seedlings, shade-tolerant species. Other areas had few seedlings or trees under 8 inches, or regeneration was primarily hardwoods like alder or maples.

Not surprisingly, sites west of the Cascades tended to have more hardwood trees under 8 inches and fewer conifers than sites east of the Cascades. The high average for hardwood seedlings east of the Cascades was controlled by one Cascade foothills site with abundant clumps of vine maple. For the sites visited, medium streams had the highest levels of reproduction per acre (Table 9). Variability was quite high, and none of these differences were statistically significant with this sample size ($p<0.05$).

An average of 58 small conifers per acre is not a high density compared to the stocking density of 120 to 60 free-to-grow saplings per acre required following clearcut harvesting by the Oregon Forest Practices Rules (OAR 629-610-020, Dec. 1, 1994). Similar to the situation for LWD, some sites appear to have adequate potential to

Table 9: Number per acre of seedlings and small trees by region and stream size for Riparian Management Areas using 1994 Oregon Water Protection Rules

	Seedlings, number/acre (range of site averages)		Trees under 8 inches DBH, number/acre (range of site averages)	
By Region	Conifer	Hardwood	Conifer	Hardwood
Eastern Oregon (n=5)	285 (42-693)	655 (0-2608)	99 (0-183)	36 (0-122)
Northwest OR (n=7)	113 (0-439)	134 (0-420)	47 (0-139)	67 (0-297)
Southwest OR (n=9)	62 (0-244)	142 (0-919)	42 (0-163)	112 (0-570)
By Stream Size				
Large (n=2)	21 (0-42)	32 (0-64)	43 (0-85)	96 (0-191)
Medium (n=8)	196 (0-693)	457 (0-2608)	86 (0-183)	96 (0-570)
Small (n=11)	106 (0-439)	161 (0-919)	40 (0-139)	64 (0-297)
Overall Average	132 (0-693)	262 (0-2608)	58 (0-183)	79 (0-570)

continue producing conifers, even if they are slow-growing shade-tolerant species, and other sites have almost no near-term potential. Management activities such as planting or thinning could be used to promote conifer regeneration near the stream in cases where that appears desirable.

Stream Shade

Adequate shading to prevent water temperature rise is another important element of aquatic habitat (Beschta et al. 1987). It was possible to visit only about half the sites before leaf fall, so the low number of sites limits the strength of conclusions about regional trends for the shade data. The information can be useful for general estimates of the results from applying the 1994 Rules, but should not be considered reliable for assessing regional effects. Average post-harvest shade over streams was 77 percent, with Western Oregon sites mostly above this value and Eastern Oregon sites mostly below this value. Angular readings of shade, focusing on SW quadrants along the summer solar path, were quite similar to shade measured over a wider angle, averaging 78 percent shade. Topographic shade generally did not play an important role, averaging 3 percent shading, and never exceeding 20 percent at the sites visited.

Snags

Snags are important habitat elements for wildlife and bird habitat (Schreiber and deCalesta 1992). Overall, sites averaged 13 snags/acre of RMA and had an average snag diameter of 14 inches, based on a minimum 6-inch diameter at breast height (Table 10). Conifers and hardwoods were both commonly represented (an average of 8 conifers/acre and 6 hardwoods/acre), except on Eastern Oregon sites (Table 10). Sites in Northwest Oregon seemed to have the greatest average numbers of snags, 16 snags/acre, compared to an average 12 snags/acre on sites in Southwest and Eastern Oregon, but variations

Table 10: Attributes of snags in Riparian Management Areas on harvests using the 1994 Oregon Water Protection Rules (minimum diameter at breast height of 6 inches)

	Average for All Sites (n=21)	Eastern Oregon (n=5)	Northwest Oregon (n=7)	Southwest Oregon (n=9)
Total number/acre	13	12	16	12
Conifers/acre	7	11	7	6
Hardwoods/acre	6	1	9	6
Average DBH (inches)	14	18	14	12
Conifer DBH (inches)	18	18	20	16
Hardwood DBH (in.)	10	8	10	10
Average Height (feet)	32	28	31	36
Conifer height (feet)	33	29	29	37
Hardwood height (ft)	30	22	32	30
Distance to stream (feet)	36	43	36	33
Conifer distance (feet)	43	43	41	44
Hardwood distance (ft)	26	26	31	22

were not significantly different for this sample (p=0.2). The largest average diameter was from Eastern Oregon sites at 18 inches, compared to 14 inches for Northwest Oregon and 12 inches for Southwest Oregon (Table 10). Snag heights averaged 32 feet, ranging from 10 to 66 feet. Hardwoods were more often found close to the stream at an average of 26 feet, while the average distance for conifer snags was 43 feet (Table 10).

Comparison of 1993 ODF Assessment and 1995 Measurements

Tree Retention

Oregon Department of Forestry examined pre- and post-harvest conditions for 37 stands harvesting using Forest Practices Rules prior to 1994, reported in the Riparian Rule Assessment (Morman 1993). This information was used as a basis for general comparison between 1994 and pre-1994 Forest Practices Rules for streamside harvesting. The 1993 Assessment included larger streams than did the 1995 dataset. To avoid unrepresentative comparisons, only streams less than 35 feet in width were used from the 1993 data, leaving 22 sites. Despite the trimming to comparable maximum stream widths, the average stream widths differed significantly (p=0.03) between sites in 1993 (average 17 feet) and 1995 (average 12 feet), perhaps due to the expansion of the 1994 Rules onto smaller streams. Stream gradients and pre-harvest stocking (total trees/1000 ft RMA) were not strongly significantly different (p=0.08, p=0.64, respectively).

The significant differences in stream width and possibly stream gradient should be considered when evaluating variables such as shade and LWD. Another source of possible differences between the datasets is the different areal extent of evaluation. The 1993 study assessed conditions over 100 feet, horizontal distance, from each stream, while the 1995 study looked at the RMA width of 50 to 100 feet, slope distance, from the streams. Total and regional averages for selected comparable variables from the 1993 and 1995 datasets are included in Table 11. Reported significant differences are

Table 11: Comparison of average results of riparian assessments before and after the 1994 Oregon Water Protection Rules, on sites with maximum stream width of 35 feet

	1993 Riparian Assessment				1995 Riparian Assessment			
Region	All n=22	E n=4	NW n=9	SW n=9	All n=21	E n=5	NW n=7	SW n=9
Stream width (ft)	17	14	22	13	12	15	9	12
% trees retained, #/1000-ft basis	55	69	63	40	82	84	84	79
% conifer retained, #/1000-ft basis	35	55	32	28	75	82	76	70
% conifer retained, BA(ft^2/acre) basis	27	47	28	17	68	67	67	70
Conifer BA after harvest (ft^2/acre)	20	37	18	14	54	54	57	52
Conifer BA before harvest (ft^2/acre)	74	79	62	82	79	81	85	74
Distance to harvest (ft)	53	39	61	51	58	75	49	57
Dist. to harvest/ RMA width (ft/ft)	1.3	1.2	1.0	1.5	0.97	1.2	0.92	0.91
% Exposed soil	11	22	4	13	7	8	9	5
Percent Shade (Angular canopy)	68	45	74	71	81	48	85	93
Snags/acre (8" min. DBH)	3	8	2	1	9	6	12	8
Snag DBH (in.)	19	18	25	12	15	19	16	13

based on nonparametric Kruskall-Wallis tests because many of the variables in this small dataset did not approximate normal distributions.

One major impetus for Rule changes was the desire to retain and encourage streamside conifers. Comparisons were made for both total trees and conifers alone. The average number of trees/1000 ft of RMA was 77 for the 1993 sites and 104 for the 1995 sites, a noticeable but not strongly significant difference (p=0.09). However, conifers did differ significantly (p=0.02) in numbers per 1000 ft of RMA, with the 1993 average being 26 trees/1000 ft and the 1995 average being 48 trees/1000 ft. Although there was wide variation in tree density at the various sites, the 1995 sites had consistently higher retention of conifers than did the 1993 sites over the range of stand densities (Figure 11).

Because the sites covered a wide geographic region and a range of site qualities and climates, the percentage of trees retained was examined to look at sites more evenly, avoiding undue influence from heavily stocked sites. For total trees, percent of pre-harvest trees/1000 ft of RMA retained after harvest was 55 percent for 1993 sites and 82 percent for 1995 sites (Table 11). The greater retention in 1995 was seen mostly on sites west of the Cascades (Figure 12). For conifers only, 1993 sites had 35 percent of pre-harvest conifers/1000 ft retained after harvest and 1995 sites had 75 percent, again with the largest increases in retention being observed on Western Oregon sites (Figure 12). On Eastern Oregon sites, many conifers had been left prior to 1994 probably to comply with the 75 percent shade rule, so lesser changes in conifer retention were seen in sites from that region, compared to the more than doubling of conifer retention in Western Oregon (Figure 12).

Percent conifer retention was also examined using basal area/acre measurements, which help account for tree diameter and RMA width in addition to tree density and RMA length. For 1993 sites, an average 20 ft^2/ac of conifers were retained, 27 percent of pre-harvest conifers. Sites in 1995 averaged 54 ft^2/ac conifers retained after harvest, 68 percent of pre-harvest conifers. Regional patterns of percent retention of conifer basal area were similar to the trends seen for trees/1000 ft of RMA, with the greater differences in retention seen in Western Oregon regions (Figure 13).

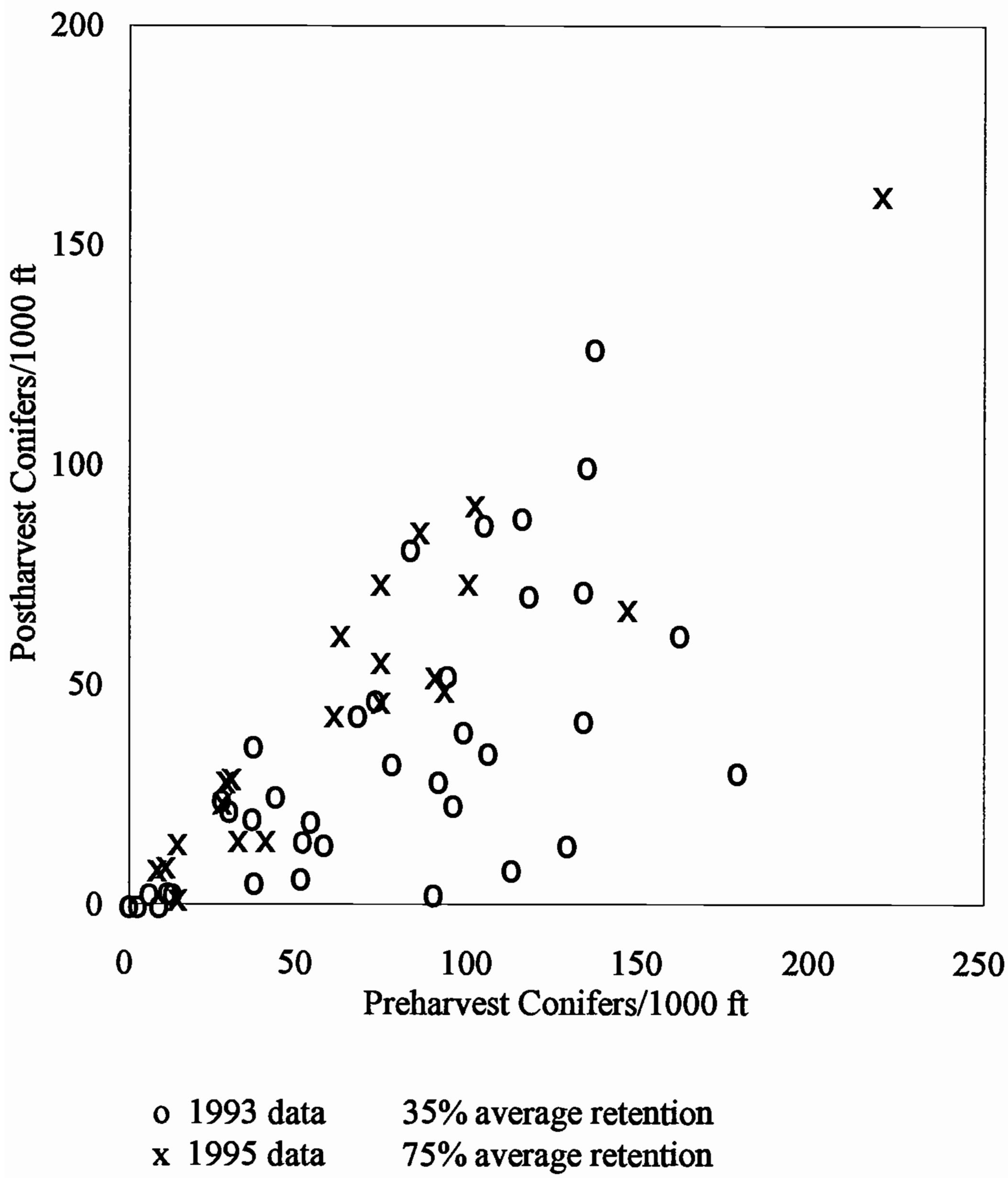


Figure 11: Site averages of pre-harvest and post-harvest conifers per thousand feet of Riparian Management Area from riparian assessments before and after the 1994 Oregon Water Protection Rules

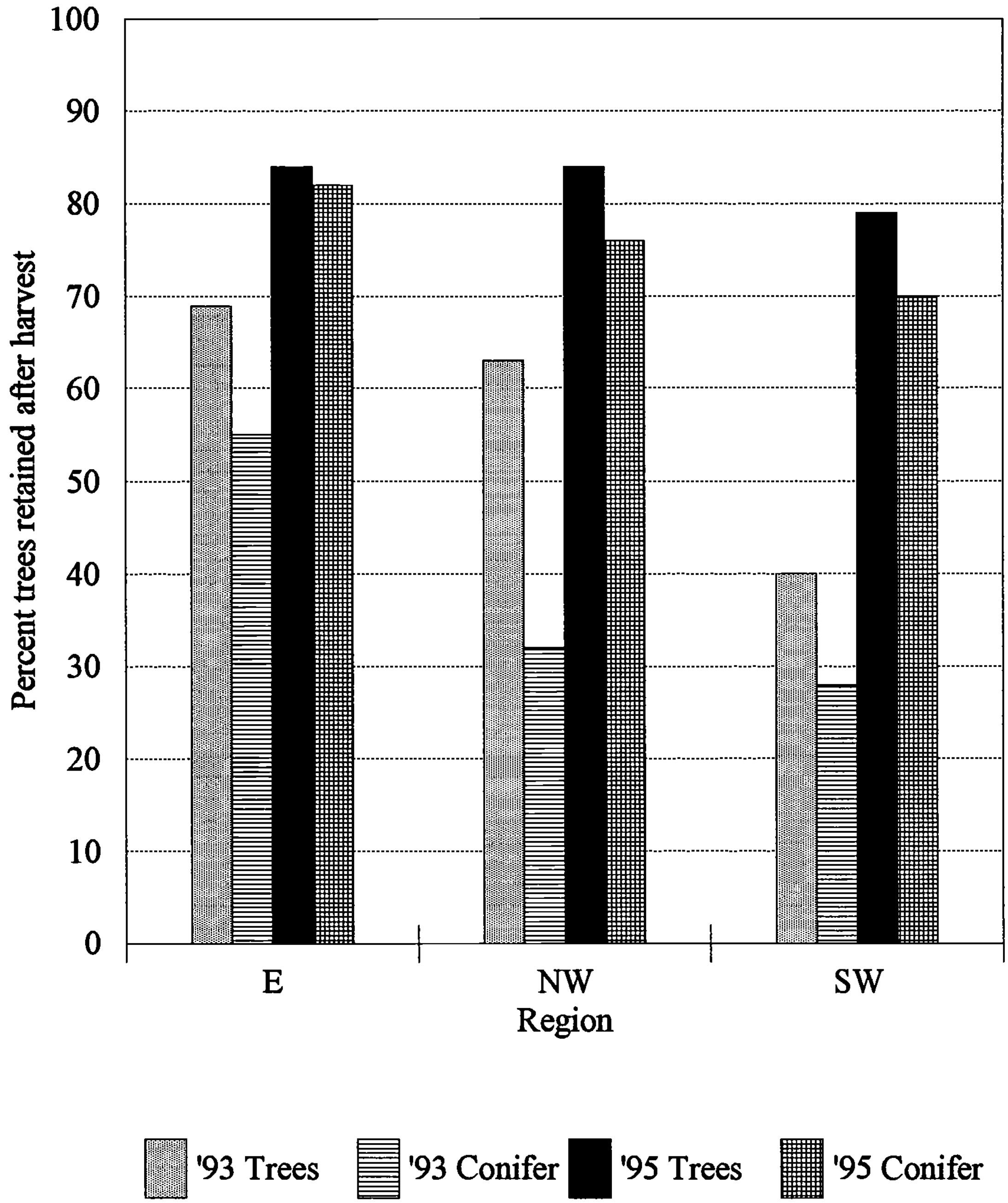


Figure 12: Percent of trees retained after harvest based on trees per thousand feet of Riparian Management Area before and after the 1994 Oregon Water Protection Rules

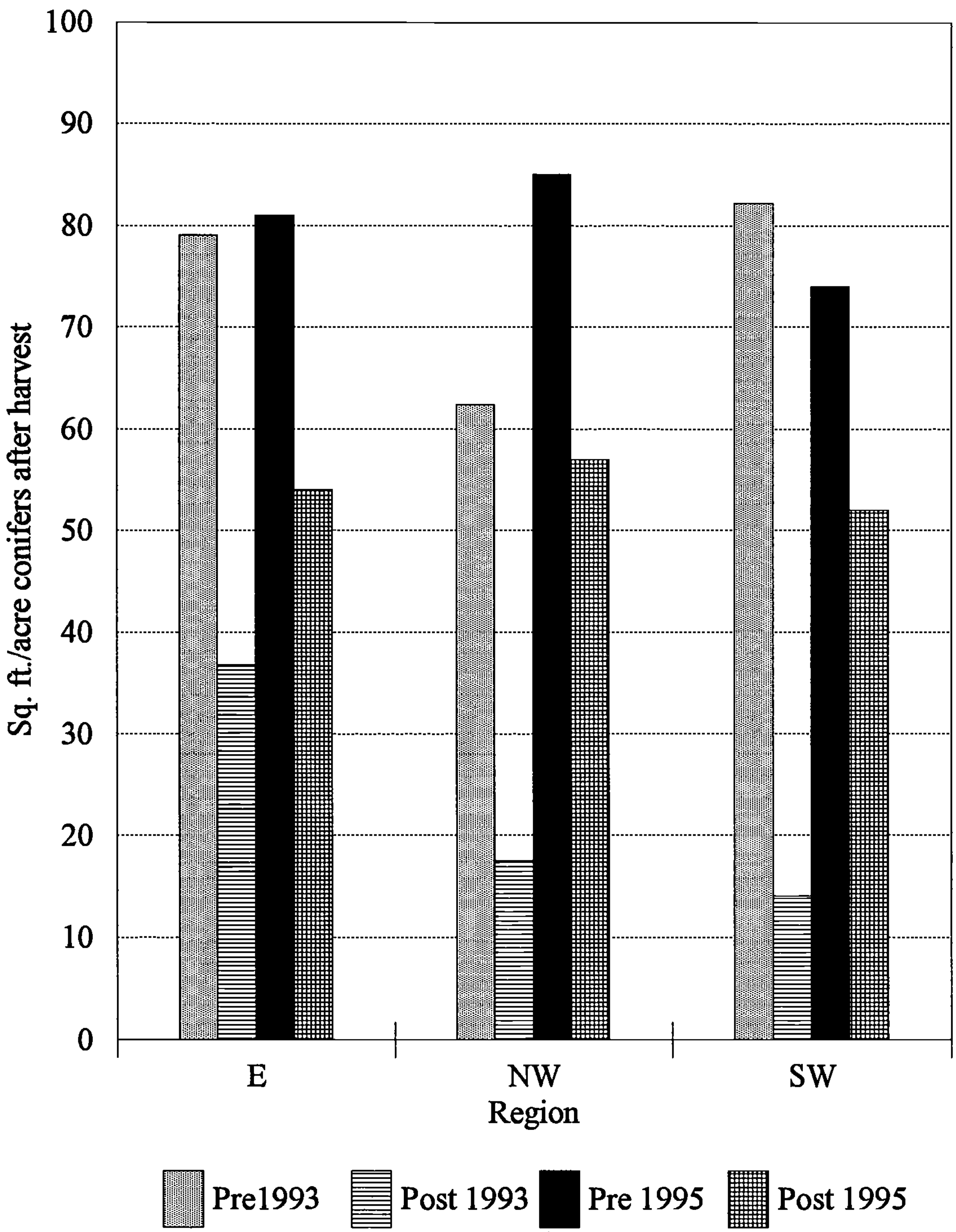


Figure 13: Pre-harvest and post-harvest basal area per acre of trees retained after harvest in Riparian Management Areas before and after the 1994 Oregon Water Protection Rules

For 1993 and 1995 sites, the percent retention based on basal area was lower than percent retention based on tree densities, suggesting that more of the larger trees had been removed. Some differences in percent retention could have been due to differences between an acreage basis and a per-1000-ft basis, so average diameters of cut and removed trees were examined to look at the question directly. For 1995 sites, average DBH of all retained trees was 14 inches, while average estimated DBH of stumps was 16 inches; for conifers alone, average tree DBH was 17 inches, smaller than the average estimated stump DBH of 18 inches. These results confirm that, on the average, trees cut in the RMA tended to be larger than trees left there. Stump DBHs were estimated using taper equations, and analysis of check data showed that the bias most likely to be present was underestimation of DBH. If stump DBHs were indeed underestimated, results would only show greater DBHs for removed trees, strengthening the relationship seen in the existing numbers. The large increases in minimum basal areas for RMA retention requirements in the 1994 Rules were hoped to encourage harvesters to leave larger trees because large diameters count more towards basal area. The desired trend of leaving larger trees was not frequently seen on the visited sites.

Harvest Disturbance

Maximum RMA widths were the same for 1994 and pre-1994 Rules but many small streams had wider RMAs under the 1994 Rules, and RMAs were used farther up small streams. Under both sets of rules, harvesting was permitted under some circumstances in the RMA. The question of whether the different RMA requirements would result in greater distances to disturbance from harvesting was of interest. Average distances to the harvest area were 53 feet for 1993 sites and 58 feet for 1995 sites, and were not significantly different ($p=0.36$). The 1995 data included more small streams and had different widths required for RMAs, so comparisons of distance to harvest were made relative to the required RMA width. Distance to harvest disturbance/RMA width showed that distances on the 1995 sites were similar to or lesser than distances on the 1993 sites relative to the required buffer (Figure 14).

In unharvested portions of the RMAs, various sources of disturbance could expose mineral soil, including harvest activities, animal trails and burrows, windthrow, and flood waters. Average exposed mineral soil in the RMA was 11 percent on 1993 sites and 7 percent on 1995 sites, but site averages varied widely and these differences were not significant ($p=0.4$). For 1995, less than half (an average 3 out of 7%) of the exposed mineral soil in unharvested portions of the RMA was caused by harvest-related activities. Methods for collecting percent mineral soil differed (strip-transect for 1993 and fixed-radius plots for 1995), which might introduce differences in estimates unrelated to actual effects of disturbances. Additionally, the estimates of exposed soil from either study represent only potential for sediment in streams, not actual presence, because not all exposed areas will erode and not all eroded sediment will reach the water before redepositing.

Shade

The 1994 Rules require the 20 feet closest to the stream and specified basal area per 1000 feet of RMA to be left uncut, measures that can provide significant shade to adjacent waters. Prior to 1994, 75 percent of the pre-harvest shade had to remain after harvest. Angular shade (percent of area covered by canopy oriented to summer solar path) averaged 68 percent on 1993 sites and 81 percent on 1995 sites, significantly different at $p=0.01$. Western Oregon sites averaged greater shading than Eastern Oregon sites for both datasets (Figure 15). The shade data for the 1995 sites should be viewed with caution, however, because only 11 sites were visited early enough in the season to collect shade information. The comparison between datasets should be representative of broad trends, but the Eastern Oregon regional average with only two sites should not be viewed as a reliable estimate. Further complicating interpretation of the differences in shading is the fact that 1995 sites tended to be smaller streams. The

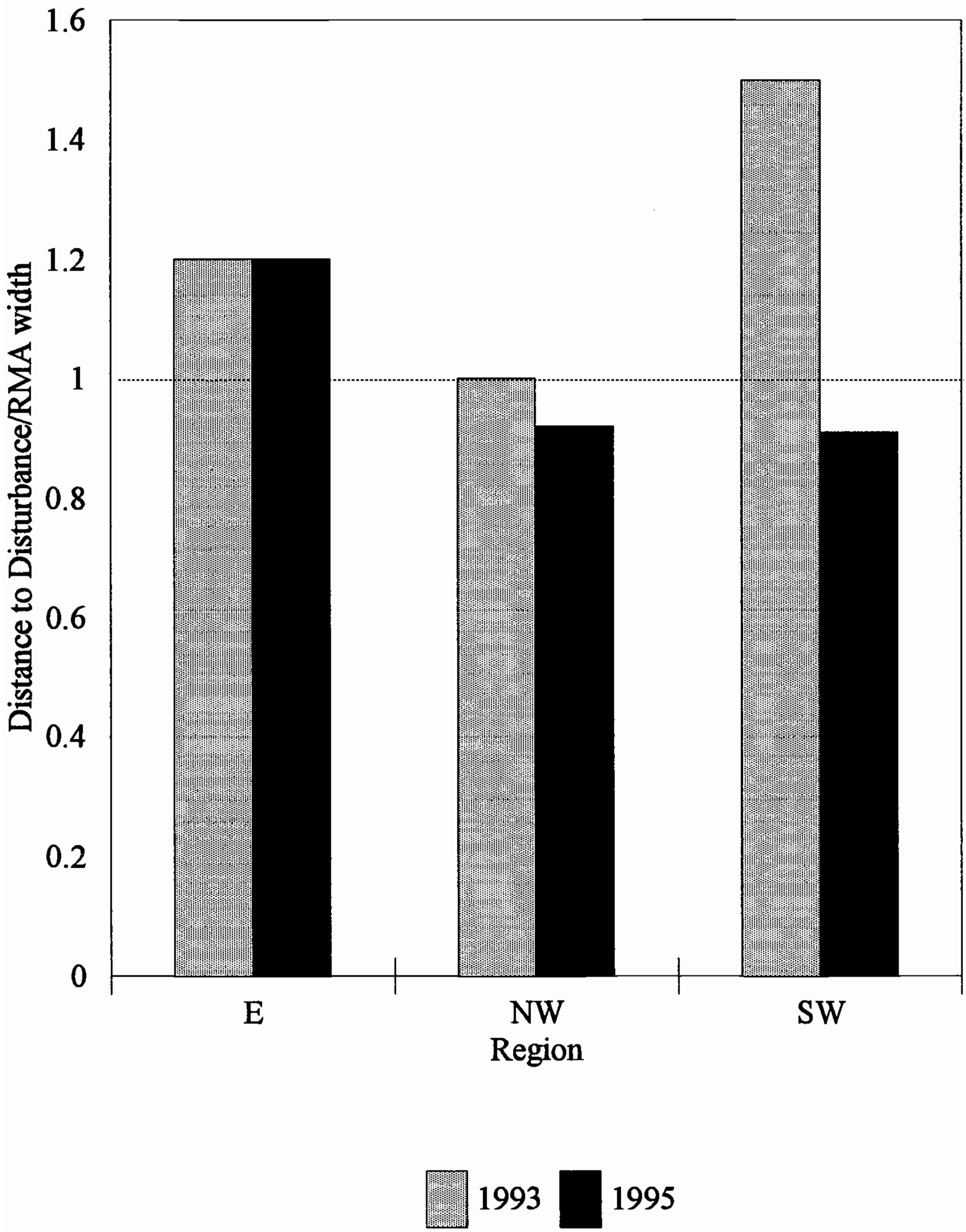
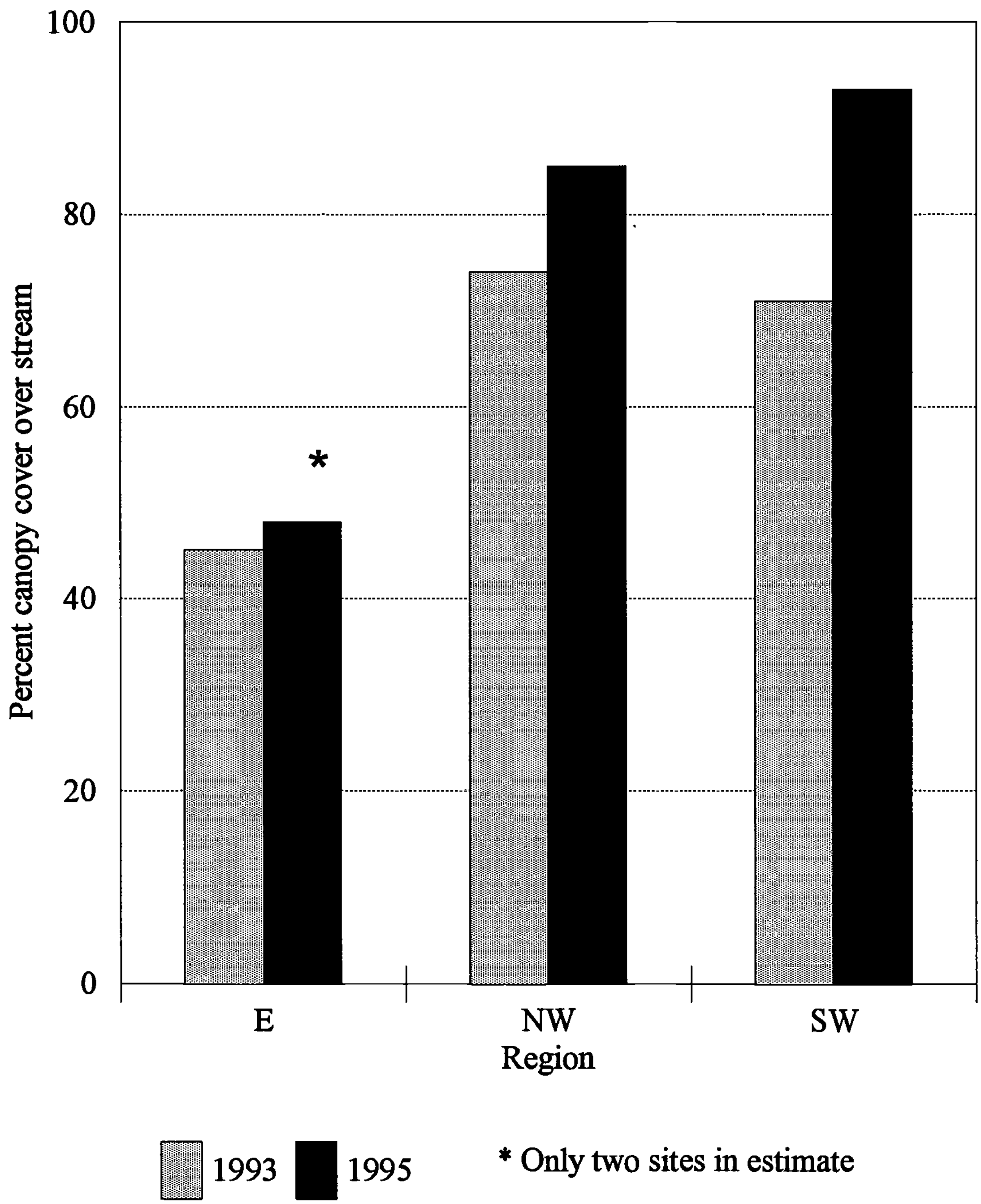


Figure 14: Distance to harvest disturbance relative to Riparian Management Area width on harvests before and after the 1994 Oregon Water Protection Rules



Note: 1995 study had smaller streams on average.

Figure 15: Percent canopy cover over stream along solar path (angular canopy) by region on sites harvested before and after the 1994 Oregon Water Protection Rules

narrower the stream, the smaller the potential natural canopy opening over the stream and greater shade would be expected. More sites would be needed to draw reliable conclusions about shade using the 1994 Rules, but this preliminary information suggests that on most sites, the Rules provide at least as much shade as under previous rules. The Oregon Department of Forestry monitoring program has been collecting detailed information on shade and water temperature, which may provide more conclusive information about effects on shade from applying 1994 Water Protection Rules.

Snags

Wildlife habitat is another of the concerns of the Oregon Forest Practices Rules, and leaving standing snags helps address this concern. Rules for snag retention were similar before and after 1994, but the 1994 Rules allowed basal area of snags to count for up to 10 percent of the required basal areas in some circumstances (OAR 629-640-100(7) and (8) for fish-bearing streams). The 1993 data was based on a minimum 8-inch diameter and 10-foot height, so the 1995 data was trimmed to the same standards. The number of snags 8 inches DBH or larger was 3/acre for 1993 sites and 9/acre for 1995 sites, with much of the larger number for 1995 due to sites in Western Oregon (Figure 16). This difference in snag density was significant at $p<0.01$. Snag diameter is one of the key variables determining usefulness as wildlife habitat (Schreiber and deCalesta 1992). The mean diameter of snags on 1995 sites was 15 inches, smaller but not significantly different ($p=0.3$) than the mean snag diameter from 1993 sites of 19 inches (Figure 17). The lower average snag diameter raises some concerns about adequacy of future snags in managed stands. The differences in snag diameter were not significant with the variability and sample size seen here, but further research is needed to confirm or dismiss these concerns.

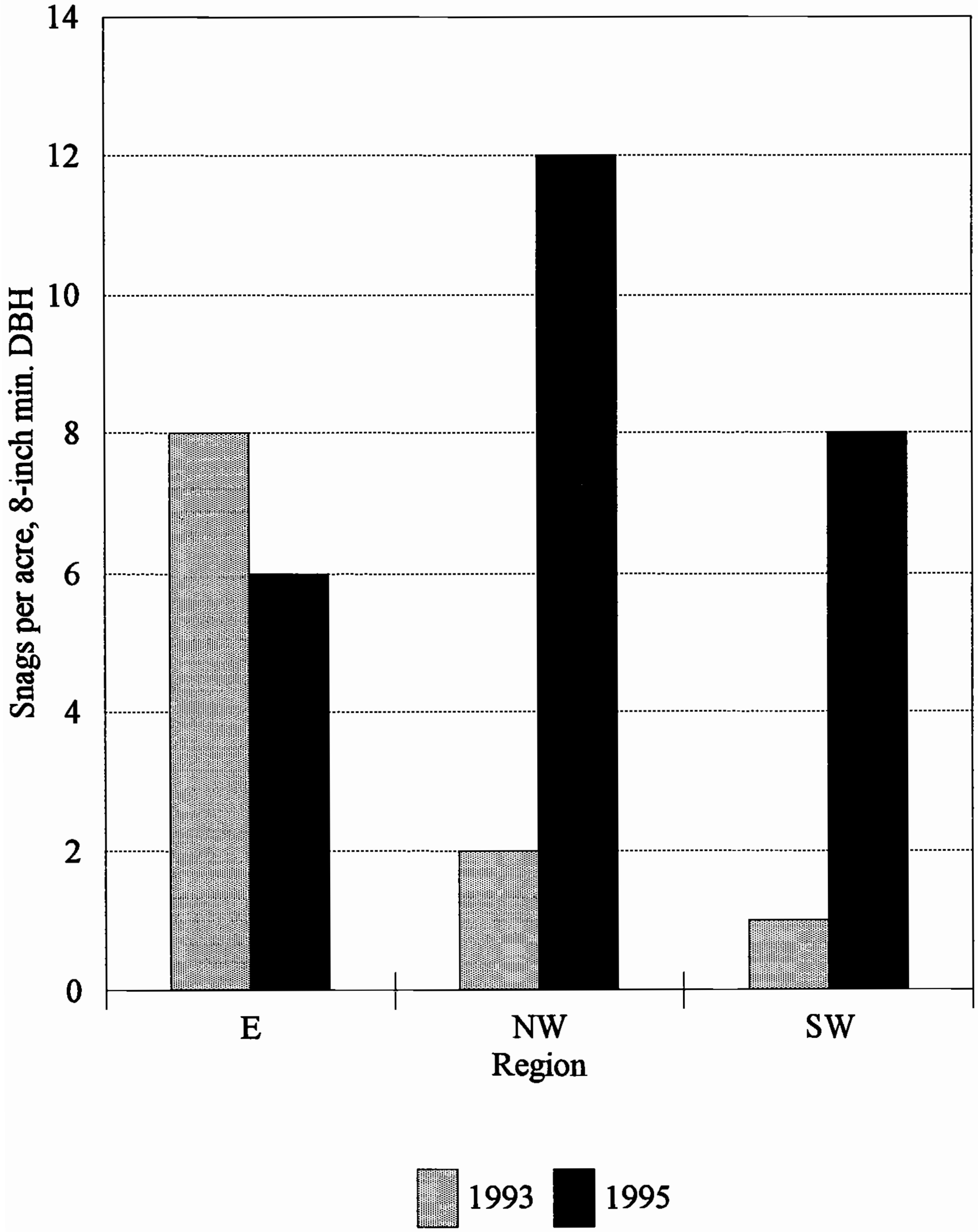


Figure 16: Snags per acre in Riparian Management Areas by region on sites harvested before and after the 1994 Oregon Water Protection Rules

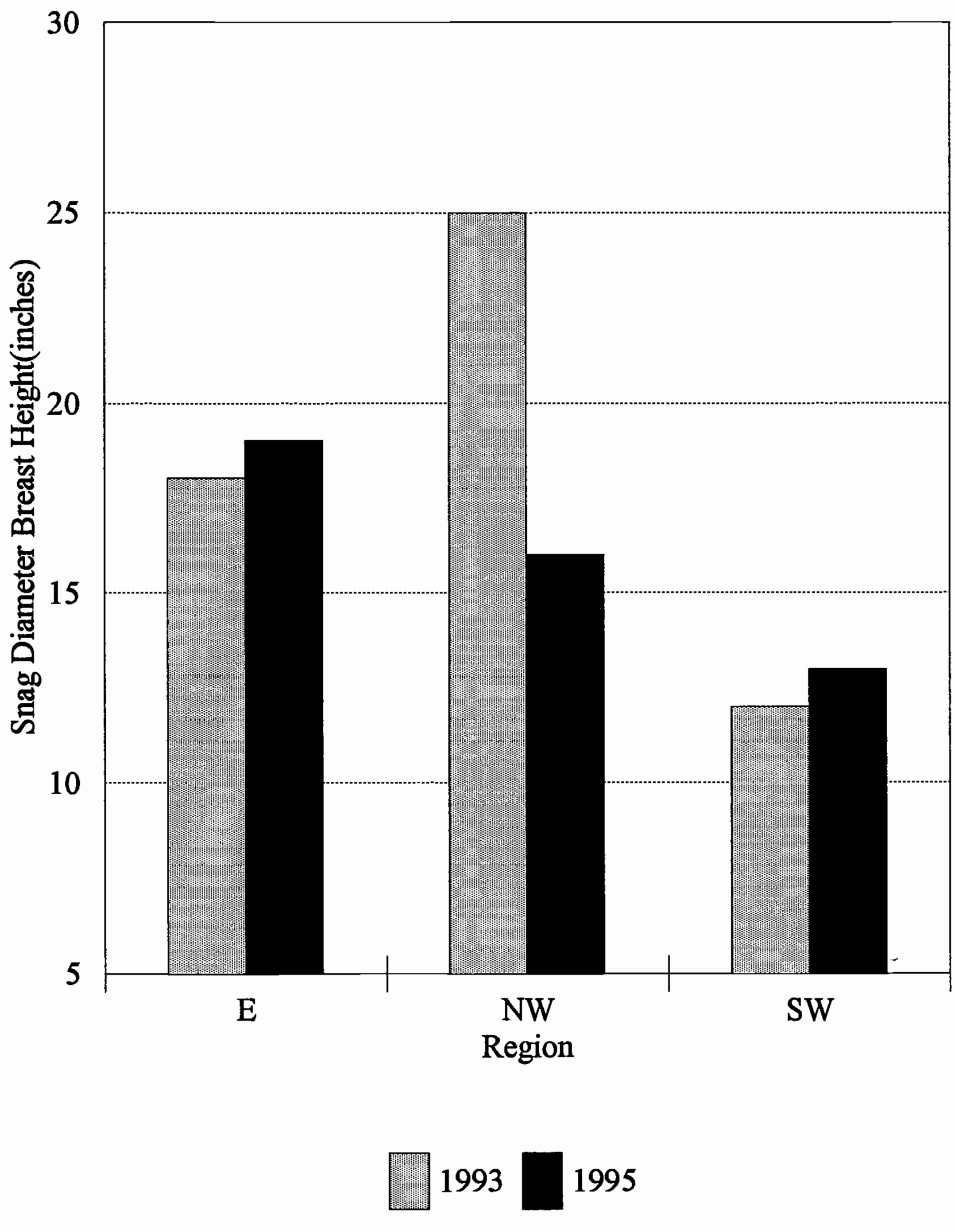


Figure 17: Average snag diameter at breast height in Riparian Management Areas on sites harvested before and after the 1994 Oregon Water Protection Rules

CONCLUSIONS

Stream Rules Survey Results and Water Protection Rule Implementation

The Stream Rules Survey of harvesters using the 1994 Water Protection Rules for streamside harvests found a majority (61%) supporting the Rules. However, about as many felt that the Rules had gone too far as thought that the Rules were now about right for protecting stream resources. The most frequently chosen factors that were important for harvesters' support of the Rules were related to concerns about financial costs of the Rules and about personal control over management directions. The survey results show clear attention by harvesters to financial self-interest but also values for less tangible factors such as science-based policy, norms of stewardship, and identity concerns. There was some evidence of influence from fair allocations of burdens (distributive justice) and fair and inclusive process for developing the Rules (procedural justice), but they did not appear to strongly alter support for the Rules.

The generally relevant result for policy design is that a mixture of economic self-interest and social norms were revealed as influential for attitudes about regulations. This suggests that robust policies will use both economic and normative appeals to create effective and widely applied programs, even in situations with the legal structure of regulations and punitive fines. Policies can potentially tap the evident willingness to contribute to some extent to public goods, but there are clearly limits to this approach. At least in Oregon where forest practice regulations have been used for 25 years, the level of support and goodwill towards the goals of a set of new and controversial regulations remained a clear majority. However, a significant and sometimes strongly expressed minority of rule users in opposition was apparent, and some supporters felt that the Rules were excessive or not very effective.

The mixture of self-interested and normative motivations found here supports the premise of Daniels' Integrated Behavior Model, which combines traditional policy analysis based on rational self-interest from economics with elements of social and behavioral psychology. Daniels' model could be useful as a basis for developing or analyzing policy options because it requires consideration of both economic incentives and social or behavioral traits. The model could also be useful when developing education or communication programs as a means to encourage clear information about economic concerns in addition to planning for likely social networks and cognitive heuristics. Despite these advantages, the model relies on a thorough knowledge and evaluation of the particular setting being assessed. Increasing the breadth of considerations simultaneously increases the complexity of the analysis.

If policies have clear economic benefits to rule users, without substantial conditions for participation or prerequisites of technical knowledge, a strong response seems likely across a spectrum of types of rule users. However more complex economic programs that require some restrictions on future actions are likely to be less popular, given general concern about retaining control over management decisions. Even fear of future restrictions may be likely to reduce program participation; uncertainty about future restrictions may be limiting use of the riparian tax incentives offered by Oregon Department of Fish and Wildlife. Economic programs designed with some of the socially-based concerns in mind are likely to be more effective than without this. Likewise, voluntary programs or involuntary rules with limited enforcement should seek ways to reduce financial costs or create benefits for long-term effectiveness.

The use of good science in policy-making also emerged as an important influence on harvesters' opinion of the Rules, with a majority disagreeing that the Rules were based on good scientific reasoning. Comments indicated that they thought the Rules were based more on politics than science. The expressed value for good science grants particular power to research and science in policy-making, an exercise which merges socioeconomic, legal, and political concerns with the technical evidence from research. Economic and scientific elements appear to be viewed more positively than social, legal, and political elements, even though all are important for policy.

Survey results also showed some important differences among groups of rules users, categorized here into industry foresters, logging operators, and nonindustrial private forest owners (NIPF). Industry foresters seemed most likely to share similar norms, such as good science, flexible management options, and an inclusive process for developing rules. Logging operators, who may work for forest industry or NIPF owners, responded to survey questions sometimes more like industry and sometimes more like NIPF owners. NIPF owners were very diverse in responses and characteristics. Consideration of the typical situations for people in each group offers insight into where shared group norms might develop and how they might be used to influence policy education.

Industry foresters are likely to consider information about forest management regulations as very salient to their lives, and the group shares similar education, job descriptions, and professional organizations. Given these characteristics and evidence of slightly greater similarity of norms from the survey, industry foresters could be expected to more easily share group-based norms; this could encourage expansion of voluntary cooperation if a small group of companies adopts new practices or contributes to a program.

Logging operators are somewhat less similar in characteristics such as education, and do not have as many organizational connections within their group. The main logging industry association, Associated Oregon Loggers (AOL), has recently developed the Professional Logger Program offering logger certification. Emerging mechanisms such as this may prove to be a valuable means of education or encouraging voluntary cooperation with public goals. Because loggers work for both of the other groups, another effective route to logging operators in all the different situations may be through the employers.

NIPF owners are quite diverse in opinions and characteristics such as age, education, and reasons for owning land. There is an active small woodland owners organization, but less than 15 percent of NIPF owners belong. Most NIPF owners probably are more likely to be in groups unrelated to their ownership role than otherwise, such as Rotary, American Legion, or Elks. Although some owners may be interested in voluntary cooperation with resource protection because of their personal norms and ownership goals, there does not appear to be a strong avenue to develop or tap group-based values for the whole spectrum of NIPF owners. Groups such as watershed associations may be useful for outreach efforts for participating communities.

Because not all NIPF owners are interested in harvesting and many harvest only infrequently, this group is particularly difficult to identify in situations like trying to inform affected landowners about rule changes. Changing demographics of NIPF owners towards smaller parcels (Birch 1996) and frequent turnover of property means that numbers of new NIPF owners will continue to rise, requiring continued outreach and education efforts. For information and education about forest management and regulations, the Forest Practices Forester (FPF) may prove to be an important contact. FPFs are considered important in harvest decisions by all groups, but for NIPF owners, there may be few other realistic avenues to provide information that could affect harvesting behavior. Consultants are available and can offer forestry expertise and experience with harvesting rules to owners unfamiliar with forest management, but only 13 percent of the NIPF owners in the Stream Rules Survey indicated that consultants were important in harvest decisions. Consultants could be an important route for informing owners about management options, helping overcome the barrier of complex rules, and encouraging good practices, but only if the proportion of owners using consultants rises significantly. Other possible avenues for communication, especially before harvest planning, are the ODF Service Foresters and Extension Service Foresters and Specialists.

Any of the responses to voluntary appeals are likely to be vastly improved if supported by an economic benefit, a concern shared by all groups. Forest industry expressed preferences for tax incentive mechanisms while logging operators and NIPF owners more commonly preferred compensation.

Post-harvest Riparian Stand Assessment and Water Protection Rules

The 21 sites harvested using the 1994 Water Protection Rules averaged 82 percent of the pre-harvest trees per thousand feet of Riparian Management Area (RMA) retained after harvest, compared to 52 percent retention on the 22 sites harvested under the previous rules. The 1994 Rules seem to result in significantly greater tree and conifer retention, looking at both number and basal area of trees in the RMA. Comparison of estimated stump DBHs and leave tree DBHs showed that, on average, larger trees were removed than left in the RMA. The pricing structure creates a substantial financial incentive to remove the larger trees, even though they would contribute proportionately more than smaller trees towards meeting RMA basal area requirements because basal area uses the square of the diameter. The data on canopy cover suggests that similar or greater levels of shading happen under the 1994 Rules compared to previous rules, but numbers of sites for this measurement were too limited to provide conclusive evidence or confirm regional differences. Average snags per acre were significantly greater on the sites using the 1994 Rules than the previously measured sites. Average snag diameters were lower but not found to be significantly different on the 1994-Rule sites, a possible trend that should be substantiated or disproved by further research.

On average, about half of the trees retained in the RMA after harvest were physically capable of falling directly into the stream as large woody debris (LWD) at least 5 feet long and 8 inches in diameter. With continued growth, this percentage would increase. The existence of a substantial proportion of trees unlikely to become LWD suggests that there may be potential to improve the efficiency of regulations in providing future LWD. Rapid evaluations of a tree's potential contribution as LWD can be done using techniques like that of Robison and Beschta (1990b) with a prism. Even rapid techniques applied to individual trees would mean substantial time investment to increase removal of trees with low LWD potential and reduce the value left in uncut trees. This approach could be developed as another management option available to harvesters, realizing that many would not have the time or expertise to use it, at least initially. Of course, trees in the RMA provide other functions such as shading, nutrient inputs, slope and bank stability, and wildlife habitat, so such a potential policy should be evaluated for possible detriment to these functions.

The sensitivity analysis for potential LWD contribution from trees left in the RMA showed the greatest effect from considering increased windthrow potential on poorly drained terraces where root depth is limited. Assumptions for greater downhill direction of fall on steep slopes also resulted in significantly greater differences in estimated LWD loading. Effects on total potential LWD loading from considering severely leaning trees were small due to the low numbers and different directions of lean. These results suggest that evaluating a site's likelihood of contributing LWD should pay careful attention to factors that would affect rate of delivery of LWD to the stream, while also noting major site factors that could affect direction of fall. For windthrow, the occurrence of poorly drained terraces, bedrock, or other factors limiting rooting depth should be noted. The likelihood of other delivery mechanisms such as debris slides or floodplain reworking should also be evaluated. The rate of LWD delivery seems to be quite variable in space and time, but this information may offer the best estimates of an individual site's potential to contribute LWD over time. Site factors such as exposure to storm winds and slope steepness should also be evaluated.

Combining Social and Natural Resource Investigations

This research combined investigations of social and natural resource elements, increasing the scope and complexity of the research substantially compared to looking at either one singly. What advantages can be expected from such an approach? Having both types of information available about a specific situations allows the evidence from one to inform conclusions about the other, and to observe the relationships between our social and natural resources. Trends in resource condition can be observed in natural resources research, but the social research is needed to identify the motivations for the behaviors that may have caused the trends. This would not be useful in every instance because trends could be related to factors such as geomorphology, climate, or land use history. However, this approach is likely to be important for many situations in land use policy where peoples' activities affect the natural resource conditions.

For the Water Protection Rules, there were significantly more trees being left in the RMAs, and there was evidence of broad concern about the costs (foregone income) related to the increased tree retention. This combination suggests that the implementation of the 1994 Rules seen in this study should be enhancing protection of the natural resources, but may be stressing the social resources of future goodwill towards public goals. The survey evidence suggests that goodwill, or support of the Rules, is being generally maintained despite the economic stresses, but raises questions about willingness to accept further restrictions that limit income or increase costs.

The 1994 Rules were more complex than the previous rules, which made it harder for individuals who harvest infrequently, such as many NIPF owners, to learn about and use the Rules to minimize costs. Despite this, in the survey, complexity was less frequently seen as important to Rule support than flexibility or ability to decide how to take care of the land. Complexity may be best viewed as a barrier to early use that becomes less significant long-term than having limited management options. These results suggest that policies should offer a range of options even if complexity is increased, with some simple options available. Expectations of policy implementation should take into account the likelihood that some rule user types will not invest the time or resources to undertake complex options.

Support from a majority of the regulated community offers hope that the Rules will remain effective over time, because the resources to rely solely on enforcement and fines to motivate compliance on all forest harvests in Oregon are not available. Voluntary compliance alone has been found to be insufficient to meet water quality goals (Wolf 1995), but the combination of regulations and general support for forest practices suggests that application will be broad enough to meaningfully affect water quality and aquatic habitat.

Industry foresters/employees typically had lower cost estimates for meeting the Water Protection Rules than did the logging operators or NIPF owners. On the site visits, forest industry used the more detailed management options such as cutting to minimum required basal area and cutting hardwood conversion blocks much more frequently than did the NIPF owners. The different patterns of use and perceptions of the Rules for the two groups illustrate some important differences that are manifested in harvesting behavior. NIPF owners were much less likely to attend the ODF training sessions or be aware of the rule development process, suggesting that this group is not being effectively reached by the current ODF programs.

From a policy perspective, both types of information, as well as others, are needed to consider the efficiency, sufficiency, and effectiveness of future policy directions or methods of implementation. With the broader results, the information from social science can be used to pursue natural resource goals, such as how to target different types of rule users with information that would be expected to motivate desired changes in behavior, such as the NIPF owners mentioned above. Economic incentives may be available for some programs or goals such as reforestation, but other goals may have little potential economic assistance (e.g., quality of snag retention or LWD replacement). Evidence suggests that normative appeals should not be relied on alone, but they may be the only avenue available in the near future to policy makers and implementers. In these situations, recognizing the differences in how various types of rule users acquire, use, and share information could be invaluable for increasing the use and quality of implementation of desired practices. For example, the clearest possible information on the scientific basis is likely to be persuasive for many rule users, most particularly industry foresters. Assuring that desired practices can be implemented in a way that landowners can meet their own goals and ideas of stewardship and retain control could be persuasive for NIPF owners.

Recommendations for Future Research

Riparian Stand Research

Information on timing and methods of wood entry into streams is needed to develop better predictions of future LWD inputs. There are several directions in which more information is needed: rates of wood input from chronic and episodic sources, patterns of occurrence such as windthrow-prone areas or aspects, the role of terraces and other windthrow or disturbance-prone sites, effects and typical patterns of bole breakage during fall and entry into the stream, and effects of downslope sliding. Existing research on the contribution of steep slopes and tree lean is very limited and far from conclusive, and more research is needed before their effect on LWD input can be thoroughly evaluated. Research on LWD in Eastern Oregon or similar areas of the Interior West is also very limited. Research in these drier regions should be pursued to determine the importance of LWD in these systems and to identify significant differences in delivery or transport mechanisms compared to Western Oregon.

Another needed element for pursuing questions about future LWD is the changes in potential LWD contribution that are likely to happen as trees grow over decades. The Rules were based on expected entry every 50 years for clearcuts. An important question is the ability of this future stand to contribute LWD after 50 years of growth. Many of the trees too small to be considered in the 10-year scenario may be important contributors after a couple of decades. That task was beyond the scope of the research here, but the tree inventories could be used to develop tree lists for growth models to predict future growth and competition-based mortality. There are some important cautions for both the tree inventory data and the available growth models. The tree inventory data collected here does not include site index or stand age information or specific crown ratios (only a crown competition rating), information that is important for improving precision of estimates from many growth models. Most growth models are based on information from upland stands (perhaps chosen for their uniformity) and do not necessarily include the ranges in variation in site quality or disturbance regime that can be found in riparian areas. Some growth models are meant to predict growth for single-species stands, and the riparian stands measured here contained multiple species. Models such as Prognosis (USFS) can handle multiple species in a stand, but the relationship to riparian conditions is still unknown. Some method of increasing the expected mortality rate would probably be appropriate, given the greater frequency of and mechanisms for disturbances in riparian areas compared to upland stands. The growth model used should be developed from data covering the entire range of stands to be modeled, with regional adjustments where appropriate. Meeting these methodological and informational challenges is necessary to develop relatively precise estimates of an expected future stand, information needed to be able to evaluate LWD contribution over a longer time period such as 50 years.

Better information for LWD prediction is only one of the steps needed to bridge research and practice for LWD management. Standards for LWD loading, whether for voluntary targets to move towards desired conditions or for clear enforcement of regulations, are not readily available. The complexity and variability in time and space of LWD and its delivery mean that the development of standards will not be simple. The same sort of gap exists for stream habitat management projects. More information is needed to understand desirable habitat conditions for various goals, not LWD alone. Even given knowledge about desirable habitat conditions across the landscape, the ability to plan and carry out stream habitat management projects to bring about that desirable habitat continues to need development.

Large woody debris was the focus chosen for this research because of the particular concerns expressed about this function and its relevance to hydrology, but it is not the only function of riparian trees. Further analysis of riparian forest management policy should also consider the other functions of riparian trees, outside of the trees' ability to provide instream wood for fish habitat, that are inherently related to the characteristics of streamside vegetation. For example, if stream habitat management is encouraged to quickly provide LWD to streams, considerations of the roles of riparian trees in shading, nutrient cycling, and bank stability over time also should be taken into account.

Other important avenues of research would be to confirm or disprove the information on canopy cover and shading and trends in snag diameters. The ODF Monitoring Program already has a research program in place for assessing effects of management using the 1994 Rules, which hopefully can offer more conclusive results, at least for shade and stream temperature. The potential for decreased snag diameter is important because it could raise questions about the ability of the current models or patterns of forest management to provide snags large enough for the range of wildlife currently relying on them. If large snags are becoming rarer, and the size-dependency is mostly related to nesting rather than roosting or feeding, management actions such as installing nest structures could avoid future problems. Another response could be at the policy level, where currently the incentive to leave larger snags is in the limited situations where they can be counted towards required minimum basal area in the RMAs.

Policy Research

This research explored only a small area of the social influences on forest management decisions and behavior. The effects of communities and opinions of influential peers and relatives could also be expected to be important in attitudes and behaviors of harvesters. Research focused on natural-resource-based, especially timber-based, communities would be useful in judging whether the behavioral research results found in other settings or through contrived experiments can be reliably extended to forest management situations. Attitudes and behaviors of people may be related strongly to the land or regions as an important source of personal identity (place-based identity) in ways not evaluated in this research. The utility of these potentially strong relationships to the land or land ownership role could be another important pathway for influencing management behaviors to pursue natural resource goals.

The policy process is also affected by groups other than the rule users and their communities, another arena for future research. The interest groups that stimulated the 1991 law (SB 1125) in the Oregon legislature requiring a new stream classification system obviously had an important role in policy formation for the Water Protection Rules. This research evaluated Rule implementation from the perspective of Rule users only. To evaluate policy implementation in a democratic process, the scope of stakeholders to be considered is broad, including a range of interest groups and the general public. Survey results summarized in the Literature Review offer some insight on attitudes of the general public. To further evaluate the Water Protection Rule implementation, information on the perspectives of the other stakeholders should be collected. This includes the level of interest or attention of various stakeholders, including the general public, how they are affected by the Rules, how they could affect future policy directions, and the structure or relative importance of their various interests.

Another potentially fruitful area for policy research is how education can be used to influence the implementation of incentives or more complex management options. This research may be particularly crucial to the NIPF situation, given the changing demographics of NIPF owners, turnover of land, and expected changes in land ownership in the next few decades (Birch 1996). Research should distinguish between owners of small parcels and large forestland holdings, a distinction found useful in explaining attitudes about forest management and regulation (Johnson et al., in review). This research offers information to help orient or focus educational programs, but does not in any way test the effectiveness or efficiency of these avenues.

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APPENDICES

APPENDIX A: RIPARIAN AND STREAM CONDITIONS SUMMARIES BY SITE

Site 1: **Matlock Creek** Central Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 5 sites, from the eastern Cascades to NE Oregon.

Stream characteristics: Legal Description: T6S R29E Section 13
Small F stream
Area sampled: 50-foot width by 600 foot length sampled, two sides of stream
Acreage (horizontal basis): 1.35 acres
Channel Habitat Unit Frequency: 8% Pool, 58% Riffle, 34% Glide, 1 multiple channel
Channel Substrate Frequency: 92% Cobble, 8% Bedrock
Confinement: 17% Unconfined, 83% partially confined, none confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	18	12-27	15
Stream Gradient (%)	2	-1-4	6

Bank Transects:	Average	Range	Regional Average
Percent Slope	21	0-50	25
Percent Exposed Mineral Soil	23	0-90	8
Harvest-related Exp. Min.Soil	9	0-50	2
Distance to Disturbance (ft)	78	15-100+	87

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	57/acre	57/acre	0/acre	99/acre
Seedlings:	153/acre	153/acre	0/acre	286/acre

Stream Shade:
site visited after leaf-fall, not measured

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	13	68
Number of Pieces over 10" diameter	8	33
Percent solid(recently entered)	0%	7%
Percent functional (in-channel) debris	100%	88%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	1.5	1.5	0	12
Average Diameter	43	43	0	18
Average Height	33	33	0	28
Average Distance	28	28	0	43

Level of Decay: Moderate, 2.5 on scale of 1(solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	14	14	0	78
Basal Area/1000 ft. (ft2/1000 ft)	11	11	0	84
Basal Area/ acre	10	10	0	58
Average DBH (inches) (Diameter at 4.5 ft)	11	11	0	14
Average Distance to Stream (ft)	35	35	0	36
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	18	18	0	36

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	0	0	0	30
Basal Area per 1000'*				38
Predicted Average DBH (in.)				13
Average Distance (feet)				57

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	8	34
Basal Area per 1000'(ft2)*	16-19	55-64
Predicted Average DBH (in.)	18-19	16-17
Average Distance (feet)	35	44

*Estimates calculated on stump heights ranging from 1 foot to 2 feet.

Site Notes:
Partial harvest, mechanical feller, tractor skidding. Site visited 11-20-95.

With the low gradient and partially confined channel, large woody debris could be effective in forming pools. However, habitat may be limited by the current low level of gravels and wood may not be stable during high flows in unconfined reaches. There was little shade, instream woody debris, or other pool-forming factors, although channel complexity and streamside vegetation increased downstream. Streamside vegetation was low, probably from grazing. Where the tractor had crossed the streambed and moved along the floodplain, there was little rutting; effects on compaction or hydrology are unknown. Few trees were near the stream and little regeneration was present, suggesting that shade and LWD are likely to continue to be low, particularly without active management or changes in grazing management. Streamside vegetation is important for moderating temperature extremes (summer warming and fall/spring icing). If streamside vegetation is increased, placement of additional wood could be useful in the stream.

Site 2: **Ochoco Creek** Central Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is **not an assessment of compliance** with the Forest Practices Act. The regional average is based on 5 sites, from the eastern Cascades to NE Oregon.

Stream characteristics: Legal Description: T14S R18E Sections 21,28

Large F stream

Area sampled: 100-foot width by 800 foot length sampled, one side of stream

Acreage (horizontal basis): 1.78 acres

Channel Habitat Unit Frequency: 25% Pool, 8% Riffle, 67% Glide, single channel

Channel Substrate Frequency: 33% Fine, 50% Gravel, 17% Cobble

Confinement: 100% Unconfined, none confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	21	12-33	15
Stream Gradient (%)	2	-1-4	6

Bank Transects:	Average	Range	Regional Average
Percent Slope	25	0-65	25
Percent Exposed Mineral Soil	15	0-85	8
Harvest-related Exp. Min.Soil	0		2
Distance to Disturbance (ft)	117	105-130	87

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	85/acre	85/acre	0/acre	99/acre
Seedlings:	42/acre	42/acre	0/acre	286/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range
	1	0	0

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	10	68
Number of Pieces over 10" diameter	3	33
Percent solid(recently entered)	17%	7%
Percent functional (in-channel) debris	83%	88%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	1	1	0	12
Average Diameter	17	17	0	18
Average Height	10	10	0	28
Average Distance	85	85	0	43

Level of Decay: Moderately High, 3 on scale of 1(solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	91	91	0	78
Basal Area/1000 ft. (ft2/1000 ft)	93	93	0	84
Basal Area/ acre	42	42	0	58
Average DBH (inches) (Diameter at 4.5 ft)	13	13	0	14
Average Distance to Stream (ft)	74	74	0	36
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	3	3	0	36

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	10	10	0	30
Basal Area per 1000'*	8-9	8-9	0	38
Predicted DBH (inches)*	11-12	11-12	0	13
Average Distance (feet)	86	86	0	57

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	21	34
Basal Area per 1000'(ft2)*	24-28	55-64
Predicted DBH (inches)	14-15	16-17
Average Distance (feet)	79	44

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Partial harvest, feller-buncher, tractor skidding. Site visited 10-24-95.
The stream gradient was low enough for large woody debris to potentially be effective in forming pools and complex fish habitat. However, the unconfined channel and abundant gravels suggest that stream widening might occur. Little shade, streamside vegetation, woody debris, or other pool-forming factors were present, and algal mats were common (late summer). Streamside vegetation would be important both for moderating stream temperatures (to reduce summer warming and fall/spring ice scour) and for stabilizing streambanks against widening. There were many trees in the RMA, but few had the size to reach the active channel with a sizable piece via windthrow. Trees could contribute woody debris by downslope sliding of broken boles or reworking in the floodplain during high flows. Little regeneration or small trees other than juniper were present near the stream, suggesting that woody debris or shade may continue to be low. Exposed mineral soil was most commonly from grazing, gophers, and the steep bank at the edge of the floodplain. If streamside vegetation is increased, placement of wood in the stream could be useful for developing fish habitat, designing for the abundant gravels and unconfined channel.

Site 3: **Tony Creek Tributary** Central Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is **not an assessment of compliance** with the Forest Practices Act. The regional average is based on 5 sites, from the eastern Cascades to NE Oregon.

Stream characteristics: Legal Description: T1N R9E Section 34
Medium N stream
Area sampled: 70-foot width by 600 foot length sampled, one side of stream
Acreage (horizontal basis): 0.63 acres
Channel Habitat Unit Frequency: not observed, later summer sampling
Channel Substrate Frequency: 48% Fine, 23% Gravel, 14% Cobble, 15% Boulder
Confinement: 100% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	6	3-14	15
Stream Gradient (%)	12	4-17	6

Bank Transects:	Average	Range	Regional Average
Percent Slope	43	1-69	25
Percent Exposed Mineral Soil	0		8
Harvest-related Exp. Min.Soil	0		2
Distance to Disturbance (ft)	86	20-250	87

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	229/acre	172/acre	57/acre	99/acre
Seedlings:	1126/acre	458/acre	668/acre	286/acre

57 planted Douglas-fir seedlings/acre also noted within RMA.

Stream Shade:	%Shade	%Shade in Solar Path	Range

Not measured, site visited after leaf-fall.

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	77	68
Number of Pieces over 10" diameter	22	33
Percent solid(recently entered)	17%	7%
Percent functional (in-channel) debris	74%	88%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	40	38	2	12
Average Diameter	8	8	6	18
Average Height	25	25	10	28
Average Distance	17	17	30	43

Level of Decay: Moderate, 2 on scale of 1(solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	162	162	0	78
Basal Area/1000 ft. (ft2/1000 ft)	114	114	0	84
Basal Area/ acre	109	109	0	58
Average DBH (inches) (Diameter at 4.5 ft)	11	11	0	14
Average Distance to Stream (ft)	15	15	0	36
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	51	51	0	36

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	58	58	0	30
Basal Area per 1000'*	44-51	44-51	0	38
Predicted DBH (inches)*	11-12	11-12	0	13
Average Distance (feet)	39	39	0	57

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	22	34
Basal Area per 1000'(ft2)*	22-25	55-64
Predicted DBH (inches)	13-14	16-17
Average Distance (feet)	16	44

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, highlead logging. Site visited 10-23-95.

As a highly confined nonfish-bearing stream with steep gradient and seasonal flow, large woody debris is probably more useful for sediment storage and energy dissipation than for fish habitat. The stream could supply some wood to downstream areas during high flows. Trees for future woody debris were present, although smaller in diameter, and were close to the stream. The streamside vegetation may be important for stabilizing the channel and moderating sediment transport. The clustering of leave trees by the stream has provided substantially more trees surrounding the stream than required by the Water Protection Rules alone. The stream is unlikely to be a useful area to place additional woody debris for fish habitat.

Site 4: **Ditch Creek** Central Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 5 sites, from the eastern Cascades to NE Oregon.

Stream characteristics: Legal Description: T2N R9E Section 14
Medium F stream
Area sampled: 70-foot width, 800 ft sampled on one side of stream, 300 ft on other
Acreage (horizontal basis): 1.85 acres
Channel Habitat Unit Frequency: 25% Pool, 63% Riffle, 12% Glide, 4 multiple channels
Channel Substrate Frequency: 19% Gravel, 53% Cobble, 28% Boulder
Confinement: 19% confined, 69% intermediate, 12% unconfined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	15	6-25	15
Stream Gradient (%)	13	5-20	6

Bank Transects:	Average	Range	Regional Average
Percent Slope	27	-7-59	25
Percent Exposed Mineral Soil	1	0-30	8
Harvest-related Exp. Min.Soil	0	0-20	2
Distance to Disturbance (ft)	34	15-55	87

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	305/acre	183/acre	122/acre	99/acre
Seedlings:	3301/acre	693/acre	2608/acre	286/acre

Hazel seedlings not counted towards hardwoods.

Stream Shade:	%Shade	%Shade in Solar Path	Range
	92	96	83-100

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	197	68
Number of Pieces over 10" diameter	108	33
Percent solid(recently entered)	3%	7%
Percent functional (in-channel) debris	89%	88%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	12	9	3	12
Average Diameter	14	15	9	18
Average Height	53	58	35	28
Average Distance	34	37	23	43

Level of Decay: Moderate, 2.2 on scale of 1(solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	95	68	27	78
Basal Area/1000 ft. (ft2/1000 ft)	150	117	33	84
Basal Area/ acre	97	76	21	58
Average DBH (inches) (Diameter at 4.5 ft)	16	17	14	14
Average Distance to Stream (ft)	14	15	11	36
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	74	69	85	36

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	79	78	1	30
Basal Area per 1000'*	122-143	122-143	0.3-0.4	38
Predicted Average DBH (in.)*	16-17	16-17	8-9	13
Average Distance (feet)	47	47	45	57

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (most conifer):	Average	Regional Average
Number per 1000'	45	34
Basal Area per 1000'(ft2)*	94-108	55-64
Predicted Average DBH (in.)*	19-20	16-17
Average Distance (feet)	34	44

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, shotgun skyline/shovel logging. Site visited 9-19-95.

The stream was well-shaded, with some gravels, pools, and habitat complexity from multiple channels and islands. Stream gradient was somewhat steep for large woody debris to be effective in forming additional pools and complex habitat. Large woody debris was present, though recent inputs did not seem to be high. Trees were larger than other stands sampled in the region, and most were close enough to the stream to potentially contribute sizable future wood to the stream through windfall. Hardwood sprouts were abundant, creating potential competition for future conifers. Water management as an irrigation channel could be greatly influencing fish use. With the relatively steep gradient, existing wood, and potential future sources, placement of woody debris in this stream may not be useful for fish habitat currently.

Site 5: **Foley Creek** Central Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 5 sites, from the eastern Cascades to NE Oregon.

Stream characteristics: Legal Description: T11S R17E Section 31 NW 1/4

Medium F stream
Area sampled: 70-foot width, 600-foot length sampled, one side of stream
Acreage (horizontal basis): 0.96 acres
Channel Habitat Unit Frequency: 42% Pool, 33% Riffle, 25% Glide, 2 multiple channels
Channel Substrate Frequency: 25% Fine, 50% Gravel, 25% Cobble
Confinement: 100 % unconfined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	13	6-22	15
Stream Gradient (%)	2	0-6	6

Bank Transects:	Average	Range	Regional Average
Percent Slope	7	-1-27	25
Percent Exposed Mineral Soil	3	0-15	8
Harvest-related Exp. Min.Soil	0		2
Distance to Disturbance (ft)	118	80-200	87

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	0/acre	0/acre	0/acre	99/acre
Seedlings:	81/acre	81/acre	0/acre	286/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range

Not measured, site visited after leaf-fall.

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	45	68
Number of Pieces over 10" diameter	22	33
Percent solid(recently entered)	0%	7%
Percent functional (in-channel) debris	93%	88%

13 sites of wood placement (out of 61pieces) from past stream improvement project.

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	5	5	0	12
Average Diameter	8	8	0	18
Average Height	18	18	0	28
Average Distance	50	50	0	43

Level of Decay: Moderate, 2.2 on scale of 1(solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	28	28	0	78
Basal Area/1000 ft. (ft2/1000 ft)	51	51	0	84
Basal Area/ acre	32	32	0	58
Average DBH (inches) (Diameter at 4.5 ft)	17	17	0	14
Average Distance to Stream (ft)	41	41	0	36
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	35	35	0	36

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	0	0	0	30
Basal Area per 1000'*				38
Predicted Average DBH (in.)*				13
Average Distance (feet)				57

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	73	34
Basal Area per 1000'(ft2)*	117-138	55-64
Predicted Average DBH (in.)*	17-18	16-17
Average Distance (feet)	56	44

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Precommercial thinning, feller-buncher, skidder. Site visited 11-21-95.

The stream had riparian fence and substantially more herbaceous vegetation than most comparable streams in the region. The placed large woody debris from a previous stream improvement project was still present and functioning for collecting gravels and forming pools. The stream was incised and relatively few trees are near the stream for shade and future large woody debris. Algal mats were present in late summer. Despite the riparian fence, few young trees were present and only scattered shrubs, probably because of well-established grasses and herbs. Trees were removed in past selective harvests, and regeneration has not replaced what was removed. Trees and shrubs nearer the stream could be beneficial for moderating temperatures to minimize summer warming and spring/fall icing and maintaining streambank stability. With the low gradient and few trees near the stream, placing additional woody debris might be useful for developing pools and storing sediment in the future as the existing debris decays. The floodplain was generally unconfined and had abundant gravels, which could contribute to stream widening, so any debris placement should take these conditions into account.

Site 6: **Gunner Lake Tributary** Northwest Oregon Region

This form summarizes selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 7 sites, Clatsop to Lincoln Counties, North Coast Range.

Stream characteristics: Legal Description: T3N R3W Section 4
Medium F stream
Area sampled: 70-foot width, 600-foot length sampled, two sides of stream
Acreage (horizontal basis): 1.79 acres
Channel Habitat Unit Frequency: 33% Pool, 50% Riffle, 17% Glide, 3 multiple channels
Channel Substrate Frequency: 25% Fine, 58% Gravel, 17% Cobble
Confinement: 42% unconfined, 58% intermediate, none entirely confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	18	9-48	9
Stream Gradient (%)	3	0-7	10

Bank Transects:	Average	Range	Regional Average
Percent Slope	39	-4-102	45
Percent Exposed Mineral Soil	3	0-45	9
Harvest-related Exp. Min.Soil	1	0-45	5
Distance to Disturbance (ft)	68	45-85	49

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	0/acre	0/acre	0/acre	47/acre
Seedlings:	244/acre	20/acre	224/acre	113/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	84	84	56-96	86

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	152	164
Number of Pieces over 10" diameter	120	91
Percent solid(recently entered)	7%	18%
Percent functional (in-channel) debris	91%	81%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	14	4	10	16
Average Diameter	13	22	8	14
Average Height	24	19	26	31
Average Distance	47	52	45	36

Level of Decay: Moderately low, 2 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	134	15	119	113
Basal Area/1000 ft. (ft2/1000 ft)	138	26	112	145
Basal Area/ acre	92	18	75	134
Average DBH (inches) (Diameter at 4.5 ft)	13	17	13	15
Average Distance to Stream (ft)	35	54	33	34
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	44	44	43	53

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	22	17	5	22
Basal Area per 1000'*	29-34	18-22	10-12	41
Predicted Average DBH (in.)*	14-15	14-15	16-17	17
Average Distance (feet)	61	62	56	41

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	13	10
Basal Area per 1000'(ft2)*	129-147	56-66
Predicted Average DBH (in.)*	39-41	30-32
Average Distance (feet)	42	35

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, highlead & shotgun cable yarding, and grapple skidding all used. Site visited October 11-12, 1995.

The low gradient, plentiful gravel, and relatively unconstrained nature of the stream allow large woody debris to be useful in creating fish habitat. These conditions also allow channel widening, particularly if sediment loads or peak flows increase. Some reaches had abundant large woody debris and the lower reaches have developed complex habitat with multiple channels. Some reaches had little debris, and most of the largest debris is fairly decayed, with relatively low levels of new debris added. There was relatively little conifer in the buffer, with most of it on the outer edges of the RMA. Less than half of the conifers available could easily contribute a sizable piece of debris to the channel by windthrow. In a few areas, large debris from the farther conifers could be delivered through landslides or downslope sliding of broken boles. Placement of additional wood could be useful in the future as existing stable large-diameter debris decays and is not replaced.

Site 7: **Coal Creek Tributary** Northwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 7 sites, Clatsop to Lincoln Counties, North Coast Range.

Stream characteristics: Legal Description: T4N R10W Section 35
Small F stream
Area sampled: 50-foot width, 600-foot length sampled, two sides of stream
Acreage (horizontal basis): 1.22 acres
Channel Habitat Unit Frequency: 58% Pool, 25% Riffle, 17% Glide, 2 multiple channels
Channel Substrate Frequency: 38% Fine, 29% Gravel, 33% Cobble
Confinement: 67% intermediate, 33% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	9	5-14	9
Stream Gradient (%)	9	3-17	10

Bank Transects:	Average	Range	Regional Average
Percent Slope	52	12-110	45
Percent Exposed Mineral Soil	8	0-100	9
Harvest-related Exp. Min.Soil	2	0-20	5
Distance to Disturbance (ft)	46	30-95	49

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	95/acre	95/acre	0/acre	47/acre
Seedlings:	153/acre	153/acre	0/acre	113/acre

Mostly hemlocks

Stream Shade:	%Shade	%Shade in Solar Path	Range	Regional Average
	86	81	58-98	86

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	255	164
Number of Pieces over 10" diameter	170	91
Percent solid(recently entered)	14%	18%
Percent functional (in-channel) debris	84%	81%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	17	6	11	16
Average Diameter	10	13	9	14
Average Height	25	21	27	31
Average Distance	20	29	16	36

Level of Decay: Moderately low, 2.1 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	127	56	71	113
Basal Area/1000 ft. (ft2/1000 ft)	139	63	76	145
Basal Area/ acre	137	62	75	134
Average DBH (inches) (Diameter at 4.5 ft)	13	13	14	15
Average Distance to Stream (ft)	28	31	26	34
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	55	43	64	53

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	32	18	14	22
Basal Area per 1000'*	37-43	26-30	11-13	41
Predicted Average DBH (in.)*	14-15	16-17	12	17
Average Distance (feet)	44	49	38	41

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	12	10
Basal Area per 1000'(ft2)*	98-112	56-66
Predicted Average DBH (in.)*	38-40	30-32
Average Distance (feet)	31	35

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, skyline yarding and tractor skidding used. Site visited 10-2-95.

The stream was partially confined and somewhat steep for large woody debris to be useful in creating complex fish habitat. Wood in steep streams can be important for trapping sediment and dissipating stream energy. The stream had relatively abundant large woody debris, and some recent input of wood over 5" diameter. Gravels were present, but so were plentiful fines, probably related to some of the unstable banks and windthrown trees near the stream. Although hardwoods outnumbered conifers, and the conifers tended to be further away, a majority of conifers could still contribute sizable pieces of wood in the future. The average distance for old stumps was the same as the average distance for existing trees, suggesting that conifers have been persisting in the buffer. Most tree regeneration is hemlock, which should persist, if not grow fast. With a fairly steep gradient and the existing debris, placement of additional woody debris for fish habitat does not seem useful in this location.

Site 8: **Yaquina River Tributary** Northwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 7 sites, Clatsop to Lincoln Counties, North Coast Range.

Stream characteristics: Legal Description: T11S R10W Section 19
Small F stream
Area sampled: 50-foot width, 600-foot length sampled, two sides of stream
Acreage (horizontal basis): 1.23 acres
Channel Habitat Unit Frequency: 17% Pool, 25% Riffle, 58% Glide, single channel
Channel Substrate Frequency: 13% Fine, 37% Gravel, 50% Cobble
Confinement: 8%unconfined, 67% intermediate, 25% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	4	2-8	9
Stream Gradient (%)	9	5-13	10

Bank Transects:	Average	Range	Regional Average
Percent Slope	50	10-115	45
Percent Exposed Mineral Soil	11	0-70	9
Harvest-related Exp. Min.Soil	7	0-70 (fire trail)	5
Distance to Disturbance (ft)	57	25-75	49

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	61/acre	20/acre	41/acre	47/acre
Seedlings:	102/acre	41/acre	61/acre	113/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	94	93	83-98	86

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	83	164
Number of Pieces over 10" diameter	30	91
Percent solid (recently entered)	10%	18%
Percent functional (in-channel) debris	66%	81%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	15	0	15	16
Average Diameter	7	0	7	14
Average Height	25	0	25	31
Average Distance	24	0	24	36

Level of Decay: Moderately low, 2.1 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	120	8	112	113
Basal Area/1000 ft. (ft2/1000 ft)	123	49	74	145
Basal Area/ acre	120	47	72	134
Average DBH (inches) (Diameter at 4.5 ft)	12	29	11	15
Average Distance to Stream (ft)	34	63	32	34
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	36	33	40	53

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	0	0	0	22
Basal Area per 1000'*	0	0	0	41
Predicted Average DBH (in.)*	0	0	0	17
Average Distance (feet)	0	0	0	41

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	10	10
Basal Area per 1000'(ft2)*	32-40	56-66
Predicted Average DBH (in.)*	22-25	30-32
Average Distance (feet)	47	35

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, skyline yarding, slack-pulling carriage. Site visited 9-26-95. The stream's small size, steep gradient, and generally constraining banks mean that large woody debris would not be able to add a great deal to stream habitat complexity, especially at the upper end where the stream is almost seasonal. Wood can be important in these steep streams for trapping sediment and dissipating stream energy. The stream had some old large woody debris, but little recent input of fresh large wood. The average distance for old stumps was greater than the average distance for existing trees, suggesting that conifers have not persisted well in the buffer. A few large conifers are in the RMA, some of sufficient size and nearness to potentially contribute debris to the stream through windfall in the future. Conifers farther away could still contribute through downslope sliding of broken boles. Current conditions show somewhat low frequencies of pools and large woody debris, and the dominance of hardwoods means that most future woody debris will not be large-diameter, decay-resistant conifer. As existing debris decays and little large-diameter material is added from the riparian stand, placement of additional wood could be useful for stream structure and sediment storage; placement of wood for complex fish habitat might be more useful in lower-gradient reaches downstream.

Site 9: **Agency Creek Tributary** Northwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 7 sites, Clatsop to Lincoln Counties, North Coast Range.

Stream characteristics: Legal Description: T5S R8W Section 6
Small F stream, Conversion unit on last 250 feet sampled
Area sampled: 50-foot width, 600-foot length sampled, two sides of stream
Acreage (horizontal basis): 1.31 acres
Channel Habitat Unit Frequency: 50% Pool, 36% Riffle, 14% Glide, 1 multiple channel
Channel Substrate Frequency: 4% Fine, 50% Gravel, 25% Cobble, 21% Boulder
Confinement: 64% unconfined, 36% intermediate, none confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	12	7-17	9
Stream Gradient (%)	4	2-5	10

Bank Transects:	Average	Range	Regional Average
Percent Slope	31	4-75	45
Percent Exposed Mineral Soil	20	0-95	9
Harvest-related Exp. Min.Soil	16	0-95	5
Distance to Disturbance (ft)	37	20-75	49

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	38/acre	0/acre	38/acre	47/acre
Seedlings:	191/acre	0/acre	191/acre	113/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	69	74	4-100	86

Conversion area had almost no shade; otherwise channel was completely shaded by salmonberry.

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	193	164
Number of Pieces over 10" diameter	87	91
Percent solid(recently entered)	55%	18%
Percent functional (in-channel) debris	86%	81%

Numbers include 7 sites of LWD placement(out of 315 pieces) with conversion harvest.

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	15	8	7	16
Average Diameter	30	41	19	14
Average Height	36	39	33	31
Average Distance	43	57	28	36

Level of Decay: Moderately high, 2.8 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	57	9	48	113
Basal Area/1000 ft. (ft2/1000 ft)	158	33	125	145
Basal Area/ acre	144	30	114	134
Average DBH (inches) (Diameter at 4.5 ft)	22	23	21	15
Average Distance to Stream (ft)	42	106	30	34
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	82	36	91	53

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	24	2	23	22
Basal Area per 1000'*	50-58	7-8	43-50	41
Predicted Average DBH (in.)*	19-20	26-28	18-20	17
Average Distance (feet)	34	43	36	41

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	1	10
Basal Area per 1000'(ft2)*	3-4	56-66
Predicted Average DBH (in.)*	27-29	30-32
Average Distance (feet)	25	35

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, skyline yarding on one side, shovel logging on other, piled & burned. Site visited October 5-6, 1995.

The stream's reasonably low gradient, lack of tightly confining banks, plentiful gravel, and abundant salmonberry precluding young conifers made this site potentially useful as a conversion unit with wood placement. The alder were larger than many stands in the region, which means that most trees left in the RMA could potentially contribute sizable woody debris through windthrow. There were a few conifers, most farther away, some of which could potentially windthrow into the creek. The hardwood-dominated buffer and distance of most conifers make it unlikely that the stream would have much conifer wood in the future without the conversion unit. The seep area logged by the creek may be difficult to regenerate because of high moisture and abundant slash. Some pools and woody debris were present below the conversion unit, but the placed debris enhanced the stream's current capacity to form complex fish habitat. Activity on the stream banks from the large woody debris placement created one of the highest levels of exposed mineral soil encountered in the study.

Site 10: **Roaring Creek** Northwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 7 sites, Clatsop to Lincoln Counties, North Coast Range.

Stream characteristics: Legal Description: T1N R5W Section 22
Small F stream for lower 450 feet, Small N stream for upper 350 feet
Area sampled: 50-foot width, 800 ft length sampled on left bank, 400 ft on right bank
Acreage (horizontal basis): 1.14 acres
Channel Habitat Unit Frequency: 25% Pool, 50% Riffle, 25% Glide, 3 multiple channels
Channel Substrate Frequency: 9% fine, 25% gravel, 34%cobble, 19% boulder, 13% rock
Confinement: 38% intermediate, 62% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	10	5-20	9
Stream Gradient (%)	13	4-44	10

Bank Transects:	Average	Range	Regional Average
Percent Slope	68	10-102	45
Percent Exposed Mineral Soil	9	0-80	9
Harvest-related Exp. Min.Soil	4	0-40	5
Distance to Disturbance (ft)	50	25-70	49

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	436/acre	139/acre	297/acre	47/acre
Seedlings:	179/acre	139/acre	40/acre	113/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	93	92	63-100	86

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	210	164
Number of Pieces over 10" diameter	132	91
Percent solid(recently entered)	3%	18%
Percent functional (in-channel) debris	72%	81%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	13	7	6	16
Average Diameter	15	19	9	14
Average Height	31	18	46	31
Average Distance	36	36	36	36

Level of Decay: Moderately high, 2.7 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	98	29	69	113
Basal Area/1000 ft. (ft2/1000 ft)	156	99	57	145
Basal Area/ acre	165	104	61	134
Average DBH (inches) (Diameter at 4.5 ft)	14	21	12	15
Average Distance to Stream (ft)	33	32	33	34
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	43	74	30	53

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	2	1	1	22
Basal Area per 1000'*	3	2-3	0-1	41
Predicted Average DBH (in.)*	15-16	22-24	8-9	17
Average Distance (feet)	35	30	40	41

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	5	10
Basal Area per 1000'(ft2)*	34-39	56-66
Predicted Average DBH (in.)*	34-37	30-32
Average Distance (feet)	40	35

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut Harvest, cable and ground skidding, scarified for site preparation. Site visited 9-20 and 9-29-95.

A steep bedrock slide blocked fish passage upstream part way through the unit. Many of the conifers left in the RMA were large enough and near enough to potentially provide future wood through windthrow into the stream, although conifer numbers were limited. Young trees (mostly hemlocks and some redcedar) were also present and could be potential long-term sources of woody debris. Distances of remaining conifers are less than many of the old conifer stumps, suggesting that conifer has persisted in the buffer. There was large woody debris present in the stream, some of it quite large, but little has been added recently. Much of the stream is steep and generally confined, meaning that LWD would have limited ability to develop complex fish habitat. Wood in steep reaches can be useful for trapping sediment and dissipating stream energy. If additions of large wood continue to be low and existing wood decays, future placement of wood could be useful for fish habitat or stream structure, particularly in lower-gradient reaches.

Site 11: **Unnamed Creek, Tigard** Northwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 7 sites, Clatsop to Lincoln Counties, North Coast Range.

Stream characteristics: Legal Description: T2S R1W Sections 4 and 3

Small N (intermittent) and F stream

Area sampled: 50-foot width, 450 ft length sampled (450 right bank, 200 left bank)

Acreage (horizontal basis): 0.73 acres

Channel Habitat Unit Frequency: 0% Pool, 33% Riffle, 56% Glide, single channel

Channel Substrate Frequency: 100% fine, no gravel, cobble, boulder, bedrock

Confinement: 11% intermediate, 89% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	3	2-5	9
Stream Gradient (%)	9	3-17	10

Bank Transects:	Average	Range	Regional Average
Percent Slope	23	0-70	45
Percent Exposed Mineral Soil	4	0-25	9
Harvest-related Exp. Min.Soil	1	0-20	5
Distance to Disturbance (ft)	25	1-30	49

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	95/acre	0/acre	95/acre	47/acre
Seedlings:	420/acre	0/acre	420/acre	113/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	87	92	56-100	86

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	53	164
Number of Pieces over 10" diameter	20	91
Percent solid(recently entered)	21%	18%
Percent functional (in-channel) debris	88%	81%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	15	10	5	16
Average Diameter	10	10	9	14
Average Height	44	50	33	31
Average Distance	46	59	24	36

Level of Decay: Low, 1.3 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	102	49	52	113
Basal Area/1000 ft. (ft2/1000 ft)	126	58	68	145
Basal Area/ acre	112	52	60	134
Average DBH (inches) (Diameter at 4.5 ft)	14	14	15	15
Average Distance to Stream (ft)	31	38	25	34
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	64	56	71	53

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	43	43	0	22
Basal Area per 1000'*	101-118	101-118	0	41
Predicted Average DBH (in.)*	21-22	21-22	0	17
Average Distance (feet)	33	33	0	41

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	9	10
Basal Area per 1000'(ft2)*	31-35	56-66
Predicted Average DBH (in.)*	24-26	30-32
Average Distance (feet)	21	35

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Diameter limit harvest, ground skidding. Site visited 10-4-95.

The stream had low flow, fine-textured bottom, few pools or riffles, and little instream woody debris, all of which provide limitations for fish habitat. The lower reaches of the small creek may be important for winter habitat, for example as refuge areas from high flows in the larger creek just downstream. Woody debris can be important in small or steep streams for trapping sediment and dissipating stream energy. Near the mouth of the small creek, few conifer were present for future sources of large woody debris. Alder were present and were of similar size to many of the conifer. They could play a role as woody debris, but often decay faster than conifers, so are not as stable over time. Further upstream where the stream becomes intermittent, conifer are in locations that could contribute large woody debris. Placement of wood could be useful in developing pools in the lower section of the stream where the gradient is fairly shallow.

Site 12: **Slab Creek Tributary** Northwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 7 sites, Clatsop to Lincoln Counties, North Coast Range.

Stream characteristics: Legal Description: T6S R10W Section 9
Small D stream
Area sampled: 50-foot width, 600 foot length sampled (above logging road), two sides
Acreage (horizontal basis): 1.24 acres
Channel Habitat Unit Frequency: 17% Pool, 83% Riffle, 0% Glide, single channel
Channel Substrate Frequency: 38% fine, 50% gravel, 12% boulder
Confinement: 100% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	6	3-8	9
Stream Gradient (%)	25	20-33	10

Bank Transects:	Average	Range	Regional Average
Percent Slope	49	8-95	45
Percent Exposed Mineral Soil	7	0-60	9
Harvest-related Exp. Min.Soil	3	0-60	5
Distance to Disturbance (ft)	60	20-85	49

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	76/acre	76/acre	0/acre	47/acre
Seedlings:	439/acre	439/acre	0/acre	113/acre

many small hemlock and spruce, suppressed

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average

not measured, site visited halfway through leaf-fall.

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	200	164
Number of Pieces over 10" diameter	77	91
Percent solid(recently entered)	13%	18%
Percent functional (in-channel) debris	79%	81%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	26	14	12	16
Average Diameter	12	16	9	14
Average Height	30	29	30	31
Average Distance	34	31	38	36

Level of Decay: Moderate, 2 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	155	73	82	113
Basal Area/1000 ft. (ft2/1000 ft)	177	91	86	145
Basal Area/ acre	171	88	83	134
Average DBH (inches) (Diameter at 4.5 ft)	14	14	13	15
Average Distance to Stream (ft)	32	31	33	34
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	48	44	52	53

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	32	26	6	22
Basal Area per 1000'*	38-48	34-44	4	41
Predicted Average DBH (in.)*	14-16	15-17	11	17
Average Distance (feet)	40	41	36	41

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	21	10
Basal Area per 1000'(ft2)*	68-85	56-66
Predicted Average DBH (in.)*	24-26	30-32
Average Distance (feet)	37	35

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Diameter limit harvest, ground skidding. Site visited 10-16-95.

The stream was steep, narrow, and highly constrained by the banks, so that large woody debris had little opportunity to develop complex fish habitat. Wood can be important in steep streams for trapping sediment in step pools, dissipating energy, and protecting the streambed and banks. The lower reaches of the small stream may be important for winter fish habitat, for example as refuge areas from high flows in the larger creek just downstream. There were almost as many conifers as hardwoods in the buffer and conifer regeneration, mostly Sitka spruce and hemlock, was abundant. Almost half of the conifers were in locations that could easily contribute large woody debris through future windfall. Average distance of existing conifers was less than the average distance of old conifer stumps, suggesting that conifer has persisted in the buffer, although with much smaller diameters. With the steep gradient, existing wood, and riparian conifers, placement of woody debris in the stream would not be very useful for fish habitat here.

Site 13: **North Rock Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T21S R5W Section 11
Medium F stream
Area sampled: 70-foot width, 600 ft length sampled, one side
Acreage (horizontal basis): 0.89 acres
Channel Habitat Unit Frequency: 33% Pool, 42% Riffle, 25% Glide, one multiple channel
Channel Substrate Frequency: 46% fine, 37% gravel, 17% cobble
Confinement: 50% intermediate, 50% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	11	7-18	12
Stream Gradient (%)	5	3-8	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	41	-10-76	38
Percent Exposed Mineral Soil	3	0-30	5
Harvest-related Exp. Min.Soil	1	0-20	1
Distance to Disturbance (ft)	28	25-75	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	0/acre	0/acre	0/acre	42/acre
Seedlings:	244/acre	244/acre	0/acre	62/acre

All seedlings found were planted Douglas-fir.

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
Shade not measured, site visited after leaf-fall				93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	252	193
Number of Pieces over 10" diameter	118	117
Percent solid(recently entered)	9%	13%
Percent functional (in-channel) debris	92%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	8	3	5	12
Average Diameter	12	9	14	12
Average Height	44	45	43	36
Average Distance	34	62	14	33

Level of Decay: Low, 1.3 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	115	47	68	111
Basal Area/1000 ft. (ft2/1000 ft)	176	97	79	134
Basal Area/ acre	119	65	53	98
Average DBH (inches) (Diameter at 4.5 ft)	16	18	14	15
Average Distance to Stream (ft)	41	47	38	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	59	61	59	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	30	27	3	19
Basal Area per 1000'*	57-66	53-62	4	32
Predicted Average DBH (in.)*	18-19	18-20	14-15	17
Average Distance (feet)	52	54	38	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	28	13
Basal Area per 1000'(ft2)*	140-160	78-90
Predicted Average DBH (in.)*	29-31	32-34
Average Distance (feet)	46	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, skyline yarding, slack-pulling carriage. Site visited November 9 and 10, 1995.

The stream was somewhat steep and has some constraining banks, but it was large enough and had enough floodplain to allow large woody debris to develop complex fish habitat. The stream had woody debris functioning to form pools and collect gravels. The substrate had a substantial portion of fines among the gravel, which may limit habitat quality for fish spawning. Additions of fine sediment in excess of the ability of the stream to transport them can contribute to stream widening, braiding, and transport of gravels. The road adjacent to the stream may provide a source of fine sediment under some conditions. Many of the trees left in the RMA, both conifer and hardwood, could easily be capable of providing large woody debris to the stream through future windfalls. There was no natural regeneration of trees except for seedlings planted at the edge of the RMA. Nonetheless, average distance of old conifer stumps is similar to average distance of living conifers, suggesting that conifers have been persisting in the buffer. The stream potentially could respond to placement of additional large woody debris, which may be useful if future inputs of wood are low and existing debris decays.

Site 14: **Renfro Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T26S R8W Section 34
Medium F stream, Basal Area Credits from stream enhancement work used.
Area sampled: 70-foot width, 600 ft length sampled, one side
Acreage (horizontal basis): 0.84 acres
Channel Habitat Unit Frequency: 50% Pool, 42% Riffle, 8% Glide, 2 multiple channels
Channel Substrate Frequency: 33%fine, 8%gravel, 42% cobble, 8% boulder, 7%bedrock
Confinement: 17% unconfined, 66% intermediate, 17% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	21	17-26	12
Stream Gradient (%)	7	2-12	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	56	-11-95	38
Percent Exposed Mineral Soil	12	0-55	5
Harvest-related Exp. Min.Soil	7	0-55	1
Distance to Disturbance (ft)	30	20-35	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	17/acre	17/acre	0/acre	42/acre
Seedlings:	69/acre	52/acre	17/acre	62/acre

An additional 70 seedlings/acre of planted Douglas-fir were observed.

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	Shade not measured, site visited after leaf-fall			93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	272	193
Number of Pieces over 10" diameter	137	117
Percent solid (recently entered)	31%	13%
Percent functional (in-channel) debris	84%	85%

There were 11 sites of placed woody debris noted (out of 304 total number of pieces).

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	18	12	6	12
Average Diameter	19	21	14	12
Average Height	58	66	42	36
Average Distance	38	45	24	33

Level of Decay: Intermediate, 2.3 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	63	43	20	111
Basal Area/1000 ft. (ft2/1000 ft)	101	64	37	134
Basal Area/ acre	72	45	27	98
Average DBH (inches) (Diameter at 4.5 ft)	16	15	18	15
Average Distance to Stream (ft)	23	23	23	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	63	50	92	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	20	17	3	19
Basal Area per 1000'*	49-57	47-55	2	32
Predicted Average DBH (in.)*	20-21	22-23	11	17
Average Distance (feet)	59	58	63	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (most conifer, 1hdwd):	Average	Regional Average
Number per 1000'	10	13
Basal Area per 1000'(ft2)*	45-52	78-90
Predicted Average DBH (in.)*	26-28	32-34
Average Distance (feet)	22	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, highlead cable yarding. Site visited 10-30-95.

The stream gradient was somewhat steep, but the stream was large enough and had enough room in its banks to allow large woody debris to develop complex fish habitat. The wood placed in conjunction with the harvest functioned as the base of debris accumulations, forming pools and bars, and augmenting the natural debris in the stream. Windthrow of residual trees was adding even more wood. Some of the windthrown trees were still suspended above the stream (nonfunctional), and would contribute debris later. Larger cobbles were more common than gravels as stream substrate, which may be limiting areas of breeding habitat for salmonids. Wood can be important in steep streams for trapping and storing sediment. Many of the trees left in the RMA could easily be capable of providing large woody debris in the future through windthrow. With the steep slopes on the site, trees farther away might still be able to contribute large wood to the stream through mechanisms such as bole breakage and downslope sliding. Natural regeneration was not abundant, but Douglas-fir seedlings had been planted in harvested portions of the RMA.

Site 15: **Camp Creek Tributary** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T16S R1W Section 32
Small F stream
Area sampled: 50-foot width, 750 feet length sampled on left bank, 300 feet on right
Acreage (horizontal basis): 1.17 acres
Channel Habitat Unit Frequency: 40% Pool, 47% Riffle, 13% Glide, 3 multiple channels
Channel Substrate Frequency: 43% fine, 30% gravel, 27% boulder
Confinement: 27% unconfined, 53% intermediate, 20% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	11	6-20	12
Stream Gradient (%)	4	1-7	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	22	-5-68	38
Percent Exposed Mineral Soil	2	0-30	5
Harvest-related Exp. Min.Soil	1	0-15	1
Distance to Disturbance (ft)	46	20-105	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	100/acre	50/acre	50/acre	42/acre
Seedlings:	1103/acre	184/acre	919/acre	62/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	88	87	54-100	93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	115	193
Number of Pieces over 10" diameter	72	117
Percent solid(recently entered)	4%	13%
Percent functional (in-channel) debris	90%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	5	5	0	12
Average Diameter	11	11	0	12
Average Height	39	39	0	36
Average Distance	19	19	0	33

Level of Decay: Moderately low, 1.7 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	54	52	2	111
Basal Area/1000 ft. (ft2/1000 ft)	83	74	9	134
Basal Area/ acre	75	67	8	98
Average DBH (inches) (Diameter at 4.5 ft)	16	16	29	15
Average Distance to Stream (ft)	27	27	30	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	74	73	100	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	37	37	0	19
Basal Area per 1000'*	40-47	40-47	0	32
Predicted Average DBH (in.)*	13-15	13-15	0	17
Average Distance (feet)	38	38	0	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	18	13
Basal Area per 1000'(ft2)*	100-118	78-90
Predicted Average DBH (in.)*	31-33	32-34
Average Distance (feet)	27	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, feller-buncher harvester and forwarder. Site visited October 18 and 19, 1995.

The stream's reasonably low gradient and lack of tightly constraining banks could allow large woody debris to develop complex fish habitat. In the reaches closer to the road, the stream had some existing woody debris forming pools and gravels were present. Farther downstream, the stream flattened out, meandered more, and was marshy with a lot of fine sediment. Many of the trees left in the RMA could easily be capable of providing large woody debris to the stream through windthrow. Hardwood sprouts and seedlings were abundant, providing potential competition for future conifers. Existing conifers had average distances similar to that of old stumps, suggesting that conifers have persisted near the stream. Placing additional woody debris could be useful for developing fish habitat in the middle section of the stream, where it could supplement the relatively low levels of woody debris, help trap sediment, and create complex fish habitat. Large wood had collected just above the culvert for the road, and may have been limiting wood inputs from upstream to the reach measured.

Site 16: **Owens Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in S. Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T15S R6W Section 33
Medium F stream, Conversion Unit
Area sampled: 50-foot width, 600 feet length sampled, two sides
Acreage (horizontal basis): 1.31 acres
Channel Habitat Unit Frequency: 25% Pool, 33% Riffle, 42% Glide, single channel
Channel Substrate Frequency: 33% fine, 8% gravel, 21% cobble, 13% boulder, 25% rock
Confinement: 50% unconfined, 50% intermediate

	Average	Range	Regional Average(study sites)
Stream Width (ft)	11	6-16	12
Stream Gradient (%)	5	3-9	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	32	-15-98	38
Percent Exposed Mineral Soil	2	0-15	5
Harvest-related Exp. Min.Soil	1	0-10	1
Distance to Disturbance (ft)	41	15-70	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	143/acre	0/acre	143/acre	42/acre
Seedlings:	81/acre	0/acre	81/acre	62/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
Shade not measured, site visited after leaf fall				93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	208	193
Number of Pieces over 10" diameter	107	117
Percent solid(recently entered)	10%	13%
Percent functional (in-channel) debris	84%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	9	1	8	12
Average Diameter	12	38	10	12
Average Height	35	15	37	36
Average Distance	15	15	1	33

Level of Decay: Moderately low, 1.6 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	93	2	91	111
Basal Area/1000 ft. (ft2/1000 ft)	94	8	86	134
Basal Area/ acre	86	7	79	98
Average DBH (inches) (Diameter at 4.5 ft)	12	29	12	15
Average Distance to Stream (ft)	23	48	22	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	38	41	50	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	26	13	13	19
Basal Area per 1000'*	23-27	13-16	10-12	32
Predicted Average DBH (in.)*	12-13	13-14	11-12	17
Average Distance (feet)	54	55	53	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (most conifer, 2 hdwd):	Average	Regional Average
Number per 1000'	10	13
Basal Area per 1000'(ft2)*	43-50	78-90
Predicted Average DBH (in.)*	27-29	32-34
Average Distance (feet)	31	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, cable/swing yarder most of unit (some tractor skidding). Site visited October 26 and 28, 1995.

The stream was large enough and had enough of a floodplain to allow large woody debris to develop pools and bars, although the gradient was a little steep for developing complex fish habitat. The stream currently had some woody debris functioning to form pools, interspersed with some areas of scoured bedrock. Some of the trees left in the RMA could easily be capable of providing large woody debris in the future, with a greater proportion likely as trees grow larger. Many of the trees were too small to add the minimum piece size used in the analysis, 8 inches diameter and 5 foot length, except when very close. A few large cedars were in the RMA, but most other conifer had been removed at some point. Existing trees and new conifer stumps tended to be farther away than old conifer stumps, suggesting a loss of conifers near the stream over time. If the conversion unit is successful in establishing new conifers near the stream, it could reverse that trend. Gravels were low, and additional woody debris could be useful in retaining gravels and forming more pools and bars, especially in areas currently down to bedrock.

Site 17: **Whiskey Creek Tributary** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T16S R2W Section 2

Small F stream

Area sampled: 50-foot width, 600 feet length sampled, one side

Acreage (horizontal basis): 0.68 acres

Channel Habitat Unit Frequency: 34% Pool, 33% Riffle, 33% Glide, single channel

Channel Substrate Frequency: 71% fine, 4% gravel, 25% cobble

Confinement: 33% unconfined, 42% intermediate, 25% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	6	3-10	12
Stream Gradient (%)	8	1-10	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	18	-5-50	38
Percent Exposed Mineral Soil*	na	na	5
Harvest-related Exp. Min.Soil*	na	na	1
Distance to Disturbance (ft)*	na	na	57

* unit not yarded at time of site visit

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	38/acre	0/acre	38/acre	42/acre
Seedlings:	114/acre	57/acre	57/acre	62/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
Shade not measured, site visited after leaf fall				93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	130	193
Number of Pieces over 10" diameter	52	117
Percent solid(recently entered)	9%	13%
Percent functional (in-channel) debris	85%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	21	15	6	12
Average Diameter	13	15	9	12
Average Height	34	40	21	36
Average Distance	38	43	26	33

Level of Decay: Intermediate, 2.7 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	28	15	13	111
Basal Area/1000 ft. (ft2/1000 ft)	70	59	11	134
Basal Area/ acre	61	52	9	98
Average DBH (inches) (Diameter at 4.5 ft)	19	26	12	15
Average Distance to Stream (ft)	14	19	9	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	88	100	75	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	25	25	0	19
Basal Area per 1000'*	64-75	64-75	0	32
Predicted Average DBH (in.)*	21-23	21-23	0	17
Average Distance (feet)	44	44	0	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (most conifer, 2 hdwd):	Average	Regional Average
Number per 1000'	35	13
Basal Area per 1000'(ft2)*	216-247	78-90
Predicted Average DBH (in.)*	32-35	32-34
Average Distance (feet)	22	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, cable yarding. Site visited 11-3-95, while yarding was underway.

The stream had some woody debris functioning to form pools, although few pieces were very large. The old beaver pond area had a lot of fine sediment and marshy areas that did not support trees. Beaver ponds with their abundant fines and sparse gravels are not ideal for spawning areas, but can be valuable for winter refuges or rearing habitat. Because of the size and close proximity of the conifers to the stream, all of the conifers left in the RMA could easily be capable of providing large woody debris through future windthrow. As a productive conifer area, there is good potential for future conifer woody debris. Despite the high potential for contribution by the residual conifers, the total number of streamside trees is low on the harvested side and woody debris is relatively low. Placement of additional wood could be useful in portions of the streams with moderate gradient to develop and maintain complex fish habitat and trap sediment.

Site 18: **Paradise Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T22S R8W Section 3 and 2
Large F stream
Area sampled: 100-foot width, 600 feet length sampled, one side
Acreage (horizontal basis): 1.32 acres
Channel Habitat Unit Frequency: 58% Pool, 17% Riffle, 25% Glide, single channel
Channel Substrate Frequency: 63% fine, 17% gravel, 21% bedrock
Confinement: 100% unconfined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	30	25-40	12
Stream Gradient (%)	1	0-3	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	30	2-102	38
Percent Exposed Mineral Soil	6	0-50	5
Harvest-related Exp. Min.Soil	1	0-35	1
Distance to Disturbance (ft)	123	90-150	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	191/acre	0/acre	191/acre	42/acre
Seedlings:	64/acre	0/acre	64/acre	62/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
Shade not measured, site visited after leaf fall				93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	48	193
Number of Pieces over 10" diameter	13	117
Percent solid(recently entered)	24%	13%
Percent functional (in-channel) debris	93%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	12	3	9	12
Average Diameter	13	27	8	12
Average Height	26	18	28	36
Average Distance	30	58	21	33

Level of Decay: Moderately low, 2.1 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	212	73	138	111
Basal Area/1000 ft. (ft2/1000 ft)	287	165	122	134
Basal Area/ acre	130	75	55	98
Average DBH (inches) (Diameter at 4.5 ft)	15	19	12	15
Average Distance to Stream (ft)	28	63	12	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	75	57	84	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	0	0	0	19
Basal Area per 1000'*	0	0	0	32
Predicted Average DBH (in.)*	0	0	0	17
Average Distance (feet)	0	0	0	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps:	Average	Regional Average
Number per 1000'	0	13
Basal Area per 1000'(ft2)*	0	78-90
Predicted Average DBH (in.)*	0	32-34
Average Distance (feet)	0	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, tractor yarding. Site visited 11-7-95.

The recently windthrown trees had greatly increased the pool habitat in the stream, a real contrast to the bedrock bottom further upstream. The different potential of trees to contribute large wood to the stream is illustrated by a couple of the windthrown trees that had built debris complexes in the stream, while several other trees lay in the RMA without reaching the stream. The relatively low gradient and lack of tightly constraining banks allow large woody debris to develop complex fish habitat in the stream. The pools were underlain mainly by fines. As a large stream, it tends to transport wood downstream, resulting in lower levels than some of the smaller streams which make up the regional average. Windthrow and stream action in the floodplain accounted for most of the exposed mineral soil. Placement of additional wood could be useful in some reaches, for example, to develop a more varied substrate in bedrock areas, taking into account the high flows and tendency of a large stream to transport debris.

Site 19: **Parsons Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T16S R2W Section 10
Large F stream, cut using pre-1994 rules
Area sampled: 100-foot width, 600 feet length sampled, one side
Acreage (horizontal basis): 1.37 acres
Channel Habitat Unit Frequency: 33% Pool, 42% Riffle, 25% Glide, single channel
Channel Substrate Frequency: 25% fine, 4% cobble, 71% boulder
Confinement: 42% unconfined, 58% intermediate, none confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	29	21-40	12
Stream Gradient (%)	4	3-8	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	9	-14-36	38
Percent Exposed Mineral Soil	11	0-100(road)	5
Harvest-related Exp. Min.Soil	10	0-100(road)	1
Distance to Disturbance (ft)	52	30-105	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	530/acre	42/acre	488/acre	42/acre
Seedlings:	1676/acre	21/acre	1655/acre	62/acre

276 seedlings/acre of planted Douglas-fir seedlings also noted

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
Shade not measured, site visited after leaf fall				93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	28	193
Number of Pieces over 10" diameter	13	117
Percent solid(recently entered)	0%	13%
Percent functional (in-channel) debris	100%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	14	6	8	12
Average Diameter	15	22	9	12
Average Height	35	46	26	36
Average Distance	54	39	66	33

Level of Decay: Moderately low, 1.9 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	228	87	142	111
Basal Area/1000 ft. (ft2/1000 ft)	374	155	219	134
Basal Area/ acre	164	68	96	98
Average DBH (inches) (Diameter at 4.5 ft)	15	17	13	15
Average Distance to Stream (ft)	35	49	27	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	52	48	54	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	38	38	0	19
Basal Area per 1000'*	126-148	126-148	0	32
Predicted Average DBH (in.)*	24-26	24-26	0	17
Average Distance (feet)	56	56	0	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps (all conifer):	Average	Regional Average
Number per 1000'	37	13
Basal Area per 1000'(ft2)*	204-237	78-90
Predicted Average DBH (in.)*	30-33	32-34
Average Distance (feet)	56	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Selective harvest/thin, tractor yarding. Site visited November 1 and 2, 1995.

There was very little large woody debris in the reach sampled, some of the lowest counts observed in the study. The large wood that was present had substantial impact in a few cases, forming backwaters and pools. The relatively low gradient and lack of tightly constraining banks could allow large woody debris to develop complex fish habitat in the stream. Large streams tend to transport woody debris downstream, so levels of woody debris lower than the smaller streams in the regional average would be expected for this stream. No recent inputs of large wood were observed. About half of the trees left in the RMA are large enough and close enough to contribute large woody debris to the stream through future windthrow. Most soil disturbance was from roadbanks. Placement of additional large wood in the stream could be useful for creating more complex fish habitat in the stream, if carefully designed to handle the higher flows expected in a large stream. The stream bottom was dominated by boulders and additional wood could create areas that collect gravels, the preferred habitat for spawning.

Site 20: **Lost Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T28S R9W Section 2
Medium N stream
Area sampled: 70-foot width, 600 feet length sampled, two sides
Acreage (horizontal basis): 1.8 acres
Channel Habitat Unit Frequency: 50% Pool, 50% Riffle, 0% Glide, 2 multiple channels
Channel Substrate Frequency: 50% fine, 33% gravel, 17% bedrock
Confinement: 58% unconfined, 42% intermediate, none confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	10	3-21	12
Stream Gradient (%)	5	1-10	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	38	-2-90	38
Percent Exposed Mineral Soil	5	0-25	5
Harvest-related Exp. Min.Soil	0	0-10	1
Distance to Disturbance (ft)	74	55-95	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	651/acre	81/acre	570/acre	42/acre
Seedlings:	163/acre	20/acre	143/acre	62/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	98	96	85-100	93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	2228	193
Number of Pieces over 10" diameter	183	117
Percent solid(recently entered)	6%	13%
Percent functional (in-channel) debris	81%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	3	2	1	12
Average Diameter	8	9	8	12
Average Height	33	38	23	36
Average Distance	49	66	15	33

Level of Decay: Low, 1.2 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	147	85	62	111
Basal Area/1000 ft. (ft2/1000 ft)	163	99	64	134
Basal Area/ acre	109	66	43	98
Average DBH (inches) (Diameter at 4.5 ft)	14	14	13	15
Average Distance to Stream (ft)	41	53	24	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	41	30	55	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	0	0	0	19
Basal Area per 1000'*	0	0	0	32
Predicted Average DBH (in.)*	0	0	0	17
Average Distance (feet)	0	0	0	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps(all conifer):	Average	Regional Average
Number per 1000'	8	13
Basal Area per 1000'(ft2)*	117-134	78-90
Predicted Average DBH (in.)*	49-52	32-34
Average Distance (feet)	45	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, cable yarding. Site visited September 13 and 14, 1995.

The stream meandered in a fine-textured floodplain on the lower part of the reach, creating a relatively high occurrence of fines as stream substrate. There were several large debris jams, clustered in the upper part of the reach. Woody debris was abundant, but many of the largest pieces were fairly decayed and there were limited sources for large conifer debris to be added. Many of the trees present in the RMA were too small to add the minimum piece size of large woody debris used for analysis (8" diameter, 5 ft length). This situation should change as the trees grow larger, although the conifers tended to be farther away and would take longer to grow large enough to contribute a sizable piece of wood to the stream through windthrow. Since fish passage was blocked farther downstream, large woody debris would be useful more for its role in storage of sediment and dissipating stream energy than for developing complex fish habitat. With abundant woody debris currently and no anadromous fish present, placement of additional wood would not be useful at this time.

Site 21: **Little Bear Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T29S R13W Section 19
Medium F stream
Area sampled: 70-foot width, 600 feet length sampled, one side
Acreage (horizontal basis): 0.84 acres
Channel Habitat Unit Frequency: 42% Pool, 33% Riffle, 25% Glide, single channel
Channel Substrate Frequency: 25% fine, 42% gravel, 27% cobble, 6% boulder
Confinement: 17% unconfined, 50% intermediate, 33% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	9	5-15	12
Stream Gradient (%)	5	1-11	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	55	5-110	38
Percent Exposed Mineral Soil	9	0-60	5
Harvest-related Exp. Min.Soil	2	0-50	1
Distance to Disturbance (ft)	84	75-90	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	183/acre	163/acre	20/acre	42/acre
Seedlings:	0/acre	0/acre	0/acre	62/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	95	93	75-100	93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	242	193
Number of Pieces over 10" diameter	190	117
Percent solid(recently entered)	14%	13%
Percent functional (in-channel) debris	70%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	25	11	14	12
Average Diameter	8	6	8	12
Average Height	30	36	26	36
Average Distance	51	62	42	33

Level of Decay: Intermediate, 2.5 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	228	62	166	111
Basal Area/1000 ft. (ft2/1000 ft)	163	46	117	134
Basal Area/ acre	117	33	84	98
Average DBH (inches) (Diameter at 4.5 ft)	11	11	11	15
Average Distance to Stream (ft)	48	65	42	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	29	8	37	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	0	0	0	19
Basal Area per 1000'*	0	0	0	32
Predicted Average DBH (in.)*	0	0	0	17
Average Distance (feet)	0	0	0	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps(all conifer):	Average	Regional Average
Number per 1000'	2	13
Basal Area per 1000'(ft2)*	9-10	78-90
Predicted Average DBH (in.)*	30-32	32-34
Average Distance (feet)	60	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, cable yarding. Site visited September 11 and 12, 1995. Stream gradient was somewhat steep but the presence of some unconstrained banks and plentiful gravels meant that the stream could develop moderately complex fish habitat around large woody debris. Woody debris was abundant and there were some very large conifer logs in the stream, but there were few large conifers in the riparian stand that potentially could be future woody debris. The sparseness of old conifer stumps suggests that most conifer debris previously came from upslope. A low percentage of conifers in the RMA could fall directly into the stream through windthrow; most were too small and too far away to deliver the piece size used in the analysis (8-inch diameter, 5-foot length). On steep slopes such as these, bole breakage and downslope sliding could be expected, so a greater proportion of the conifers might actually be able to contribute than calculated from potential direct windthrow. Future growth would also increase the proportion of trees able to easily affect the stream. Much of the exposed soil in the RMA was due to deer and elk trails. As the large debris decays and no large-diameter wood is added from the stand, placement of additional large wood could be useful in the future to maintain fish habitat and sediment storage.

Site 22: **Talbot Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T26S R13W Sections 31& 32
Small F stream
Area sampled: 50-foot width, 1100 feet length sampled, one side
Acreage (horizontal basis): 1.12 acres
Channel Habitat Unit Frequency: 17% Pool, 42% Riffle, 41% Glide, single channel
Channel Substrate Frequency: 67% fine, 25% gravel, 8% cobble
Confinement: 50% intermediate, 50% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	4	2-6	12
Stream Gradient (%)	6	2-12	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	51	0-100	38
Percent Exposed Mineral Soil	2	0-20	5
Harvest-related Exp. Min.Soil	1	0-20	1
Distance to Disturbance (ft)	45	35-55	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	0/acre	0/acre	0/acre	42/acre
Seedlings:	0/acre	0/acre	0/acre	62/acre

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	85	95	90-98	93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	243	193
Number of Pieces over 10" diameter	185	117
Percent solid(recently entered)	8%	13%
Percent functional (in-channel) debris	83%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	8	3	5	12
Average Diameter	10	12	9	12
Average Height	26	36	21	36
Average Distance	26	33	23	33

Level of Decay: Moderately low, 2 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	63	24	39	111
Basal Area/1000 ft. (ft2/1000 ft)	70	32	38	134
Basal Area/ acre	69	31	38	98
Average DBH (inches) (Diameter at 4.5 ft)	14	15	13	15
Average Distance to Stream (ft)	28	31	25	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	67	42	81	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	35	4	31	19
Basal Area per 1000'*	34-40	9-11	25-29	32
Predicted Average DBH (in.)*	13-14	20-22	12-13	17
Average Distance (feet)	38	38	38	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps(most conifer, 1 hdwd):	Average	Regional Average
Number per 1000'	7	13
Basal Area per 1000'(ft2)*	34-39	78-90
Predicted Average DBH (in.)*	28-30	32-34
Average Distance (feet)	39	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, cable yarding. Site visited 9-6-95.

Woody debris was abundant in the stream, but recently added pieces were smaller than the older pieces. With a stream as small as this, smaller trees can be functionally useful. The gradient was not too steep in many sections for large wood to be useful for developing some complex fish habitat, especially where the banks were not tightly constraining stream movement. In steep, constrained sections, the wood may be important for forming step pools, trapping sediment, and dissipating erosive power. Slightly less than half of the conifers left in the RMA could fall directly into the stream and deliver the piece size specified in the analysis (8-inch diameter, 5-foot length). Future growth would increase this proportion, and with the steep slopes, downslope sliding of broken boles could actually allow more distant trees to contribute. Placement of additional wood would not be very useful to the stream now because wood is currently present, but may be useful in maintaining fish habitat and sediment storage in the future if inputs from the riparian stand are low as the existing wood decays.

Site 23: **Myrtle Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T30S R11W Section 28
Area sampled: 100-foot width, 350 feet length sampled, one side, pre-1994 rules
Acreage (horizontal basis): 0.69 acres
Channel Habitat Unit Frequency: 43% Pool, 14% Riffle, 43% Glide, single channel
Channel Substrate Frequency: 57% cobble, 43% bedrock
Confinement: 14% intermediate, 86% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	9	5-15	12
Stream Gradient (%)	5	1-11	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	61	10-95	38
Percent Exposed Mineral Soil	4	0-35	5
Harvest-related Exp. Min.Soil	1	0-5	1
Distance to Disturbance (ft)	73	50-80	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	242/acre	56/acre	186/acre	42/acre
Seedlings:	205/acre	56/acre	149/acre	62/acre

An additional 56 seedlings/acre were planted Douglas-fir, between 70-100 ft from stream.

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	68	71	27-100	93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	23	193
Number of Pieces over 10" diameter	14	117
Percent solid(recently entered)	13%	13%
Percent functional (in-channel) debris	100%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	5	2	3	12
Average Diameter	9	8	10	12
Average Height	25	40	18	36
Average Distance	73	70	75	33

Level of Decay: Intermediate, 2.7 on scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	180	77	103	111
Basal Area/1000 ft. (ft2/1000 ft)	127	57	71	134
Basal Area/ acre	93	41	52	98
Average DBH (inches) (Diameter at 4.5 ft)	11	11	11	15
Average Distance to Stream (ft)	39	58	25	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	24	7	36	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	63	63	0	19
Basal Area per 1000'*	76-91	76-91	0	32
Predicted Average DBH (in.)*	14-15	14-15	0	17
Average Distance (feet)	88	88	0	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps(most conifer, 1 hdwd):	Average	Regional Average
Number per 1000'	13	13
Basal Area per 1000'(ft2)*	38-44	78-90
Predicted Average DBH (in.)*	22-24	32-34
Average Distance (feet)	88	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, tractor yarding. Site visited 10-9-95.

The stream bottom was mainly cobbles and bedrock; gravels are usually preferred for fish spawning areas. Woody debris levels were lower than many encountered in the study, and there were few other mechanisms to collect gravels. Large streams tend to transport woody debris downstream, so woody debris levels lower than the regional average using some smaller streams would be expected. Where present, large woody debris was effective in forming pools and bars, even though the stream was a little steep and constrained by banks in most areas. The shade was reduced by the powerline right-of-way, but not noticeably by harvesting. Few of the conifers left in the RMA could fall directly into the stream and deliver the piece size specified in the analysis (8-inch diameter, 5-foot length). Future growth would increase this proportion, and with the steep slopes, downslope sliding of broken boles would actually allow more distant trees to contribute. Placement of additional wood could be useful in the stream to develop more varied fish habitat, if projects were carefully designed to withstand the high flows of a larger stream.

Site 24: **Floras Creek** Southwest Oregon Region

This is a summary of selected conditions in riparian areas after harvesting, focusing on large woody debris. It is not an assessment of compliance with the Forest Practices Act. The regional average is based on 9 sites, in the South Coast Range, SW Cascades, and Siskiyous.

Stream characteristics: Legal Description: T30S R14W Section 33

Large F stream, pre-1994 rules
Area sampled: 100-foot width, 600 feet length sampled, one side
Acreage (horizontal basis): 1.3 acres
Channel Habitat Unit Frequency: 42% Pool, 33% Riffle, 25% Glide, single channel
Channel Substrate Frequency: 42% gravel, 8% cobble, 50% boulder
Confinement: 58% intermediate, 42% confined

	Average	Range	Regional Average(study sites)
Stream Width (ft)	80	45-105	12
Stream Gradient (%)	2	0-5	5

Bank Transects:	Average	Range	Regional Average
Percent Slope	36	0-105	38
Percent Exposed Mineral Soil	20	0-95	5
Harvest-related Exp. Min.Soil	18	0-95	1
Distance to Disturbance (ft)	23	15-35	57

Riparian Understory:	Total	Conifers	Hardwoods	Regional Average, conifers
Small Trees (less than 8" DBH):	345/acre	36/acre	309/acre	42/acre
Seedlings:	164/acre	18/acre	146/acre	62/acre

An additional 127 seedlings/acre were planted Douglas-fir within 100 ft of stream

Stream Shade:	%Shade	%Shade in Solar Path	Range	Solar Path Regional Average
	43	41	0-98	93

Large Woody Debris:	Tally per 1000'	Regional Average
Number of Pieces over 5" diameter	52	193
Number of Pieces over 10" diameter	12	117
Percent solid(recently entered)	45%	13%
Percent functional (in-channel) debris	87%	85%

Riparian Snags:	Average	Conifer	Hardwood	Regional Average
Number per acre	22	17	5	12
Average Diameter	14	15	10	12
Average Height	36	36	34	36
Average Distance	39	44	23	33

Level of Decay: Moderately high, 2.9 on a scale of 1 (solid) to 4 (very decayed)

Riparian Trees:	Average	Conifer	Hardwood	Regional Average
Number of Trees/1000 feet	193	52	142	111
Basal Area/1000 ft. (ft2/1000 ft)	158	60	98	134
Basal Area/ acre	73	28	45	98
Average DBH (inches) (Diameter at 4.5 ft)	11	13	11	15
Average Distance to Stream (ft)	43	42	44	30
Percent able to contribute LWD by windthrow(8"diameter, 5' length)	4	10	2	60

Riparian Stumps, current harvest:	Average	Conifer	Hardwood	Regional Average
Number per 1000'	98	96	2	19
Basal Area per 1000'*	146-173	145-172	1	32
Predicted Average DBH (in.)*	15-16	15-16	8-9	17
Average Distance (feet)	58	58	35	47

*Estimates calculated on stump heights ranging from 0.5 foot to 1.5 feet

Old Riparian Stumps(all conifer):	Average	Regional Average
Number per 1000'	60	13
Basal Area per 1000'(ft2)*	136-155	78-90
Predicted Average DBH (in.)*	19-20	32-34
Average Distance (feet)	67	32

*Estimates calculated on stump heights ranging from 1 foot to 2 feet

Site Notes:

Clearcut harvest, tractor yarding. Site visited 9-21-95.

There was very little large woody debris in the stream, but large boulders created pools and trapped some sediments. The stream had islands and some meanders that could create complex fish habitat. Nearby debris slides on the other side of the stream provided abundant sediment, probably contributing to islands and multiple channels. Gravels were a common substrate, which are preferred fish habitat for spawning, but can make streams susceptible to widening with increased sediment loads. Large streams such as this tend to transport woody debris downstream, unless it is anchored by roots or trapped by other means. Levels are a little lower than might be expected even for a large stream, but there is evidence of recent inputs of wood. Few of the trees left in the RMA could contribute a sizable piece of wood to the stream through future windthrow. Future growth may increase this proportion, as the residual trees grow larger and taller. On larger streams, wood is commonly contributed from upstream areas, not just the immediate streamside. Given the large size, high flows, abundant gravels, and the importance of upstream sources of wood, placement of additional wood in this reach does not seem useful.

APPENDIX B: RIPARIAN ASSESSMENT DATA COLLECTION FORMS

SHEET # 1 AREA SKETCH PAGE___OF____

HARVEST UNIT________________________ CREW______________________________

DATE____________________

REMARKS:

RMA Width:

SHEET # 2 INSTREAM POINT DATA SHEET PAGE____OF_____

HARVEST UNIT________________________ CREW__________________________

DATE_______________

Instream measurements						view to sky				topographic shade				angular		
point #	bank-full width	chan type (O/R/L)	dom. sub-strate (F/G/C /B/R)	con-fine-ment (U/C)	gradi-ent (%)	down	left	up	right	down	left	up	right	view	topog	low cover (%)

REMARKS:

SHEET # 3 INSTREAM LWD DATA SHEET PAGE___OF____
HARVEST UNIT________________________ CREW____________________
DATE__________

600 FEET STREAM LENGTH
INSTREAM LWD TALLY ONLY

SIZE CLASS	FUNCTIONAL SOLID	FUNCTIONAL SOFT	NON-FUNCTIONAL SOLID	NON-FUNCTIONAL SOFT
1-5 inches				
5-10 inches				
10-20 inches				
>20 inches				

REMARKS:

SHEET # 4 TRANSECT DATA SHEET PAGE___OF_____
HARVEST UNIT____________________ CREW____________________

	TRANSECT # : COMPASS BEARING:						
plot	slash	bare soil (%)	disturb. L,G,M O,X,W	small hardwd (1-8")	small conifer (1-8")	seedling	slope (%)
5							
15							
35							
55							
75							
95							

REMARKS:
Disturbance:
Vegetation:

	TRANSECT # : COMPASS BEARING:						
plot	slash	bare soil (%)	disturb L,G,M, O,X,W	small hardwd (1-8")	small conifer (1-8")	seedling	slope (%)
5							
15							
35							
55							
75							
95							

REMARKS:
Disturbance:
Vegetation:

	TRANSECT # : COMPASS BEARING:						
plot	slash	bare soil (%)	disturb. L,G,M O,X,W	small hardwd (1-8")	small conifer (1-8")	seedling	slope (%)
5							
15							
35							
55							
75							
95							

REMARKS:
Disturbance:
Vegetation:

	TRANSECT # : COMPASS BEARING:						
plot	slash	bare soil (%)	disturb L,G,M, O,X,W	small hardwd (1-8")	small conifer (1-8")	seedling	slope (%)
5							
15							
35							
55							
75							
95							

REMARKS:
Disturbance:
Vegetation:

SHEET # 6 STUMP & SNAG DATA SHEET PAGE___OF____

HARVEST UNIT_________________________ CREW____________________

STUMP				SNAG				
species	diameter (inches)	dist. to stream	old/new	species	DBH (inches)	height (ft.)	dist. to stream	decay 1-4 (h-s)

REMARKS:

SHEET # 7 TREE INVENTORY DATA SHEET PAGE___OF____

HARVEST UNIT_________________________ CREW____________________

DATE_______________

Species	dbh	height	dist. to stream	comp. Factor (S/C/N)	lean	lean direction (U/D/T/W)	landform (T/S)	defect (N/S/B/C/ M/I/V)

REMARKS:

Oregon State University
Department of Forest Engineering
1995 Field Study on Water Protection Rules, Oregon Forest Practices Rules

Tree Species Codes

ABCO	Abies concolor	White fir
ABGR	Abies grandis	Grand fir
ABSP	Abies spp.	Grand or white fir
ACDO	Acer glabrum var. douglasii	Douglas maple
ACMA	Acer macrophyllum	Bigleaf maple
ALRU	Alnus rubra	Red alder
ARME	Arbutus menziesii	Pacific madrone
CHIN	Castanopsis spp.	Chinkapin
FRSP	Fraxinus spp.	Ash species
JUSP	Juniperus spp.	Juniper
LASP	Larix spp.	Larch
PICO	Pinus contorta	Lodgepole pine
PIPO	Pinus ponderosa	Ponderosa pine
PISI	Picea sitchensis	Sitka spruce
POTR	Populus trichocarpa	Black cottonwood
PRUN	Prunus spp.	Cherry or plum
PSME	Pseudotsuga menziesii	Douglas-fir
RHPU	Rhamnus purshiana	Cascara buckthorn
THPL	Thuja plicata	Western redcedar
TSHE	Tsuga heterophylla	Western hemlock
UMCA	Umbellularia californica	Oregon-myrtle, California-laurel

APPENDIX C: FREQUENCY ANALYSIS RESULTS OF THE OREGON FOREST PRACTICES STREAM RULES SURVEY

Response Rate: 67% out of 848 people filing harvest notifications in Fall 1994, greater than ½ acre ownership. Surveys were sent to industry foresters, logging operators, and nonindustrial private forest owners (NIPF). The Stream Rules are also called Water Protection or Riparian Rules. Results total to 100% for the group except where noted. "n" gives the number of responses to the individual question. Survey conducted July to November 1995

1. Have you harvested a forest stand around a stream since September 1, 1994, when the new Stream Rules took effect (even if you did not harvest within 100 feet of water)? n=555

Overall 73% yes Industry 93% yes Operators 72% yes NIPF 57% yes

2. Who was important in deciding how to harvest the streamside stand on your most recent harvest? (Choose all that apply; results give % out of 100 that response was chosen) n=393

	Overall	Industry	Operator	NIPF
Landowner	46%	39%	47%	53%
Forest Manager	44	72	37	15
Forest Practices Forester	46	37	58	38
Harvest layout crew	17	38	9	1
Logging Operator	30	12	43	33
Consultant	7	8	2	13
Timber Buyer	4	2	4	7
Other (usually ODFW)	4	9	1	3

3. How much do you support or oppose the new Stream Rules? n=391

	Overall	Industry	Operator	NIPF
Strongly support	14%	17%	9%	19%
Generally support	47	56	45	37
Neutral	12	10	12	11
Generally oppose	15	12	20	12
Strongly oppose	11	5	13	17
Don't know	1	0	1	4

4. What natural resources do you think that the Stream Rules are meant to protect? (Open-ended responses; results give % out of 100 that response was mentioned) n=375

	Overall	Industry	Operator	NIPF
Fish	78%	86%	77%	66%
Water/stream	66	80	59	59
Wildlife	37	42	34	37
Vegetation/biodiversity	25	24	23	29
Enviros/bureaucrats	8	3	8	15

5. How effective do you think the Stream Rules are in protecting the resources you listed in Question 4? n=386

	Overall	Industry	Operator	NIPF
Very effective	25%	38%	20%	14
Mostly effective	27	25	29	28
Somewhat effective	24	24	25	24
Slightly effective	8	6	10	6
Not effective	8	2	9	15
Don't know	8	5	7	13

6. Compared to your idea of what the Stream Rules should do, which statement most closely expresses your view of where the rules are now in terms of protecting streams? n=385

	Overall	Industry	Operator	NIPF
Go too far	45%	38%	53%	41%
Are about right	45	52	40	43
Haven't gone far enough	3	2	2	7
Other	7	8	5	9

7. The Stream Rules were designed to achieve mature forest conditions (80 to 120 years) along streams and other waters. Were you aware of this mature forest objective? n=385

Overall 69% yes Industry 89% yes Operator 61% yes NIPF 53% yes

8. How suitable is this mature forest objective for the streamside area on your most recent harvest? n=384

	Overall	Industry	Operator	NIPF
Very suitable	20%	26%	18%	14%
Somewhat suitable	43	42	43	44
Not at all suitable	31	23	36	36
Other-(e.g. not for alder)	6	9	3	6

9. Did you have any problem finding the classification of the stream (for example: fish use, domestic water supply, or neither)? n=384

	Overall	Industry	Operator	NIPF
Yes	25%	41%	14%	23%
No	69	58	82	58
Don't know	6	1	4	19

The Oregon Board of Forestry and Department of Forestry developed the Stream Rules from 1992 to 1994. The final draft was shaped by an appointed advisory committee representing diverse areas: forestry, water, and fisheries agencies, forest industry, loggers, water suppliers, landowners, and environmental groups.

10. How much did you know about the process used to create the rules? n=389

	Overall	Industry	Operator	NIPF
Knew a lot about it	18%	41%	7%	6%
Knew some about it	36	42	38	24
Knew a little about it	33	16	42	41
Was not aware of it	13	1	13	29

11. Did including diverse representatives when developing the rules increase, not affect, or decrease your support for the new rules? n=382

	Overall	Industry	Operator	NIPF
Increased support	27%	40%	22%	17%
Did not affect support	49	48	52	44
Decreased support	13	7	14	20
Don't know	11	5	12	19

12. How much do you agree or disagree with these statements about the Stream Rules? n=378 Results presented by groups: **Overall** (Industry,Operators,NIPF)%

	Strongly Agree +Agree	**Neutral**	**Strongly Disag.+ Disagree**	**Don't Know**
A. The rules are too complex to easily understand and apply. . . .	**51**(58,49,42)	**23**(16,26,28)	**23**(26,24,17)	**3**(0,1,13)
B. The rules have the flexibility I need for site-specific management	**29**(44,21,24)	**23**(23,26,14)	**42**(31,50,43)	**6**(2,3,19)
C. The rules need too much interpretation by the FPFs	**43**(33,51,43)	**26**(25,26,30)	**25**(42,19,11)	**6**(0,4,16)
D. The rules are backed by good scientific reasoning	**24**(29,20,25)	**26**(31,22,25)	**40**(33,49,35)	**10**(7,9,15)
E. The rules require too much valuable timber to be left uncut . .	**57**(61,60,47)	**21**(23,23,16)	**19**(16,16,27)	**3**(0,1,10)
F. The rules take too long to apply on the ground (e.g., lay out buffers)	**53**(65,48,44)	**23**(19,26,22)	**20**(16,24,20)	4(0,2,14)
G. Written plans and approvals take too much work and time	**54**(50,55,55)	**22**(24,23,18)	**21**(24,20,19)	**3**(2,2,8)
H. The rules help me take better care of the land	**32**(30,32,34)	**23**(33,20,11)	**43**(37,47,49)	**2**(0,1,6)
I. Rules don't include compensation or incentives for timber owners . .	**82**(87,80,78)	**9**(6,11,12)	**6**(6,7,3)	**3**(1,2,7)
J. Staff from OR Dept. of Forestry helped me use the rules	**69**(73,75,54)	**16**(13,15,21)	**11**(14,7,14)	4(0,3,11)
K. New rules create too much uncertainty about future restrictions	**66**(56,75,64)	**16**(24,12,13)	**13**(18,11,10)	**5**(2,2,13)

13. From the list in Question 12 above, what would you say were the two factors that most affected your level of support for the Stream Rules? n=328

Top four reasons listed, with percentage of votes:

Overall	Industry	Operators	NIPF
B 14% flexible	B 20%	I 15%	I 16%
D 13% good science	D 16%	E 13% uncut value	H 15%
I 13% compensation	H 12%	J 11% ODF help	E 14%
H 12% take care of land	I 10%	D 11%	B 13%

14. In the Stream Rules, doing stream improvement such as placing logs allows more trees in the riparian management area to be harvested. Was this option, using the active management target, chosen on your most recent harvest? n=343

	Overall	Industry	Operator	NIPF
Yes	7%	10%	4%	5%
No, but enough conifers	31	39	27	25
No, too few conifers	29	29	30	26
No, used alternative prescription	14	15	15	12
Don't know	19	7	24	32

15. How much do you agree or disagree with the following statements about doing stream improvements such as placing logs or bank stabilization? n=156 (only those w/enough conifers)

Results presented by groups: **Overall** (Industry,Operators,NIPF)%

Choosing stream improvement:	**Strongly Agree+Agree**	**Neutral**	**Strongly Disag.+ Disagree**	**Don't Know**
A. let me increase timber volume or value removed	**51**(57,51,38)	**25**(25,27,21)	**20**(17,20,29)	4(1,2,12)
B. took too long to physically apply .	**44**(51,40,36)	**33**(25,42,34)	**20**(20,18,24)	3(4,0,6)
C. let me better manage streamside stands	**49**(49,54,40)	**22**(23,19,27)	**25**(24,23,30)	4(4,4,3)
D. took too much work and time for written plans	**52**(51,51,55)	**24**(22,25,24)	**21**(24,22,15)	3(3,2,6)
E. was possible because of help from ODF, OR Dept. of Fish & Wildlife	**37**(29,49,32)	**35**(42,29,29)	**20**(22,17,24)	**8**(7,5,15)
F. was not feasible because we didn't have expertise in placing logs . .	**11**(5,15,16)	**34**(32,28,50)	**47**(60,47,19)	**8**(3,10,15)
G. was not feasible because of lack of proper equipment or skilled workers	**10**(6, 9,22)	**26**(22,23,37)	**57**(68,64,22)	7(4,4,19)
H. let me improve fish habitat . . .	**44**(52,43,26)	**33**(30,35,39)	**18**(14,18,26)	**5**(4,4,9)
I.would create a liability during floods	**31**(25,41,29)	**22**(24,22,18)	**36**(44,30,29)	**11**(7,7,24)

16. From Question 15 above (including Other), what two factors were most important in the decision of whether or not to do stream improvement? n=135

Top four reasons listed, with percentage of votes:

Overall	Industry	Operators	NIPF
A 22% increases removals	A 22%	A 23%	A 18%
C 15% lets me better manage	B 16% long to apply	C 15%	C 18%
D 13% written plans too long	D 15%	H 12%	D 16%
H 13% improves fish habitat	H 15%	I 12%flood liability	H 13%

17. For your most recent applicable harvest, about how much was the value of the total harvest lowered because of meeting the Stream Rules, in percent? n=380

	Overall	Industry	Operator	NIPF
Value was not lowered	10%	4%	9%	21%
Less than 5%	26	45	19	12
5 to 9%	20	28	19	9
10 to 19%	18	11	21	20
20 to 40%	7	2	7	12
More than 40%	3	1	5	5
Don't know	16	9	20	21

18. The Stream Rules allow some trees left by the stream to be counted towards the required number of in-unit wildlife trees. Is this an incentive to leaving more wildlife trees by the stream? n=381

	Overall	Industry	Operator	NIPF
Yes	72%	85%	76%	44%
No	16	11	17	21
Did not know about this	12	4	7	35

19a. Do you think that the training or information available from Oregon Department of Forestry on the Stream Rules was adequate? n=382

	Overall	Industry	Operator	NIPF
Yes	65%	76%	66%	46%
No	17	15	19	19
Don't know	18	9	15	35

20. How much do you support or oppose each of the following objectives as a basis for making rules for private forest land near streams? n=387

Results presented by groups: **Overall** (Industry,Operators,NIPF)%

	Strongly Support	**Support**	**Neutral**	**Oppose**	**Strongly Oppose**	**Don't Know**
Water quality	**30**(32,25,34)	**52**(56,52,46)	**11**(6,16,10)	**2**(4, 2, 1)	**5**(2, 5, 9)	**0**(0,0,0)
Fish habitat	**23**(25,19,29)	**53**(58,56,39)	**13**(10,14,14)	**5**(5, 5, 7)	**5**(2, 5,10)	**1**(0,1,1)
Wildlife habitat	**18**(11,19,28)	**46**(49,47,39)	**19**(22,20,14)	**10**(13, 8, 6)	**6**(4, 5,12)	**1**(1,1,1)

21. Do you think that Oregon's Forest Practice Rules *for streamside areas* are generally less or more strict than streamside rules for surrounding land uses such as farming, grazing, building, or mining? n=372

	Overall	Industry	Operator	NIPF
Less strict than rules for other land uses	3%	1%	5%	2%
As strict as rules for other land uses	8	2	9	17
Stricter than rules for other land uses	74	91	72	49
Don't know	15	6	14	32

22. If the rules for nonforest uses required similar protection of streamside areas, how would it affect your support for the Stream Rules on forest land? n=289 (only those believing stricter)

	Overall	Industry	Operator	NIPF
Easier to support	36%	37%	38%	29%
Would not affect my support	39	48	33	29
Not easier to support	17	10	23	23
Don't know	8	5	6	19

23. How *effective* do you think the following methods are for government to influence forest practices on private land?: n=366

Results presented by groups: **Overall** (Industry,Operators,NIPF)%

	Highly	**Mostly**	**Somewhat**	**Slightly**	**Not**	**Don't Know**
A. Technical assistance (e.g., helping with management plans, explaining rules)	**15**(14,15,16)	**30**(33,29,27)	**31**(30,34,30)	**13**(17,13, 6)	**8**(5, 8,11)	**3**(2, 1,10)
B. Education (e.g., field tours, workshops, how-to publications)	**12**(14,12,10)	**30**(38,24,27)	**30**(31,34,19)	**17**(16,17,18)	7(1, 9,14)	**4**(0, 4,12)
C. Regulation (Forest Practice Rules)	**12**(18, 9, 5)	**34**(39,34,27)	**34**(27,37,38)	**10**(11,11, 8)	7(5, 7,12)	**3**(0 , 2,10)
D. Cost-sharing forest management expense	**22**(18,26,22)	**22**(28,21,14)	**24**(28,24,17)	**11**(16, 7, 9)	**12**(5,14,20)	**9**(5, 8,18)
E. Compensation when rules restrict harvest	**54**(55,58,46)	**15**(18,13,14)	**11**(11, 9,11)	**3**(3, 1, 8)	**11**(8,14,9)	**6**(5, 5,12)
F. Tax credits when rules restrict harvest	**52**(51,59,37)	**18**(22,13,23)	**10**(14, 5,13)	**3**(3, 2, 6)	**10**(5,14, 9)	7(5, 7,12)
G. More favorable capital gains treatment	**47**(48,47,46)	**17**(20,20,10)	**12**(13,10,14)	**4**(4, 2, 7)	**9**(6,10,11)	**11**(9,11,12)
H. Easements (sale/donation of harvest rts)	**13**(10,16,11)	**12**(13,10,12)	**22**(24,20,22)	**9**(10,10,9)	**15**(18,11,16)	**29**(25,33,30)
I. Land exchanges/swaps	**24**(23,30,13)	**18**(21,15,16)	**21**(23,17,26)	**10**(9,12,10)	**9**(10,10,8)	**18**(14,16,27)

24. Public resources such as fisheries, water supplies, and wildlife often are on private land. On a scale from 1 to 10, where 1 gives all responsibility to the landowner for protecting and not harming public resources and 10 gives all responsibility to the public, where do you think the responsibility for public resources should be? n=367

	Landowner responsible to protect & avoid harm, bearing costs or fines									**Public responsible and must pay to protect & avoid harm**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Overall	7%	3%	6%	6%	20%	9%	14%	14%	6%	15%
Industry	3	2	6	6	16	12	19	16	7	13
Operators	9	4	6	7	23	8	10	11	4	18
NIPF	9	5	4	6	21	7	13	15	7	13

25a. What are your views on compensation to landowners whose income or property value is reduced by regulations, knowing that paying compensation might cause funding cuts in other public programs? (Choose one statement closest to your view) n=341

	Overall	Industry	Operator	NIPF
Compensation should be offered if income or property value is reduced at all by complying with the rules.	47%	33%	55%	54%
Compensation should be offered after a certain loss of value on a piece of property (e.g.,10-20%).	18	26	15	9
Rather than across-the-board compensation, government assistance programs should be targeted to help the most severely affected owners.	3	2	1	7
Changing tax incentives or credits to encourage landowners to manage and invest in forests would be better than compensation payments.	29	36	26	22
Compensation should be offered for timber owners who protect more than required, but not for meeting rules that all owners must meet.	1	2	1	3
Landowners should not be compensated because they have a responsibility to protect the resources on their land.	1	1	1	1
The government should not pay compensation for losses in land values unless landowners also pay for gains in value from public activities/policies.	0	0	0	1
Compensation should not be considered for any reason.	1	0	1	3

26. About how many years have you, your family, or company owned the piece of land that was harvested? n=86 (nonindustrial private forest owners only)

NIPF only	Average: 33 years	Median: 30 years

27. How many *forested* acres, in total, do you own (singly or with others)? n=83 (NIPF)

NIPF only	Average: 914 acres	Median: 43 acres

28. Which of the following describes your main reason(s) for owning land? (choose up to 3) n=87

NIPF only	% chosen, out of 100
Income from timber	22
Long-term investment or as part of an estate to pass on	44
Pride of ownership or stewardship	39
Recreation, scenery, or aesthetic values	26
Wildlife habitat	15
Woodland is part of my residence or farm	46
Other (e.g., grazing)	17

29. What is the *most* important reason that you harvested this time? n=210

	Industry	NIPF
Needed income	61%	18%
Timber was mature	9	3
Salvage dead and diseased timber	7	19
Stand needed thinning or improvement	12	19
Prices were good	1	1
Uncertainty about future harvest restrictions	2	16
Other (or combinations of above)	8	24

30. Have you ever participated in any of the following forestry-related information, education, or assistance programs? n=323

	%Participated			
	Overall	Industry	Operator	NIPF
Extension Service (County or University) . . .	43%	65%	32%	29%
OR Dept. of Forestry Owner/Operator Training	64	93	59	21
Company or Association Training	54	70	57	23
Cost-share programs (ODF, ASCS)	na	na	na	25
Other	7	5	8	4

31. How would you rate your knowledge of: **Overall** (Industry, Operator, NIPF) in % n=376

	High	**Average**	**Low**	**No**
Opinion				
a. Forest management for timber	**58**(85,54,23)	**34**(14,44,49)	**7**(1, 1,26)	**1**(0, 1, 2)
b. Stream habitat management	**29**(44,24,15)	**60**(53,66,57)	**10**(3, 9,26)	**1**(0, 1, 2)
c. Ecological functions of riparian areas	**22**(30,18,19)	**53**(51,59,45)	**22**(18,21,32)	**3**(1, 2, 4)

32. What is your age? n=374

Average age: Industry foresters 45 yrs Operators 42 yrs NIPF 44 yrs

33. What is the highest level of education that you completed? n=377

	Overall	Industry	Operator	NIPF
Grade school	5%	0%	4%	13%
High school graduate	27	2	48	21
Some college	17	10	21	22
2-year degree/ technical school	10	8	13	9
4-year degree	32	68	13	16
Graduate degree	9	12	1	19

34. What was your total household income before taxes in 1994? n=337

	Overall	Industry	Operator	NIPF
Less than $20,000	7%	1%	4%	19%
$20,000 to $39,999	14	5	17	19
$40,000 to $59,999	32	43	31	19
$60,000 to $79,999	19	28	17	13
$80,000 or more	28	23	31	30

If you want any more information about the survey or results, contact Anne Hairston or Paul Adams, Dept. of Forest Engineering, Peavy 213, Corvallis, OR 97331-5706
Phone (541) 737-4952.
March 7, 1996

APPENDIX D: WRITTEN COMMENTS FROM THE OREGON FOREST PRACTICES STREAM RULES SURVEY

Comments are listed under the question and response that they were written beside. The codes are the tracking number of the survey, the region (E for Eastern Oregon, N for Northwest Oregon, SW for Southwest Oregon), and the Rule User Group (I for industry forester, O for logging operator, N for nonindustrial private forest owner). The Stream Rules are also called the Water Protection or Riparian Rules.

1. *Have you harvested a forest stand around a stream since September 1, 1994, when the new Stream Rules took effect (even if you did not harvest within 100 feet of water)?*

1 Yes

2437, SW, I - I work for Weyerhaeuser as Commercial Thinning Manager

1729, E, N - Harvested about 10 yellow pine trees along irrigation ditch. Trees were killed by pine beetles.

1762, NW, N - Not a class I stream.

2 No

1644, SW, N - Own land, within stream will be logging in the future.

1752, NW, N - But plan to do so by end of 1995.

1855, E, N - We have built approximately 1½ miles of access logging road along a stream area but have not hauled any logs yet but probably will yet this year.

2. *Who was important in deciding how to harvest the streamside stand on your most recent harvest?*

1 Landowner(s)

1643, SW, N - I'm going to fill out the survey as if we had harvested since we intend to do so when practicable.

2 Forest Manager or Logging Supervisor

3 Forest Practices Forester

4 Harvest layout crew

5 Logging Operator

1800, NW, N - We only had about 4 loads. It was handled by an experienced logger.

1203, SW, O - Cutting contractor.

6 Consultant

7 Timber Buyer

8 Other (please specify) ____________________

1020, SW, I - Tree farm foresters.

1015, NW, I - Fish and Wildlife biologists

1022, SW, I - ODF&W biologists

1048, SW, I - I do both logging supervision and layout

1077, E, I - Negative input from state forester

1096, NW, I - OSU Prof. Stan Gregory and Research Forest Director.

1126, SW, I - Poor wording

1129, NW, I - Fish Wildlife department biologists

1134, SW, I - Logging Engineer

1136, NW, I - I am a consulting forester working with numerous landowners. The answers herein are partly landowners opinion and partly mine as a professional forester.
1139, NW, I - Silviculturist and College of Ag - Fish and Wildlife
1157, SW, I - Oregon Department of Fish and Wildlife
1881, SW, I - Engineering/planning staff
1925, NW, I - Note: landowner represented by company's wildlife biologist.
1934, SW, I - Field Engineer
1608, SW, N - 1/4 mile from Applegate River, trees died in the drought.
1680, SW, N - Son-in-law
1801, NW, N - Washington county staff.
1809, E, N - Mr. Pirelli from Or. State, forester.
1955, NW, N - ODF rules prohibited harvest within 100' of stream.
2024, SW, N - Tree selection from within the 100'.
2105, NW, N - "Thievery", just plain rotten.
1398, NW, O - Norpac engineer helped.
1502, NW, O - State Forestry.
1547, E, O - We were not allowed within 100 feet of the water.

SECTION 1. Questions on the Oregon Forest Practices Stream Rules

3. *How much do you support or oppose the new Stream Rules?*

1 Strongly support
2 Generally support
2565, SW, O - The State of Oregon had a great system going anyway!
3 Neutral
2551, NW, O - Good idea but very costly (makes many small jobs too costly).
4 Generally oppose
5 Strongly oppose
1762, NW, N - If the public wants to prohibit harvest on privately owned streamside; the landowner should be compensated.
6 Don't know
1051, NW, I - I support some portions and oppose others.
1722, NW, N - What were the old rules?
1809, E, N - I don't know what the rules are, I never heard of them so cannot answer most of these questions. My stream is dry 4 months of the year.

4. *What natural resources do you think that the Stream Rules are meant to protect?*
1615, SW, N - The small landowners right to manage his property for timber production first, right of fish and wildlife second.

5. *How effective do you think the Stream Rules are in protecting the resources you listed in Question 4?*

1 Very effective
1391, SW, O - Note however some times protecting of a spring can be equally important.
2389, SW, O - Compared to some pitiful practices in the past.

2 Mostly effective

1608, SW, N - if you can enforce

2565, SW, O - Unfortunately too many folks have need to live next to the streams.

3 Somewhat effective

1643, SW, N - Since I don't have a copy of the rules, I'm only guessing.

4 Slightly effective

1597, E, N - One trouble is farmers drive their equipment through the creeks.

5 Not effective

1762, NW, N - I think logging practices have only a minimal impact on fish habitat. I think the major reasons for decline of salmon are drift net fishing in the ocean and the large increase in seals and sea lions.

1963, E, N - One hard rain can cause more damage to a stream than all the logging g in the past 50 years.

2037, NW, N - Foresters already. Practice ecology minded logging or they would have no future for themselves or the children, or the children's children.

2284, SW, O - Any rules will be in-effective without the conscientious stewardship of ranchers and property owners. You can't legislate ecological idealism on private land. It won't work.

6 Don't know

1014, NW, I - The Stream Rules are only a part of protecting these resources. There are many more factors involved.

1786, NW, N - I believe most people have enough sense to manage with such rules and regulations.

1491, NW, O - I think they will end up the same as the old ones if the rules were followed properly.

2577, E, O - In a well managed area no better.

6. *Compared to your idea of what the Stream Rules should do, which statement most closely expresses your view of where the rules are now in terms of protecting streams?*

1 Rules go too far

1127, SW, I - Beyond the mandates of SB1125.

1308, NW, O - Especially considering private landowners are not compensated.

1329, SW, O - Industry worked in the late 80's to agree - then in 1991 to meet in the middle - 1994 went too far. What is next, 300-500 foot corridor?

2506, NW, O - Certain aspects go too far.

No Number, NW, O - Leave trees on north side, don't do no good.

2 Rules are about right

1015, NW, I - But will need adjustment as we learn more.

1149, E, I - However individuals interpretation of these rules vary widely.

1972, NW, N - According to forester.

1504, NW, O - Need some relaxing in alder draws.

2551, NW, O - Depends on job.

3 Rules haven't gone far enough

2240, NW, O - For loggers but not enough for farmers.

2389, SW, O - 1/3 strength DDT spray applications are being circumvented by combining 3 types of applications at once for example.

4 Other (please specify) ________________________

1009, SW, I - In 5 years what will be the rule?
1021, NW, I - On very small streams rules goo too far
1051, NW, I - Rules impose an unfair cost on landowners that should be paid by the public.
1058, SW, I - Ok for clearcut to far for thinning
1065, NW, I - Some parts are a big improvement - alder conversions
1086, SW, I - Overall about right, go too far in some small areas.
1119, SW, I - Old rules provided wider RMA protection by actually being more restrictive on tree removal.
1121, SW, I - The rules protect streams adequately but are still too broad-brush and don't take into account differences from drainage to drainage.
1152, NW, I - Rules go a bit too far - need some provision to harvest some high-value trees next to river.
1156, NW, I - Rules are about right for larger streams but go too far on smaller streams.
1176, SW, I - Rules need continued refinement through continued research.
1894, E, I - Not flexible enough.
1922, SW, I - Between 1 and 2 above
1608, SW, N - Too close to the river.
1703, SW, N - Each stream needs different things to be healthy.
1722, NW, N - I believe in private property and private property rights and I am not a rabid "ecology" freak. Most liberal ecology freaks are liberal drones and live in urban areas.
1729, E, N - Following the rules may be part of the problem.
1763, NW, N - Fail stated objective but keep government in business.
1800, NW, N - The big operators don't abide by the rules.
1918, NW, N - None are right.
1943, NW, N - Too much logging where not should be.
2024, SW, N - Need more flexibility in some cases, some areas rules go too far.
2096, SW, N - I don't know what the rules are.
2105, NW, N - Where do you get these rules - rotten.
1189, E, O - Rules should be for the stream conditions and drainages to the streams and not by classifications of the streams.
1203, SW, O - Some streams need more or less than others.
1229, E, O - Timber industry is over ruled compared with other user cattle, mining, recreation.
1230, E, O - Stop the Japs from fishing.
1267, NW, O - Little too late.
1308, NW, O - I think rules could go as far as the public is willing to pay to compensate private landowners.
1380, SW, O - Should know about it more before they make the rules.
1391, SW, O - I am not a big fan of any rules, however.
1475, NW, O - I believe in clearcuts. On private property most people don't live to be 80-120.

1491, NW, O - Too much scientific study, not enough common sense.
1530, NW, O - Small intermittent streams on the west side of the coast range. I think is over reaction.
1545, NW, O - In certain cases, they go a little far. All in all the streams are a good place to leave timber.
1579, SW, O - Don't address upstream watershed clearcuts.
2353, SW, O - We can't undo what has already been done through poor practices in the '40s and '50s.
2396, SW, O - Over protect large and medium, under protect small.
2473, NW, O - Not flexible to conditions.

7. *The Stream Rules were designed to achieve mature forest conditions (80 to 120 years) along streams and other waters. Were you aware of this mature forest objective?*
2577, E, O - Who set this objective?

1 Yes

1145, SW, I - and disagree with it -- diversity along streams is important -- including hardwoods and direct sun/openings. It was more of a political objective and reduced mature conditions in recent past.
1615, SW, N - With drought years the trees are dying along small streams thus defeating the dream.
2037, NW, N - By then you will have dead and dying trees. If trees are not selectively harvested or any other growing crap you get disease and malnutrition subsequently more vulnerable to wild fires.
1329, SW, O - But why? No logging or salvage entry allowed.
2228, SW, O - I was aware of the intent, but reality and intent are not the same.

2 No

1083, NW, I - Mature definition is relative!
1152, NW, I - Thought it was longer.

8. *How suitable is this mature forest objective for the streamside area on your most recent harvest?*

1 Very suitable

1015, NW, I - by very expensive
1122, NW, I - Will "mature" hardwoods by sufficient?
1136, NW, I - On a large fish bearing stream
2037, NW, N - Just was doing some thinning on a hillside far enough away from a creek that is not a year round creek but dry in the summer months.

2 Somewhat suitable

1136, NW, I - On a medium fish bearing stream
1884, NW, I - Trees are all young 25 years +
1722, NW, N - Harvested fir was 60-70 years old
1329, SW, O - Unless never allowing harvest.
1504, NW, O - Alder needs to be converted.
2339, SW, O - Very often in high site areas these conditions can be achieved in 25-30 years. New rules do not consider the real growth rate of trees on high site coastal lands.

2525, SW, O - Too much alder along stream needed corridors cut for conifers.

3 Not at all suitable

1111, SW, I - Streams were involved in the Hull Mountain fire.
1615, SW, N - Lost too much salvage volume and income.
1963, E, N - Down dead logs and dying trees are a nuisance and a waste. Timber is a renewable resource.
1308, NW, O - Stream is on industrial forest land. Property is roughly 90% alder which has a maturity of 60 years. Rotation age for this company is approximately 4-5 years. I don't see 120 year old conditions.
1461, NW, O - Large trees will blow down.

4 Other (please specify)______________________________

1009, SW, I - Wind is a big factor in trying to maintain leave trees.
1010, NW, I - Before influences by humans, were all streamsides in mature conditions. Why try to put all existing streams into this condition and create something unnatural?
1021, NW, I - Ok if not a hardwood stand
1074, SW, I - Streams are too small to require mature forest
1075, NW, I - Most streams do not have enough conifer basal area
1083, NW, I - I don't understand this one! Reserving a buffer will create the "mature" objective if reserved long enough. My harvest (3 units) all got D.Fir stands.
1121, SW, I - I don't think managing for mature forest conditions is "suitable" - the stands exhibit a mosaic of stand conditions - trying to keep them in one condition is going against natural processes.
1126, SW, I - Many areas, heavy to hardwood - won't help
1129, NW, I - The area is a hardwood conversion but the concept is suitable.
1136, NW, I - Not suitable for many small fish, nonfish and type streams.
1150, NW, I - Many people are not interested in biologically mature but they are interested in economically mature.
1170, SW, I - Don't understand the question.
1176, SW, I - On small streams its silly because not enough "forest" is left to really be a "forest" --> strip is too small.
1894, E, I - 95% of all tree left blew down.
1903, SW, I - Conifer/hardwood/daylight are site specific determination.
2417, NW, I - Don't really understand the question.
2420, SW, I - Alder will fall apart by 80 years.
1608, SW, N - I'm too far away but the dairy is right on the bank.
1655, NW, N - Residential site; application limited
1680, SW, N - This is private property
1697, E, N - If provisions were made to reimburse landowner for money lost during harvest. I would be supportive of this new rule.
1703, SW, N - Hardwood and brush make better shade and cover.
1722, NW, N - By the time the trees got that old (120) they would probably die off, topography of soil.
1752, NW, N - Our stream is intermittent and does not apply.
1785, NW, N - Dense housing future.
2071, NW, N - If I could of cut the trees I wanted to cut it would not of made a difference.

1475, NW, O - If you are clearcutting and have to leave two trees per acre and a buffer.
1545, NW, O - It will be mature in 25 or 30 years so it will be down the road.
2151, E, O - This area was heavily logged previously and the trees are 50 years primarily.
2240, NW, O - They were mostly hardwoods and I think they are an unstable tree prone to blow over as it gets older.
2389, SW, O - Already achieved.
2403, E, O - If all mature trees are sick, what can be done.
2501, NW, O - Don't understand question.
2577, E, O - A mature forest provides less stream side shade than a young forest 25 years.
2565, SW, O - Some species of trees still need to be removed.
No Number, NW, O - Streams that don't have fish shouldn't be sheltered.

9a. *Did you have any problem finding the classification of the stream (for example: fish use, domestic water supply, or neither)?*

1 Yes -------> 9b. What problem(s)?______________________

1001, SW, I - Hugh delay in obtaining maps
1008, SW, I - State offices do not have good records on domestic use or if fish are present in small streams.
1013, NW, I - Had to copy stream maps from local Department of Forestry office for our office.
1022, SW, I - Class maps are not up to date with ODF&W surveys from last 2 years.
1029, NW, I - Stream surveys are not complete leading to long man hours to determine classification.
1036, SW, I - Not generally classified
1037, NW, I - Domestic water systems not identified
1045, E, I - Some streams not classified
1046, NW, I - Unclassified
1051, NW, I - Probable non-fish stream was listed as being "fish". No documentation.
1055, SW, I - Unclassified streams
1058, SW, I - Most streams not surveyed, I have to walk them or electroshock
1065, NW, I - Type F was not on map however FPF's were quick to help class it.
1069, SW, I - Poor maps re ODF and ODF&W, not familiar with local conditions.
1071, SW, I - Streams mostly smaller ones, not classified yet.
1074, SW, I - State stream maps are very incomplete. Landowner is required to prove where fish use ends, even though it is the state's responsibility.
1075, NW, I - Most streams are not classified yet.
1081, NW, I - State has not completed surveys in our area.
1087, SW, I - State Forestry does not know domestic water users. State fish maps not accurate.
1088, SW, I - Current designation of "fish use" is at least 30% in error.
1094, SW, I - But state forestry is starting to get fish surveys done.

1097, SW, I - Stream had 3 prior surveys with no fish, but still needed to be shocked to check for fish use.
1099, SW, I - Time consuming
1100, NW, I - Yes, maps are not readily available with current information.
1105, NW, I - Presence of fish
1115, SW, I - Most streams are unknown for fish use
1120, NW, I - Some streams are not classified and state has 1 year to disprove any fish findings. So you have to assume there is fish until proven otherwise.
1125, NW, I - Streams which are of higher gradient and smaller size than ever expected are turning out to be fish streams.
1126, SW, I - Fish use - is it ok? Not. Not much help from ODF, ODF&W
1127, SW, I - Fish present in many reaches not classified (F).
1136, NW, I - Small fish and non fish streams were: not listed or listed incorrectly. Domestic water class should apply to drinking water only uses such as irrigation, livestock or fish ponds should either be a different class or less restrictive.
1138, SW, I - The stream was not classified so it was ASSUMED to be a FISH stream. Fish and Game did not have time to prove fish.
1146, SW, I - Tracking the owner of the water rights.
1148, E, I - State forestry had not completed their mapping.
1149, E, I - No current classification exists and when this occurs conservative interpretation leads to over protection (non-fish bearing to fish bearing)
1150, NW, I - FPF's are not willing to classify very small streams as type N.
1151, NW, I - The state has very limited knowledge of fish use in small streams (locations).
1157, SW, I - Small fish or non fish require survey for absence or presence.
1159, NW, I - Fish use, ODF/ODFW maps not complete. Ground truthing required by operator.
1162, E, I - There seems to be a lot of subjectivity applied to fish use classification prior to formal surveys, e.g. all mediums are fish use in Jackson county.
1167, SW, I - Insufficient available data
1173, SW, I - State was slow to survey streams
1175, SW, I - Not all small streams have been surveyed. USGS quad maps aren't always accurate for small stream locations.
1176, SW, I - State surveys only cover about a 10th of the total fish bearing streams. Stocking surveys by landowner are costly and time consuming. Visual surveys are not reliable.
1178, SW, I - Some streams that contain fish do not show on maps.
1873, NW, I - Fish use in suitable streams above natural barriers like large water falls.
1881, SW, I - Which streams are fish bearing are still a question on small streams.
1882, SW, I - Small fish streams and domestic water.
1891, SW, I - Information not available.
1903, SW, I - Fish use
1930, SW, I - Not all streams have been field checked and classified.
2411, NW, I - State has incomplete data on presence of fish.

2420, SW, I - Copies of official maps have been very slow in coming.
1607, NW, N - No flow in stream April thru mid December, stream classed as fish bearing.
1608, SW, N - The dairy on the applegate.
1615, SW, N - Stream bed dry part of year.
1656, NW, N - To much baloney
1675, SW, N - Prove there are no fish - prove seasonal stream in Dec.
1685, NW, N - State forester did not have the maps showing how streams were reclassified - so he had to try and figure it out on his own - he didn't know how to work the formula for water volume of flood plain area. This sloppy way of enacting new rules was extremely costly in time and money to me. They should not have made the rules in effect until everyone was on board.
1697, E, N - Did not understand, since after spring run off, stream dries up.
1712, E, N - ODF&W declared this seasonal stream class 1. There are no fish in this stream.
1741, E, N - No one sure of identity.
1747, SW, N - One rule hundred feet, next rule fifty feet, next rule 20 feet of stream, make up your minds.
1758, NW, N - I didn't understand what exactly you wanted.
1773, E, N - Unknown fish use.
1809, E, N - Never heard of it.
1832, NW, N - Gone dry in summer.
1949, NW, N - Classification given to stream doesn't fit its nature.
1963, E, N - I feel my logger was careless could have done better near a small stream.
1976, SW, N - Wasn't classified.
2014, E, N - Bull trout
2691 & 2687, NW, N - Initially, the stream was designated small "N" but was changed to small "F" which required additional protection.
2729, E, N - Stream rules protect wetlands.
1190, NW, O - Some streams were classified early on. Was not a problem.
1201, E, O - Stream class size
1207, SW, O - Stream was unknown. I have to wait 1 year.
1215, NW, O - Stream very dry in summer, classified as stream.
1227, SW, O - Just asked Lane county forester.
1323, NW, O - Had to have shocking done by fall for determination.
1391, SW, O - State does not know class of lots of streams (time is biggest problem).
1441, NW, O - Nobody really knows what they say, the rules that is.
1443, E, O - No water, still class 1, no fish at all.
1461, NW, O - June 1 deadline. Example: culvert gives way after June 1, needs to be replaced but can't because of unknown fish (unless install expensive baffled culvert).
1476, E, O - Classifications don't fit certain site specific situations.
1502, NW, O - Change in stream classification in middle of operation.
1523, SW, O - Even the forester had trouble with interpretation.
1560, SW, O - Rules don't consider excessive wood debris in small class "F" streams.

2147, NW, O - Sometimes seasonal streams have fish.
2221, E, O - Classifications seemed arbitrary, all the streams looked pretty much the same.
2284, SW, O - Unclassified.
2339, SW, O - Determined by FPO. No new comprehensive stream classification maps.
2396, SW, O - All - Fish/nonfish -- >
2473, NW, O - Planning forestry - state don't know all the time, so contractors should?
2506, NW, O - Not all streams have been surveyed by the state.
2551, NW, O - Seasonal stream with mud puddles constitutes fish habitat.

2 No

1722, NW, N - Salmon, trout and steelhead - known to be in creek once.
1211, NW, O - Unclassified watershed?
1329, SW, O - Every draw is listed as potential - of 9 classes.
1545, NW, O - Ask state forester.
2204, SW, O - If you could piss a stream, fish live in it.
2354, NW, O - As far as I am concerned all waters to be treated as class A streams.

3 Don't know

1722, NW, N - Many septic systems (substandard) up stream.
2577, E, O - When the stream rules writer doesn't know the difference! Environmental groups - here is the biggest problem.

The Oregon Board of Forestry and Department of Forestry developed the Stream Rules from 1992 to 1994. The final draft was shaped by an appointed advisory committee representing diverse areas: forestry, water, and fisheries agencies, forest industry, loggers, water suppliers, landowners, and environmental groups.

10. *How much did you know about the process used to create the rules?*

1 Knew a lot about it

2 Knew some about it

1136, NW, I - I knew a lot about it but probably not enough, especially the administrative rule making process.

3 Knew a little about it

1615, SW, N - Too many rules made in Salem and in effect before we hear about them.
1855, E, N - Purchased first forested land in 1992. Wife's family has adjoining forested land but I have not been involved in the forest practices thus did not have a need to know.

4 Was not aware of it

1162, E, I - I am new to this state.

11. *Did including diverse representatives when developing the rules increase, not affect, or decrease your support for the new rules?*

1 Increased support

1145, SW, I - However leads to more political decisionmaking and less basis on sound science (not to be confused with option of "scientists")

1608, SW, N - I support the rules but you can't enforce them.

2 Did not affect support

1762, NW, N - Should have been decided by landowners.
1383, NW, O - I see the rules for what they are, not who made them.
2557, SW, O - My support, or lack of it, will be based on the content and philosophy of the rule, not on whose name may be connected to it.

3 Decreased support

1136, NW, I - Political compromises, hidden agendas and other special interests override sound science, and common sense.

4 Don't know

1115, SW, I - We were ignored all along. Sofia's plan was rejected out right.
1152, NW, I - Would have increased support, had I known.
1391, SW, O - People should manage lands correctly without rules.

12. *How much do you agree or disagree with these statements about the Stream Rules?*

(Strongly Agree Agree Neutral Disagree Strongly Disagree Don't Know)

a. *The rules are too complex to easily understand and apply*

1149, E, I - They are complex however useable.
1873, NW, I - Obviously a committee put them together.

b. *The rules have the flexibility I need for site-specific management*

1048, SW, I - the FPF's keep their personal opinions to themselves and follow the rules.
1752, NW, N - Flexibility was applied in my case, but I felt it was an exception.
2691 & 2687, NW, N - Better than they were but still need improvement.
2339, SW, O - Interim problem with some options.

c. *The rules need too much interpretation by the FPFs*

1129, NW, I - That is what we need.
1685, NW, N - they don't know either!
1530, NW, O - There seems to be a difference of interpretation on small "N" streams among FPO's.
2339, SW, O - However some FPF's are not adequately trained.

d. *The rules are backed by good scientific reasoning*

1136, NW, I - The rules are backed by too much poor political reasoning and not enough good science.
1176, SW, I - I don't know rules often seem arbitrary.
2176, NW, O - They keep changing their minds.

e. *The rules require too much valuable timber to be left uncut*

1149, E, I - In some cases in no cut buffers.
1176, SW, I - We should be compensated through tax breaks.
1602, SW, N - Some trees should be cut so new trees can grow.
1722, NW, N - In the buffer a few selective cuttings.
1504, NW, O - Added buffer width to accomplish.

2315, SW, O - In some places where there are other kinds of big trees that provided cover. You should be able to harvest the extras. However, because of previous poor management I see why people want to leave so much.
2339, SW, O - There are specific cases where some partial cutting should be allowed.
2389, SW, O - But I don't own any Port Orford cedar stream sides or it would be 1.

f. *The rules take too long to apply on the ground (e.g., lay out buffers)*
1083, NW, I - Economic decision
1122, NW, I - But necessary to create consistency among various landowners
1149, E, I - Yes, time consuming.
1176, SW, I - This is a problem.
1685, NW, N - Amen!

g. *Written plans and approvals take too much work and time*
1015, NW, I - Both f & g require time and effort but should accomplish objectives.
1048, SW, I - Depends on the FPF you working with.
1136, NW, I - Depends on the situation and the FPF; I think on many small and medium streams this would be a correct statement.
1149, E, I - No need for a written plan if implementing FPA new stream rules.
16002, SW, N - Too much time for approvals.
2339, SW, O - There needs to be clarification in this area.

h. *The rules help me take better care of the land*
1083, NW, I - No! Water yes.
1136, NW, I - Depends on the landowners goals and motivation.
1513, NW, O - Stewardship is our priority.
2339, SW, O - They reinforce what some of us have tried to do for years.

I. *Rules don't include compensation or incentives for timber owners*
1015, NW, I - Depends on definitions of compensation and incentives.
1022, NW, I - Sometimes yes, sometime no for timber resource rules do not compensate for loss ground - ie. tax break.
1176, SW, I - Critical - we need tax breaks.
1801, NW, N - They should. Its expensive loss to hire surveyors and land.

j. *Staff from OR Dept. of Forestry helped me use the rules*
1176, SW, I - ODF has been very helpful.
1685, NW, N - They tried but didn't understand themselves.
1722, NW, N - Forced

k. *New rules create too much uncertainty about future restrictions*
1015, NW, I - They actually create more certainty if left in place, but history tells us they will change.

l. *Other (specify)* ________________
1001, SW, I - Includes too many very small tributaries.

1004, E, I - Reference to law and other rules need index or summary - the continued search is time consuming on the ground operation.
1040, NW, I - Require more roads means more erosion.
1051, NW, I - Private resources are being used to fund a project the public should pay for.
1065, NW, I - The FPF field staff I have worked with has done an excellent job.
1074, SW, I - Incomplete fish use maps create excessive work for landowners. M. Arbitrary designation of "Small" streams causes almost all logging units to be affected by stream rules.
1077, E, I - Too much state control on private lands. State foresters have too much control.
1083, NW, I - My FPF is not aware of my desire to protect -- I was confused by his requirement that he approve every step I take- I started into the RMA before that step.
1096, NW, I - The incentive to replace hardwoods with conifers, where appropriate is not only good forestry but good for fish.
1121, SW, I - The rules are based on some idea of what the public will accept - politics not so much science.
1173, SW, I - Too restrictive on conifer harvest along streams.
1894, E, I - Not site specific, need more flexibility.
1934, SW, I - Landowners should be compensated for "lost" harvestable timber left in RMA's for fish habitat (tax incentives?).
2411, NW, I - Fish passage in culverts, rules not logical.
2414, SW, I - Rule tie down the requirements for a specific stream site.
1643, SW, N - Can't answer because I don't know the rules.
1653, NW, N - Russia "tried" to have government rules handle it and failed. Anyone wanting rules go to Russia.
1655, NW, N - Rules were reasonable and imposed no hardship in our residential situation.
1722, NW, N - Necessary semi rational but B.S.
1745, NW, N - Above info obtained from my consultant forester.
1801, NW, N - Affected land owners have not been supplied rules. M. Rule changes after long term ownership needs mitigation
1829, NW, N - Landowners care about their land.
1972, NW, N - Never saw any rules.
2013, SW, N - Rules established by a vocal minority and you know it.
2024, SW, N - Was very pleased working with Denis Polpe - Roseburg.
2061, NW, N - Used consultant
2063, NW, N - Should be able to think better.
2085, SW, N - Rules are not as available to the public as they should be. They should be available and understandable for everyone.
2101, SW, N - I logged 30 acres of 20 year old tender that would not have log without the new rules.
2691 & 2687, NW, N - f & g - It depends on the length of stream involved and the volume, size classes and value of trees in the RMZ. If it is high value then in most situations, is worthwhile. If it is marginal volume or value then most owners "walk away" from it because the cost of inventory, layout, writing plans

and implementation simply isn't worth the investment today! With better incentives/compensation, I believe, better active management could be accomplished.
1190, NW, O - The rules make it difficult to harvest within the riparian area.
1206, NW, O - Rules before new rules was good enough.
1207, SW, O - ODF interpretation is inconsistent.
1229, E, O - Old rules protected streams as much and more easier to apply- people will cut the area out of the 20th no cut to heavily.
1230, SW, O - The rules will change again before this theory is proven - good or bad.
1303, SW, O - We should be allowed to think within the buffer strip so the desired stands can be created instead of being too thick.
1353 E, O - Landowners should be compensated for lost products.
1363, SW, O - Too many people.
1383, NW, O - These rules, as time allows conditions to develop, will produce crowded, suppressed unhealthy stands of timber in many (most) typical private ownership, stream areas.
1391, SW, O - People can manage their own land correctly without rules and less government.
1443, E, O - Too much government.
1499, E, O - FPF's are still trying to interpret the rules as they apply to specific areas.
1502, NW, O - No room for exiting roads and building parking areas, as an operation logging timber I could be sited for using a road that is in use 12 months a year, but by having a logging operation it makes things very confusing.
1523, SW, O - No set of rules can apply in all cases. These rules are so restrictive they actually deter conifer restoration due to their application.
1547, E, O - Private land control by government.
1562, SW, O - Bug kill and dead, dying and blowdown timber should be exempt.
2290, E, O - Changing rules make landowners suspicious.
2339, SW, O - Commercial thinning. Rules do not consider growth. To create mature stand conditions in commercial thinning you must go below current BA targets and create GROWTH on remaining stems!
2353, SW, O - Much of the riparian zone have been logged long ago, leaving very little left for today's harvests.
2354, NW, O - Would be nice if rules were enforced for everyone.
2378, SW, O - Rules not flexible enough for different types of streams.
2403, E, O - I promote forest management and forest health, not harvest! They tie my hands.
2471, E, O - What took you so long.
2506, NW, O - Waiting period for review should be abolished.
2557, SW, O - Rules have created strong indifference with many timber owners and managers, reducing interest in wise timber management.
2572, SW, O - Unconstitutional.
2577, E, O - Depends on the area and the type of overstory.

13. *From the list in Question 12 above (including Other), what would you say were the two factors that most affected your level of support for the Stream Rules?*
1083, NW, I - Basal area is fair. Stream improvement credit is incentive. My units are on Large F and Small F.
1162, E, I - The lack of "final" or "official" stream size and "use" classification has caused some headaches and inefficiencies to date. Particularly those that distinguish fish vs non fish and stream size in SE Oregon.
1615, SW, N - The restrictions on salvage of dead and dying trees along dry stream corridors that are cleared 1-11 streams.
1653, NW, N - No support, all oppose.
1659, E, N - Do not support the forest practices act.
1716, NW, N - Visual impact and blue herons.
2096, SW, N - Don't know I would need a comprehensive packet stating what the rules are and who they affect and what they mean.
1252, SW, O - Oregon Department of Forestry, have to widen a berth for more restrictions.
1398, NW, O - 50' buffer zone is enough.
1441, NW, O - I don't understand the question.
2285, SW, O - I have no support for the stream rules.
2501, NW, O - No support.

14. *In the Stream Rules, doing stream improvement such as placing logs allows more trees in the riparian management area to be harvested. Was this option, using the active management target, chosen on your most recent harvest?*
1136, NW, I - Depends on which job --- I've done more than one. Landowner wanted more protection of stream.
1894, E, I - Did different opinions on 4 separate harvests.
1729, E, N - Did not apply to the short section of irrigation ditch.
1298, SW, O - How? Who thought up this question?
2579, NW, O - Stream improvement hasn't been a part of any harvest plan I have been involved in.

{ **1 Yes**
{ **2 No, but there were enough conifers to allow it**
3 No, the site did not qualify because there were too few conifers

1303, SW, O - To harvest to make additional work worthwhile.

{ **4 No, we used an alternative or site-specific prescription**
{ **5 Don't know whether there were enough conifers to qualify**

If you chose 3, 4, or 5, SKIP to Question 17

1461, NW, O - #6, no there were more than enough conifers and BA within 20' of stream.
2389, SW, O - We did not cut withing 100', so does not apply.

15. *How much do you agree or disagree with the following statements about doing stream improvements such as placing logs or bank stabilization?*
(Strongly agree, agree, neutral, disagree, strongly disagree)
Choosing stream improvement:
a. *let me increase timber volume or value removed*
1083, NW, I - This isn't a rule?

1136, NW, I - Administrative time and machine time ate up most of the profit but gave owner more flexibility and control of the land.

b. *took too long to physically apply*
1083, NW, I - Just in progress.

c. *let me better manage streamside stands*
1083, NW, I - No, but stream quality and habitat yes
1136, NW, I - Depends on size of stream.

d. *took too much work and time for written plans*

e. *was possible because of help from ODF, OR Dept. of Fish & Wildlife*

f. *was not feasible because we didn't have expertise in placing logs*

g. *was not feasible because of lack of proper equipment or skilled workers*

h. *let me improve fish habitat*

i. *would create a liability during floods*
1145, SW, I - Legal liability mitigated by following approved guidelines.
2420, SW, I - We leave wide buffers and do instream placement of woody debris.

j. *Other (specify)*________________
1014, NW, I - Was not needed for the stream in my harvest. K. Is not worth the effort for the small benefit provided by removing more volume - (1) Strongly Agree.
1051, NW, I - Would not return enough money from extra harvest to pay the difference for costs to place the logs or whatever.
1066, SW, I - Allow managers to take active role in stream management.
1083, NW, I - This stream needs this type of help we are just beginning and I anticipate good results.
1134, SW, I - Work liability, especially for state volunteers.
1145, SW, I - Woody debris not efficient -- hazard to road stability along creek.
1176, SW, I - Costs too much to be worthwhile.
1873, NW, I - We do stream improvement and leave larger buffers than required. Do not want to harvest more trees in buffer.
1894, E, I - Man's engineered solutions often make conditions worse.
1925, NW, I - Was not necessary at this site.
2458, SW, I - Was not feasible because it does no good.
1607, NW, N - No water in stream area where crossing is too flat and wide to put logs in.
1674, SW, N - Wrong kind of site to use any kind of management.
1809, E, N - Would make banks wash.
1819, SW, N - No streams on or near property.
2013, SW, N - Expensive time wise.

1207, SW, O - Can end up with too much debris in stream.
1229, E, O - Trees did not have enough value for the time. It would be taken to do all the ground work.
1303, SW, O - We did not choose because there was too much work involved to offset the price of timber we would have gained.
1408, NW, O - As well as being a logger, we also own and manage timber land. We have ponds, lakes, streams and even a river to deal with.
1461, NW, O - Stream is definitely a good candidate for improving fish habitat.
2132, SW, O - We do not log within 100 feet of stream.
2470, E, O - Cost too high for contractor's return.

16. *From Question 15 above (including Other), what two factors were most important in the decision of whether or not to do stream improvement?*
1083, NW, I - Resource added will pay for this work (2 or 3 times).
1126, SW, I - This is not an effective option. Too much work and too impractical in many places. Have not used it to date. Very ineffective in our operation.
1149, E, I - Note: are not using stream improvements to harvest more volume in riparian areas. Will do stream projects independent of increase volume harvest.
1157, SW, I - c&h are both equal.
1176, SW, I - Just not worth the cost and effort.
1615, SW, N - With dead alder and white fir falling in small streams make sufficient logs in stream and in flood can cause channel change and excess erosion. The biologists should not have cleared streams of logs in first place.
1729, E, N - Did not apply in my irrigation ditch.

17. *For your most recent applicable harvest, about how much was the value of the total harvest lowered because of meeting the Stream Rules, in percent?*

1 Value was not lowered

1762, NW, N - Not a class I stream.
1856, SW, N - We did select timbering.
2322, NW, O - Barney reservoir expansion no buffer required.

2 Less than 5%

1056, NW, I - But this not the usual. It could be 10-15%

3 5 to 9%

1015, NW, I - was a conversion unit.
1083, NW, I - Leaving 270 BA now would have left ± 100 BA X 2000'. The difference is 170 x 2 = 340 BA = ± 150 trees. Each tree worth ± $400, $60,000 of total @ $900,000 = 7%.
2339, SW, O - Guess? Mostly hardwood.

4 10 to 19%

5 20 to 40%

6 More than 40%

7 Don't know

1001, SW I - % doesn't matter, total dollars matter.

1013, NW, I - Bad question! Depends on percentage of unit next to stream some higher than others.
1016, NW, I - $39,100 on 70' buffer along 1500 ft. of stream.
1136, NW, I - It depends on the size of harvest area: on one small job it was less than 5%, on another job with a medium size stream it was less than 10%, on another 40 acre unit with several small streams in an old stand it exceeded 10%.
1675, SW, N - We didn't want the trees taken near the stream anyway!
1722, NW, N - How much a selective cut of a tree here or there, the logger was very concerned about collateral damage - falling a tree into a tree - into the creek.
2256, SW, O - Timber did not belong to me, so value is unknown.
2501, NW, O - Not enough was harvested to calculate.

18. *The Stream Rules allow some trees left by the stream to be counted towards the required number of in-unit wildlife trees. Is this an incentive to leaving more wildlife trees by the stream?*

1 Yes

1099, SW, I - Some what, depending on value of trees in buffer.

2 No

1051, NW, I - The extra tress are required to be left. There is no incentive to leave them by the stream instead of elsewhere. THERE ARE NO INCENTIVES IN THE STREAMSIDE RULES AT ALL, ONLY COSTS.

3 Did not know about this

1976, SW, N - Thought they were separate.
1229, E, O - Only applies to clear cut which in Eastern Oregon we don't do.

19a. *Do you think that the training or information available from Oregon Department of Forestry on the Stream Rules was adequate?*

1 Yes

1126, SW, I - The publications were excellent.
1832, NW, N - But inconsistent.
1570, SW, O - But need a later follow-up (1 or 2 hours).
2339, SW, O - Except for written plans.

2 No

1056, NW, I - The FPF's need more too! More consistent!
1167, SW, I - Our company personnel (through in-house training) know more about the rules than many of the FPF's we deal with. State training is poor.
1229, E, O - Still need help from FPA to apply in field.
2501, NW, O - Not clear enough.

3 Don't know

1203, SW, O - Haven't worked directly w/state except 1 sale.
2525, SW, O - I missed the class.

19b. *Do you have any suggestions to improve or add to the training or information?*

1009, SW, I - More attention needs to be spent on smaller perennial streams.
1001, SW, I - Train (certify) consultants. I no longer have sufficient in-house time for this labor intensive work.

<u>1014, NW, I</u> - A larger tax credit would help in achieving improvement goals. Where streams may need improvement, it should be made worthwhile and desirable for landowners to improve those streams.
<u>1015, NW, I</u> - More on-the-ground examples are not available. Initial training was more theoretical. On-site visits are valuable.
<u>1016, NW, I</u> - Lots of training not all used that much.
<u>1033, NW, I</u> - Interpreting the rules when it comes to beaver dams and relatively flat ground. We should use the original stream channel as a point to begin measurement and no high water mark. These lakes come and go with the dams and FPO's are inconsistent with interpretation.
<u>1037, NW, I</u> - Scientific proof that what we are doing (buffers) help.
<u>1045, E, I</u> - My concern would be (1) that the ODF emphasis education rather than enforcement, and (2) be consistent between large landowners and small land owners.
<u>1048, SW, I</u> - Additional training on the intent of the regulations. Mandatory training for loggers on the rules.
<u>1055, SW, I</u> - Know more about the rules.
<u>1056, NW, I</u> - We need to have consistent interpretation of the rules. It varies from district to district and FPF to FPF. This is not right! Too much is left for them to figure out.
<u>1064, NW, I</u> - Spend time actually laying out a section of buffer under several different stream classifications.
<u>1066, SW, I</u> - Follow-up case studies
<u>1067, SW, I</u> - I would like to see more "case-study" type training to aid in interpreting the rules in various situations. In July '92 the DNR in Washington put on training courses that used case study exercises to show their interpretation of their rules under various scenarios. I kept the proceedings of this training in a notebook and referred to it often. Very effective technique.
<u>1077, E, I</u> - I think we as landowners know more about out land then a forester that just follows rules - state employees should listen and learn from landowners.
<u>1080, SW, I</u> - Have a follow up session to let landowners know how the rules are being accepted, used, misused, etc.
<u>1083, NW, I</u> - Repeat of the class now that we are in this program would help many of us.
<u>1094, SW, I</u> - Need actual field training.
<u>1096, NW, I</u> - Field demonstrations
<u>1097, SW, I</u> - More training <u>before</u> the rules go into effect would be good, especially concerning some of the guidelines given the FPF for implementing the new rules.
<u>1100, NW, I</u> - Continue to schedule day trips showing implementation of various stream rule practices.
<u>1105, NW, I</u> - No. The sessions I attended were well done.
<u>1115, SW, I</u> - The FPF are learning the rules along with us.
<u>1120, NW, I</u> - Have someone besides FPF's to help Industrial Foresters lay out buffers. They are too busy even to talk to you most of the time.

1121, SW, I - Any memos or correspondence or other literature put out by ODF for the FPF's to understand and implement the rules should be made available (at cost) to those of us who have to apply them. This would save time for the FPF's who end up sharing the information anyway if we do something wrong. Level the playing field so to speak.
1125, NW, I - Need additional opportunity to attend training sessions. People change positions and new people are hired out.
1127, SW, I - Waive the requirement for written plans w/the implementation of these "new" rules.
1129, NW, I - More field trips to examples of various scenarios.
1133, E, I - Allow landowner to draw up plan to be approved by State. This would allow flexibility to custom fit plan to unique circumstances.
1151, NW, I - Training was adequate, but the rules sometimes appear to be contradicting and information on fish use provided by ODF and ODFW is inaccurate or incomplete.
1152, NW, I - Send announcements of classes to people applying for permits.
1156, NW, I - Field sessions.
1157, SW, I - Information on small headwater streams are needed.
1159, NW, I - Use examples instead of repeating the text word for word.
1162, E, I - Develop accurate size class maps ASAP and fish/domestic use classes ASAP.
1173, SW, I - More funds for classifying and defining acceptable operations around streams is needed. Also, landowners should be better reimbursed for taking value from them.
1175, SW, I - Training didn't include enough emphasis on stream adjacent wetlands.
1176, SW, I - People should be made aware that a simple phone call to their FPF is very helpful.
1873, NW, I - Yes - there was too long a delay before stream classification maps were available and they are slow to get now.
1882, SW, I - Get fish presence determined ASAP.
1894, E, I - Need more practical applications not the bullshit some PhD came up with. Energy can not be created or destroyed. When we do something to displace existing energy flow regimes on a stream new problems often arise.
1903, SW, I - Hardwoods (inc. Red Alder) need to be considered as a key component in desired future streamside conditions.
1911, NW, I - N/A = never received training from ODF, only OSU.
1912, SW, I - Simplify, simplify, simplify!
2437, SW, I - Simplify the rules! Get away from B.A.
1144, NW, N - For operators - spec's on placement
1601, SW, N - More training, field trips in local areas, simplify instructions, give some paper examples.
1615, SW, N - Need good common sense, not base so much on theory.
1643, SW, N - I need a copy of the rules!
1653, NW, N - Pay for errors or lose your job like industry. In eastern Oregon (see the Oregonian story) forestry begged and pleaded not to leave 100 ft stream strips; even wrote memos to Fish and Wildlife as proof. 2 years later

came the fine, burned along the stream and scorched the land so nothing would grow. Soil erosion, predicted by forestry in a memo, washed the creek bed of soil erosion and mud and no further fish. Fish and Wildlife told forestry to clean up. Forestry said pay for your own mistake. We told you so. Either pay, pay for mistakes or forever hold your peace. Fish and Wildlife failed to pay. Fine them!

1655, NW, N - NA - we are not commercial growers.

1656, NW, N - Hire some good common sense people, forget the over educated know it all people.

1674, SW, N - Yes, but you wouldn't want to hear it.

1680, SW, N - Study private land owners one on one.

1685, NW, N - The paperwork, technical data and other information required from the landowner - logger is far too burdensome. You don't have to have a college education to own land or a logging company. The concepts used in the new stream rules were pretty much already being adhered to by most ethical loggers and landowners. Common sense and caring for your own land, has not been replaced by a time sucking set of new rules. Allowing us less time to do what we do best - care for our land.

1697, E, N - Yes. To assist the landowner in maintaining a year around stream. If you are going to protect it. It does not make sense to me. To protect a year around stream that is dry most of the year.

1703, SW, N - I didn't know there was a training program.

1712, E, N - Train the ODF&W to identify a fish bearing stream. They claimed mine to be fish bearing. I protested the stocked it in the early spring when there was water. They found no fish and refused to change the designation.

1722, NW, N - Correspondence courses for small wood lot owners. Not everyone has the time to commute or a schedule compatible for fixed site classes. Cash incentives with no strings attached. Technically all the rules constitute a taking of a right or property right - socialist crap rules.

1745, NW, N - Have available for inspection examples of areas where various options have been applied - no field trip need - able to see on own time - with written explanation.

1762, NW, N - I still don't know whether the creeks on my land are covered by the act. I have been told by local forestry department personnel that my creeks are not covered since they are too small to have fish in them. I am concerned that this interpretation may change at any time without further notice.

1768, SW, N - As a 40 acre timber owner I don't have enough experience in stream management to form an opinion.

1801, NW, N - Was not aware there was training or information available. Was told we had to hire a surveyor and a biologist for both wildlife and stream survey. This was required via the county staff.

1809, E, N - Tell the landowner the rules exist and give him a copy of them.

1832, NW, N - Buy, pay for what you take.

1837, E, N - Send copies of rules to landowners.

1855, E, N - Rules effected most in building an access road into an area with no road access in very steep wooded canyons. Small streams with 75' and 50' riparian zones. To not affect small creeks or cross them has been expensive.
1955, NW, N - Have more field trips demonstrating implementation of the rules.
1963, E, N - Be very careful not to create a bureaucracy top heavy with people that don't understand economics of harvesting timber, nature heals more scars than all the people that could be employed protecting the environment.
2013, SW, N - Yes - have more brochures available.
2024, SW, N - In general, I feel there should be more government salvage and thinning.
2037, NW, N - The scientist should work more closely with those coho live on work and dam the land. Look at Eastern and Central Oregon with all the shade trees because no thinning or selective harvesting was done and caused unhealthy trees vulnerable to the pine beetle attack.
2061, NW, N - Simplify procedure.
2085, SW, N - How about a video tape with information and examples rentable or loanable from State Forestry by landowners and loggers?
2094, NW, N - Not at this time.
2096, SW, N - When a private landowner starts a logging operation he should be furnished a complete copy of the rules so he knows what is expected of them.
1189, E, O - Should use the shade on the water and not the basal area of the trees. The Oregon Department of Forestry needs to have people to work with the landowner or timber purchaser to fully understand the rules.
1202, SW, O - Make sure everyone is aware of the changes.
1203, SW, O - We generally agree w/stream protection rules. Possibly use more flexibility in harvesting valuable trees opposed to defective or rotten trees.
1206, NW, O - Besides just written or typed rules additional drawings, or pictures of actual or simulated situations to help identify types of water or riparian situations.
1207, SW, O - Consistent interpretation (use common sense on unknown streams).
1213, NW, O - In areas where it will be opened to the wind, there is no reason to leave tall second growth or old growth as they will probably blow down anyway. Small conifers is fine.
1216, NW, O - The local forest practices foresters need to get out and do some ground truthing for the stream size and stream use classifications as designated on the maps.
1229, E, O - Going to basal area made it harder and more time consuming, need more examples, tables, etc.
1267, NW, O - More state foresters to help.
1274, NW, O - Make it simple.
1279, NW, O - Maps and classifications of streams should be more readily available to loggers and timber owners. Shouldn't have to go to state office to get information on any given stream.

1303, SW, O - Not at this time.
1321, NW, O - All streams are different some need more trees left. Some need fewer, can't be done with a measuring tape. It takes common sense and years of being in the bush.
1380, SW, O - Make it more simple.
1383, NW, O - Yes, change the rule.
1394, NW, O - Put on more schools with some different times and dates. Locations were also a problem.
1408, NW, O - Rules should be written differently. Why not print them on 8 by 10 pages to be placed in notebook binder. My husband wont stop complaining about small print.
1461, NW, O - Develop rule standards based upon sound reliable studied scientific information. As each decade passes, more blundered decisions made by fish and wildlife very quickly get pointed towards forestry and their "bad" practices.
1465, SW, O - Return to pre-1992 plans.
1475, NW, O - I think refreshing periodically would help.
1476, E, O - On the job training at the site works best.
1482, SW, O - The ODF would try to work with the landowner and the loggers idea on the logging plans with some open mind. Because all areas of logging are different, all laws are same for all areas of logging. There should be a little flexibility in some areas.
1499, E, O - I believe that any rules, as written, must remain somewhat flexible as the black and white print cannot be site specific. Many of our central and eastern Oregon streams see more variation in terms of water flow and changing riparian areas due to climate cycles. Some streams are west of the Cascades type, but many are Class "F" one year, then not again Class "F" for 5-10 years.
1502, NW, O - Something where ODF is not so tentative on making a decision on their own.
1504, NW, O - Timber people adjust quickly. It takes a little time for all concerned. All operators should receive the little yellow book.
1507, SW, O - Maybe another seminar in November or December when more people would be able to attend.
1513, NW, O - Let's see what we can do about the negative attitudes in the general public about timber management, and try to specifically target negative attitude with small woodland owners.
1516, NW, O - Yearly seminars in winter. Classes broken up, some of us will never use some sections of the rules as they do not apply to our area or resources. We should zero in on rules that we know we will use.
1517, SW, O - Farmers should be required to meet all regulations that forest users are required to meet.
1547, E, O - The Forest Practice officers of the State need to have training in the areas of helping fight the takeover by the government of private land.

1562, SW, O - More leniency to small landowners with dead and dying timber on their land and using a little more common sense for these streams instead of a blanket set of rules for all. (Some streams are dried up or with just a trickle and the same rules apply as if it were class 1.)
1570, SW, O - After the rules were in place and people had a chance to use them and study the rules there should be a short question and answer period and more help on written plan requirements.
1592, SW, O - Make simpler.
1594, NW, O - Small training groups at specifically different riparian sites would be helpful.
2128, NW, O - Make more simple, too complicated for average smuck.
2129, NW, O - I feel the forestry personnel has done a pretty good job working with us to try to do the job that was intended even though I don't agree with all of the rules especially saving trees on north side of streams.
2150, NW, O - Send out more information. Maybe some on the ground demonstrations, not all of the FPO's are consistent.
2151, E, O - I think the basic concept concerning riparian areas is a sound one, however, I believe alternative measures such as planting lower growing plants, trees and shrubs could be substituted for leaving taller mature trees and would actually stabilize the soil and shade the stream more effectively than leaving taller mature trees. I realize however that the period right after harvest is very important and planting or placing of shrubs, willows, brush, etc. would take a period of time that one may not have.
2163, NW, O - Make maps showing what classification it is.
2186, SW, O - We need forestry officers with common sense and use the book rules only as a guide, also whom will listen to the input of what the landowner and logger have to say.
2236, NW, O - The written plans need to have a good general form to use as a master plan. To be provided for reference. Measuring of trees in RMA takes entirely too long if your thinning area should be taken care of with on site meeting.
2240, NW, O - To have good foresters that work with the loggers and landowners such as Linn farm.
2315, SW, O - I think, even if there is only a small patch of trees long the creek, as long as you leave a good canopy you shouldn't have to count basal feet and leave all the conifers. Also, considering that the trees you do fall are fell precisely, without smashing too much when fell or skidded.
2339, SW, O - Workshop on written plans. Standardized training of FPO. Reconsideration of BA requirements where commercial thinning is going to create growth.
2354, NW, O - I think forestry should have a video available or once a year a type of classroom for these requirements or new laws put into effect.
2378, SW, O - If this is going to work there needs to be less intermidation and threats on wrong doing. Loggers and landowners need to be more in the equation on rules and regulations. The rules are always take, take, take with little or no good coming of them. I feel (as a fifth generation Oregon logger)

that I have more love for the land, timber, wildlife and habitat than those make rules. We the logger, landowner, the people need to be figured in. (Please!)
2525, SW, O - Move classes, easier system in figuring basal area and maybe a point system or something.
2562, SW, O - A 3-4 hour followup session 2 or 3 months later would have been helpful.
2572, SW, O - Lets look at this constitutionally not a bunch of people who don't care and take illegally.
2577, E, O - The person that manages the rules determine the attitude toward the like or dislike of any rule.
2600, NW, O - All loggers are not stupid! There are some of us who are capable of making on site decisions about logging practices without using a manual or FPF's who don't always have time to spend in the field.

SECTION 2. Questions about the Issues Surrounding the Forest Practice Rules:

20. *How much do you support or oppose each of the following objectives as a basis for making rules for private forest land near streams?*
1722, NW, N - Depends upon the impact on me and how realistic the objectives and by whom driven.
(Strongly Support, Support, Neutral, Oppose, Strongly Oppose, Don't Know)

a. *Water quality*
1329, SW, O - Within reason.
2506, NW, O - Depends on location.

b. *Fish habitat*
1329, SW, O - Nothing has been harmed.
2518, E, O - The habitat is in better shape than ever. The problems are on the main stream and ocean.

c. *Wildlife habitat*
1097, SW, I - Burden should not be put on the small private landowner without just compensation.
1136, NW, I - I generally support the rules but strongly believe the owner should have flexibility and incentives or compensation for the state "taking" of their rights and trees.
1615, SW, N - Dry streams are not good fish habitat. We support wildlife as they move in anyway.
1675, SW, N - Don't need 100 feet.
1697, E, N - If stream is free running year around.
1762, NW, N - Private landowners should be compensated.
1329, SW, O - They are doing fine even in replanted land and 2nd growth.
2132, SW, O - Not on private property, property owner should decide.
2551, NW, O - Not at landowners expense (taxation without representation).
2577, E, O - If that is in fact what they do.

21. *Do you think that Oregon's Forest Practice Rules for streamside areas are generally less or more strict than streamside rules for surrounding land uses such as farming, grazing, building, or mining?*

1 Less strict than rules for other land uses

2 As strict as rules for other land uses

3 Stricter than rules for other land uses

1876, SW, I - Farming and grazing.

4 Don't know If you did NOT chose 3, SKIP to Question 23.

1010, NW, I - Two wrongs don't make a right, but it is tough for foresters to watch many agricultural abuses that are adjacent to forested areas.

22. *If the rules for nonforest uses required similar protection of streamside areas, how would it affect your support for the Stream Rules on forest land?*

1 Easier to support

1207, SW, O - This would avoid people building road, clean streams, as a ranch operation rather than logging operation.

2 Would not affect my support

3 Not easier to support

1383, NW, O - Repressive rules added to one another will not justify either.

23. *How effective do you think the following methods are for government to influence forest practices on private land?:*

1116, SW, I - I don't understand question, so I won't answer.

1150, NW, I - Federal government and universities have lost touch with industrial management (except some extension profs like Paul!). Even ODF often shows little understanding of forestry as a business.

1722, NW, N - Is that the same as dictates? Under penalty of what? The government that governs less or least governs best.

1763, NW, N - Ambiguous, may be effective but I do not support method.

1801, NW, N - This question appears to be asking about current practices. If so - they are all totally ineffective or non-existent and should be improved.

HOW EFFECTIVE? (Highly Mostly Somewhat Slightly Not Don't Know)

a. *Technical assistance (e.g., helping with management plans, explaining rules)*

b. *Education (e.g., field tours, workshops, how-to publications)*

c. *Regulation (Forest Practice Rules)*

2691 & 2687, NW, N - Written guidelines ("Rules") are effective establishing desirable criteria and what not to do. Penalties for noncompliance give ODF the "teeth" to enforce the rules which most landowners will comply with because they are good law abiding citizens. Incentives, compensation, and credits would be more wisely accepted and adaptable to various on the ground situations, would not eliminate or decrease an owners "bundle of rights" and could remove ODF from its police role. This policy role creates distrust of the ODF by landowners.

1513, NW, O - Regulation means conflict to most people.

d. *Cost-sharing forest management expenses*
1722, NW, N - No strings.

e. *Compensation when rules restrict harvest*
1722, NW, N - No strings.

f. *Tax credits when rules restrict harvest*
1722, NW, N - No strings.

g. *More favorable capital gains treatment*
1176, SW, I - f & g must occur.

h. *Easements (sale/donation of harvest rights)*
1722, NW, N - No way.

i. *Land exchanges/swaps*
1136, NW, I - As long as it is fair and equitable for both parties, however the present governmental criteria require the agency to clearly be the primary beneficiary or be in their best interest before they will even consider an exchange. It also takes an unreasonably long time to work out these agreements when the landowner needs a reasonably quick response.
1722, NW, N - Perhaps, ok land - productive type.

j. *Other (specify)* ______________________
1051, NW, I - Landowners will completely support programs which pay them the full cost of the restriction so long as it does not give the public access rights.
1115, SW, I - Rules that people truly support and understand.
1129, NW, I - Strong reasoned base for the rules or goals.
1145, SW, I - Reduced regulation based on historical performance of individual operator - demonstration of achievements.
1881, SW, I - Provide certainty overtime.
1722, NW, N - The death penalty torture, drugs.
1801, NW, N - if you mean "would be" effective; improved a,b,d,e,f,g would all be effective incentives.
1832, NW, N - If the public wants something - pay for it.
2024, SW, N - If government stops logging for reasons such as spotted owls or other endangered species, government should compensate timber owners with fair market value, or timber swap.
2037, NW, N - People living with the land do a better job without the expense of government interference.
1207, SW, O - Check for compliance.
1303, SW, O - Making better forms. All these suggestions would elevate taxes and ultimately be paid by us to implement against us for our benefit - no sense to that to be had.

1321, NW, O - Government should have a limited role. Should not spend money they don't have.
1461, NW, O - Note "C" is highly effective because of FINES and not because the regulations result in good practices.
1502, NW, O - Compensation is the best way when you take something away.
2132, SW, O - I think government should stay out of decisions made by private property owners on their own land.
2506, NW, O - Should survey streams immediately upon request and not take a year to do it. Also waive the one year waiting period for streams being surveyed.
2557, SW, O - d,e,f,h,i - not fair to most taxpayers. Only supporting taxpayers and government employees and legislators should cover expense of items de,e,f,h,i.
2577, E, O - Why can't the government stop trying to rule the private land and private enterprise.

24. *Public resources such as fisheries, water supplies, and wildlife often are on private land. On a scale from 1 to 10, where 1 gives all responsibility to the landowner for protecting and not harming public resources and 10 gives all responsibility to the public, where do you think the responsibility for public resources should be?*
1134, SW, I - Poor question; three distinct categories with different answers/background, e.g. fisheries praises effort at every juncture; habitat and water flows, dams, fishing escape, predators.
1150, NW, I - When landowner has no authority, they must have no responsibility.
1722, NW, N - Says who - what ever happened to freedom and responsibility? Dismantle the Bonneville Power Administration and all public and private dams - save the salmon - go nukes.
1949, NW, N - Public resources should be purchased for the public.
1274, NW, O - Don't like question, no comment.
1391, SW, O - Not necessary, create more government fat.
1523, SW, O - This is a non-applicable question, wildlife on private land are private property. If they are public property, landowners should be compensated for their care.

Landowner responsible to protect & avoid harm, bearing costs or fines	**Public responsible and must pay to protect & avoid harm**

•<----•--------•--------•--------•--------•--------•--------•--------•--------•---->•
1 2 3 4 5 6 7 8 9 10

1010, NW, I - Landowner is responsible for "on the ground" management, however public is responsible for any compensation due!
1547, E, O - Its private property they should be left alone.

2151, E, O - Landowners as a whole rely on the land and tend to take care of it.

25a. *What are your views on compensation to landowners whose income or property value is reduced by regulations, knowing that paying compensation might cause funding cuts in other public programs?*

1015, NW, I - After compensation is paid, who owns the resource?

1 Compensation should be offered if income or property value is reduced at all by complying with the rules.

1415, SW, O - Unless you are a communist (liberal socialist).

2 Compensation should be offered after a certain loss of value on a piece of property (such as 10 or 20%).

3 Rather than across-the-board compensation, government assistance programs should be targeted to help the most severely affected owners.

1015, NW, I - We don't need more government programs.

4 Changing tax incentives or credits to encourage landowners to manage and invest in forests would be better than compensation payments.

1015, NW, I - This is appealing but don't know how it would work.
1125, NW, I - Can work but tends to hide real costs from public.
1176, SW, I - We paid for entire property, anything less is a "fuke"!!

5 Compensation should be offered for timber owners who protect more than required, but not for meeting rules that all owners must meet.

1145, SW, I - Depends on what this is - Oregon - agree, California - existing rules too restrictive.

6 Landowners should not be compensated because they have a responsibility to protect the resources on their land.

7 The government should not pay compensation for losses in land values unless landowners also pay for gains in value from public activities or policies.

1001, SW, I - Landowners already do - thru the tax system
1015, NW, I - Nonsense

8 Compensation should not be considered for any reason.

25b. *Do you have comments or other opinions on compensation, incentives, or takings?*

1001, SW, I - The Governor negotiated in bad faith.

1004, E, I - The taking is out of hand - the taking of so much land to satisfy a few is beyond reason, the state of Oregon has only a small percentage of private land left. With all the federal, state and local laws - what is private land?

1014, NW, I - Landowner is providing a public good, but also a good for him/her-self. A certain cost should be shared by landowner, but the majority of cost should be compensated by the public for providing the public good.

1033, NW, I - Really disappointed - severely distressed governor vetoed our compensation for takings Bill. More timber and farm ground will go for house and electronics as a result. Bad, bad, bad!!! Laws should encourage people to grow and harvest trees rather than force people to sell to developers and cut prematurely.
1034, NW, I - Strongly feel that the "public good" impact should be carried to much greater extent by the public.
1048, SW, I - When you change or initiate regulations that reduce the value or restrict what private landowners can do with their property. That landowner should be compensated by whomever institutes that regulation.
1051, NW, I - Landowners have the power to exclude wildlife and probably fish from their land. There is no legal requirement to allow the use of your land by the public's wildlife. The same is not true for water. It falls everywhere. As such, every landowner has a responsibility to protect water quality but none to provide wildlife habitat. If the public requires landowners to provide habitat, it should pay the cost of providing it.
1056, NW, I - The public needs to be aware that these rules come with a cost to society (ie. schools, roads).
1063, NW, I - Private property rights should be protected whether its timber land as a person's home. Too many people write off timberland because so few own it. The old "it doesn't effect me" cop out.
1064, NW, I - I don't think the public is aware of the huge amount of value that is left in riparian areas. It is easy to vote for more and more restrictions if you don't have to pay for them.
1065, NW, I - The value of compensation is that the public might understand what we are giving up as a group not just the "big rich landowner".
1067, SW, I - Landowners have rights and responsibilities to protect "common" resources. I have always felt that regulations to protect common resources are not a taking simply because they reduce the value of an asset; however, landowners should not have to pay taxes on assets with no value. I would like to see the cost basis of timber left due to regulations transferred to the adjacent timber which I can sell. Landowners should not have to pay ad valorem or property taxes on land reserved for resource protection. Landowners should get a timber tax credit for timber left to protect common resources. Landowners should be absolved from fire protection levies on acres reserved for resource protection. In addition, I would like to see the cost of reforestation up to the minimum by law (200 free to grow seedlings on Site Class I, II, III, for example) treated as an expense of sale for tax purposes rather than being capitalized. In other words, the costs of complying with regulation should be expended in the year incurred. My logic here is to link the expense to the event or activity which triggers it. Since harvesting timber triggers the reforestation requirements, that portion of the reforestation expenses required to meet the law should be expendable in the year incurred. The remainder would be capitalized. In summary, I would like to see more effort expended to transfer the cost of protecting common resources from

landowners to society at large by using more indirect non-cash mechanisms. Tax policy is one such area. Tradeable environmental credits is another. Another idea would be to absolve small woodland owners from estate taxes on the timber portion of their total estate.
1074, SW, I - When working up with incentives both landowner and regulator work toward maximizing public benefits. When using only regulations without compensation the regulator's minimum acceptable target becomes the landowner's maximum goal, thereby producing inferior results.
1076, NW, I - Perhaps we should privatize public resources.
1077, E, I - Private property rights are very important. Let the government stay out of our business.
1083, NW, I - Timberlands are now taxed at low rates - owners affected by large % of their timber being affected, should be helped, ie. mom and pop "40" ½ in buffer strips.
1094, SW, I - Incentives are always better than regulation in accomplishing objectives on private lands.
1099, SW, I - If complying to the rules benefits the public resource than the public should pay for the benefits. It is not an issue of being good stuwarts. All landowners should be good stuwarts regardless. Compensation for timber value lost is the key.
1104, E, I - The idea that the public at large (state and federal, or nationally) cannot afford to pay for the cost of protecting public values on private land but individual landowners can afford to pay these costs is absolutely ludicrous. If all citizens want to benefit from the protection of natural resources on private land then all citizens should bear the cost equally thru some form of taxation.
1105, NW, I - I do not believe any government should be allowed to take any private land value without compensation.
1108, SW, I - Incentives to grow desirable stand conditions with flexibility to maintain a percentage of the available land base in the desirable stand condition over time is preferable to the present system of penalizing the owner when an endangered species takes up residence on his land.
1111, SW, I - Compensation should be given at present net worth plus future net worth of succeeding harvests.
1115, SW, I - Landowner should have the right to practice intensive forest management at the expense of wildlife biodiversity and water temperature.
1118, SW, I - I do not believe that paying compensation would cause funding cut in other public programs. Some programs should be cut regardless! (PORK!)
1121, SW, I - If we look at other states' Forest practices rules (especially California's) we can see examples where overly restrictive or unclear rules actually become a disincentive to good forest management - certainly not the kind of thing we're after. We need to make sure the public always gets the level of protection they need and that they help pay for the level of protection they want.

1125, NW, I - When the public can determine values (fish, wildlife, etc.) without being responsible for paying landowners losses they sometime will put high values on all wildlife in all locations.
1126, SW, I - Compensation is a big can of worms, impossible to administer or anything else. Regulatory burden is extremely high - need to look at incentives!! Lower tax rates, etc.
1130, NW, I - Private landowners are responsible for caring for resources on their lands, but should not be required to care for resources on adjacent lands (i.e. owl circles).
1132, NW, I - Compensation should be offered and an easement bought by the public. The tribe could then be managed and the public reimbursed over long term.
1133, E, I - All takings should be compensated, either through incentives or directly. Owning land is a privilege - not a right, but the public should not be allowed to reduce a landowners net worth w/o compensation.
1134, SW, I - Incentives are essential for long term success. If not, gradual degradation will follow. Also all society has to step up to the issue. Too much is laid on forest landowner. Uncertainty/fear caused some good tree-farmers to chance assets.
1142, NW, I - Landowners should not be saddled with the entire cost of public policies.
1145, SW, I - Regulations should be used as a last resort. Basic "Best Mgt. Practices" should be used as a guide or a site by site basis to meet landowner objectives while still not causing harm to public resources. Given this type of approach, most landowners will probably conduct operations with a greater positive impact on public resources than through negative, narrowly defined "rules" which limit options for good management (example...just review landowner activity during 4D discussions and prior to new stream rule effective date). Professional foresters, not politicians, should conduct forest management.
1146, SW, I - Trees in the buffers have been taken by the government for the people of the country. Therefore landowners should receive a fair price from the government for the trees.
1151, NW, I - Just that I think there should be minimum protection standards and compensation in the form of a reduction in capital gains whenever stream protection measures exceed the minimum standard. This would be done on an ownership basis rather than unit by unit and tied to a long term (10 year) management plan.
1152, NW, I - Would apply to rules changing value after time the person purchased the land. This obviously can not be done retroactively.
1156, NW, I - Governments should not be taking private property - with or without compensation. Some loss has been accepted historically by landowners as part of doing business but the value of resources is too high to arbitrarily trade a non-consumable resource fora consumable (ie scenic corridors vs timber production).

1167, SW, I - Losses due to regulatory compliance constrain available harvest volume which in turn can incrementally raise stumpage values and thus offset some of these losses. Ex) Restricted harvests on federal lands due to spotted owls dramatically increased the value of private timber holdings even when private set-asides for owls are factored in. I believe the public has overlooked this. My company has profited greatly from the spotted owl issue despite having several activity center set-asides on us.
1173, SW, I - Compensate for reducing value.
1174, E, I - If compensation were required, the public could see what the programs and regulations were costing and then they could choose which ones were the most important to them. It is easy to support something when their pocketbook is not affected.
1175, SW, I - Long term investments need some protection against the public restricting harvest.
1176, SW, I - We deserve a tax relief.
1881, SW, I - Public policy should encourage forest management by recognizing the long term nature of investments and providing certainty in laws and rules and tax treatment and incentives that encourage environmentally responsible and productive forest management on private land. A class distinction should be maintained between public and private lands both in policy development and the role each type of land should play in our society.
1894, E, I - The 5th amendment of the Constitution.
1901, E, I - Landowners should be responsible standards of the land and resources, but should be given flexibility to meet their goals without lots of red tape. Rigid rules that are not site specific can cost landowners too much.
1903, SW, I - Direct compensation is very difficult to determine, coupled with high administration costs.
1923, SW, I - When people with no financial commitment (98% of people) can tell (2%) what they can o can not do on their property - something must be done - I do not like to see tax dollars used but 98% of the people will not voluntarily donate money.
1940, NW, I - Being good stewards of the land is a responsibility of landowners but loss of value of more than 10% should be compensated by the public.
2417, NW, I - Other new rules are put into place that prohibit a landowner from harvesting timber he has paid tax to grow and was legal to cut under previous rules, he should be compensated.
2458, SW, I - If the government is going to steal from the people they should be made to pay like any other thief!
1144, NW, N - Present loss or tolerable - but when next increase in taking occurs I'll rebel!
1597, E, N - If you have wetland you should have compensation if you can't thin your trees.
1607, NW, N - If government wants valuable to be left along a stream bank then there should be fair compensation.

1643, SW, N - In general, I do not think that landowners should be directly compensated for reduction of value because of regulations. In certain extreme cases, government should pay for development rights or should actually purchase land at fair market value.
1653, NW, N - Webster's Dictionary states steal = to take another's property without permission, dishonesty, or unlawfully, especially in a secret on surreptitious (such as attaching a new rule to some other legislation) manner." If I therefore object to your or anyone taking property I purchased, or someone not paying for it THEN it is THEFT. If our laws allow stealing what other of the ten commandments will government be allowed to violate? Name them all! Either pay for what is taken away or you are stealing it. Enough stealing!
1655, NW, N - Forestry is a long term operation. Compensation/incentives should not apply to short term "loss" - only to long term. Leaving trees to grow for 100 years along streams which is then combined with a selective harvest should yield in long term gain both in lumber value and in preventing erosion, etc.
1674, SW, N - The US Bill of Rights says it all. When the Highway Department takes your house or part of it for a road, they _____ it. Why shouldn't they pay for my trees, land, etc.?
1675, SW, N - Keep the government as far as possible from the landowner.
1685, NW, N - As landowners, we never really own the land, we just purchase or inherit the right to control that land for the course of our life time. If the public wants control rights on our property, they should have to purchase those rights just as we landowners did.
1686, NW, N - If government wants to protect a resource than the government should compensate the landowner.
1703, SW, N - I do not think they should be able to take timber that (I own) the public didn't pay the tax on this timber for years but I did.
1712, E, N - Resources occurring on private land belong to the landowner. Any restrictions must be paid in full, as such these expenses would limit the nonproductive government incursions into the private sector.
1722, NW, N - As noted above in the margins and etc. Sorry if some of the notes are a little radical or too much beside the point. Some of the questions are difficult to answer for me due to personal involvement, political orientation and outlook and a basic ingrained distrust and dislike of government.
1745, NW, N - Rules enacted that "take" or restrict use may have an adverse on value. This value may have been the planned retirement income - such "loss" should be considered by compensation or shift of application to public owned land.
1763, NW, N - The 4th amendment explicitly forbids taking value from private forest land. These regulations are a direct violation of the 4th amendment. If this is not enough, these rules encourage the land holder to abandon care of streams and stream side environment. I for one will not spend one dime on an area that I cannot expect to get some return.
1801, NW, N - We support the rights of property owners to be compensated if rules and regs decrease the value or use of their land. The country was

founded with principles supporting ownership of land by private individuals. We also support responsible use of the land by the individual. If the public is to demand higher requirements then when owner purchased the property, then the public needs to be responsible for compensation to the owner for whom they are changing rules!

1832, NW, N - Takings must be paid for - as in condemnation.

1854, SW, N - It is a wonder no one has been shot! If you take - you pay. If someone took food out of your cupboard, would you expect them to pay?

1963, E, N - I am an advocate of private enterprise as our constitution proclaims - eminent domain is acceptable to me for public benefit. Rules and regulations are not acceptable that up costs and diminish property values, people making the rules may not pay taxes or have property.

2024, SW, N - Compensation should be in equal land and timber swapping with the government. This would not hurt funding for other programs.

2037, NW, N - If the landowner is regulated by government and unable to harvest his land he should be amply compensated for his loss plus all expenses incurred doing the paper work required.

2085, SW, N - Our family has protected streams and banks wildlife habitat for the last 50 years without rules or compensation. A common sense thing such as this should not require compensation. We all benefit from it.

2096, SW, N - Declaring a wetland area on private property without compensation in my mind is illegal. The government has done that in the past. Compensation should be according to present land values.

2101, SW, N - Compensation should be paid for anything taken by government whether it be trees or land or anything we pay taxes on. Your new rule got a lot of riparian zone logged that was too small or would not have been cut if not for your rule.

2699, NW, N - Komains and no compensation.

1182, SW, O - I feel 50' would be sufficient some areas, at other times a 100' would be better depending on the stand of timber.

1184, SW, O - The size of the land should be a factor. What I mean is a landowner with a small parcel, under 500 acres, or there abouts. Should fall under a different designation than say Wayco I.P.

1189, E, O - When the property values are reduced when complying with the rules it is to the benefit of the public, wildlife, etc., but it doesn't benefit the landowner.

1190, NW, O - If the public takes away landowners timber resource they should compensate them somehow for this. Just like they lose by not harvesting state and federal lands.

1206, NW, O - I feel compensation for the small landowner is more just than a major corp. A man planted 30 acres trimmed, nurtured trees to harvest during retirement, or for nest egg. Now cannot harvest part of it. Compensation I feel is in order so his children will keep up the same thought.

1207, SW, O - Forestry is a long term commitment. We use to figure in risk for fire, insects and disease. Today I see the largest risk being government regulation. We need to reduce this concern by compensating for additional regulations to encourage long term management.

1216, NW, O - Would be willing to leave valuable trees and incur more costs if the public is willing to buy the resources through credits, compensation or easements.

1229, E, O - I strongly agree with #4.

1232, E, O - I think that if regulations are for the good of the public at large, they should help pay the cost of the said regulation.

1303, SW, O - It's a bitter pill we all should have to swallow - on a financial basis - it is very difficult on a general effect basis its better for environment.

1308, NW, O - I think timing and ownership is an issue. Where a landowner has had a long term ownership and recent laws-regulations devalue his land for the good of public resources - water - air - visual etc., then they should be compensated fully.

1321, NW, O - Don't look for ways to spend money. The laws and rules are working. Let's sit back for a few years and watch. Making hasty decisions are costly.

1329, SW, O - Don't use taxpayers money, it is very committed. Credits would work - if it is a taking, allow a BLM or USFS land swap. Mostly keep land in production at some level of timber base (thinning, salvage, etc.). Please create jobs - workers taxes support the nation.

1342, NW, O - Landowners should not be forced to pay 100% for public resources. If the public votes for increased restrictions, then they need to put their money where their mouth is.

1363, SW, O - Birds, 10%; Logging, 10%; Ranching, 10%; Farms, 10%; Sport Fisherman, 10%; Commercial Fisherman, 10%; Power Company, 10%; Indians, 10%; Predator fish, 10%; Gill nets, 10%, Seals, 10%; Foreign fleet, 10%; People, 10%, for a total of 130%.

1368, NW, O - If the government is going to condemn private property, we should not have to pay taxes on that land. In just a few years we will probably loose all control of the rest of the land.

1383, NW, O - These are not good questions because they are based on compliance with oppressive rules and regulations which are based not on common sense but on the "scientific theory" (sic) - (religious doctrine) of evolution. Adopt good laws (about like they were before recent changes). Then these questions would be more appropriate.

1391, SW, O - Changing of stream rules, just increased logging along streams. Like all increase in government regulations. This had people harvesting out of fear! This is why rules are BAD. Education on forestry matters wold. How done more good! As per "Thomas Jefferson" the government which governs least governs best.

1408, NW, O - We strongly believe that, lets say we can't harvest due to the spotted owl, the public should compensate us. We strongly think if they (the general public) wore our boots, you can bet they would expect us to compensate them.

1414, NW, O - If the public wants to take value away from the landowner, the public should be willing to pay for it.
1443, E, O - If government shut down, land, should compensate both landowner and logger.
1475, NW, O - To grow timber is like growing a garden, you have to have sunlight and no weeds. I think buffers are ok but mostly hardwoods seem to grow there. I think take the trees do stream work get a good crop growing fast keep it for 50 years as a no entry.
1476, E, O - Decisions should be from the local level based on site specific common sense and not politically influenced. Keep the bureaucrats out of it.
1502, NW, O - Help the small timber owner not the big boys.
1504, NW, O - Small woodlot owners should be compensated.
1507, SW, O - I don't like compensation because it is a one time fix. What about down the road the 2nd rotation. I think timber can be managed along streams. Foresters and landowners can agree on harvest methods that will not harm the stream.
1513, NW, O - Natural resources are a privilege we all share in, however, the landowner, large or small, must not be made to pay the cost in whole - it must be a public burden as well.
1519, NW, O - When government takes, it should pay!
1547, E, O - It is a proven fact that landowners can manage their resources far more efficient than the government. The private sector has to manage their resources to the max or they are out of business. So leave the private landowner alone.
2129, NW, O - After people have paid taxes and kept property for years to harvest timber especially in their senior years it seems that if the government or public feels it should be left then some compensation should be made.
2132, SW, O - If government wants to dictate what is done on any private property they should have to compensate landowner. I think if that was put into effect and government had to put up money or shut up we would have a lot less rules and regulations from them!
2150, NW, O - Water or stream protection have a price. The price should not be paid by private timber owners. If the state feels the new restrictions are the best way to protect the water coming from private property they need to pay for it.
2186, SW, O - I felt that the legislators had passed a good law that was vetoed by the governor. I think it was put back in partially, but only being forced by a tradeoff.
2195, NW, O - Show me one example of government control being better than private control.
2228, SW, O - Deed holders of record prior to rule changes should be compensated for their loss in value. Compensation should come from agency or group benefiting from rule (or intended) changes!
2240, NW, O - I don't think landowners should be compensated for land value loss, only in certain cases. I do think they should be paid for timber that would be made no longer harvestable by a new regulation.

2284, SW, O - #7 above is an absolutely hideous statement. What possible gain in value could ever come from public activities or policies on private land? Unless it were activities that received landowner permission.
2285, SW, O - Keep the government out of and off of private land.
2290, E, O - As research continues the rules become more restrictive in all areas. The landowners that I deal with suspect political correctness and not science dictating rule changes. Conclusion; if threatened by compensation, results of "scientific study" will have more science and less political correctness as result.
2315, SW, O - If someone does harvest the timber on their land and has to leave some marketable timber to comply with regulations, and they do comply, then #4 tax credit or incentives is a great idea.
2339, SW, O - Compensation should always occur in some form when the public "taxes" value from a landowner in the form of tax breaks, tax incentives, or direct compensation. The public should pay for what it wants!
2353, SW, O - I am strongly against takings, at all, for any reason.
2389, SW, O - Most compensation plans would only benefit large well organized owners, the paper work would prevent small landowners from qualifying although small lots on river or stream frontage would be disproportionately affected. Such as my 20 acres on Row River.
2525, SW, O - Compensation should only be offered if property was bought before new rules came into effect that would lower their value.
2557, SW, O - Landowners should be held responsible for quality of water leaving their property but not for preserving plant and wildlife or their habitat. Especially predatory animals which are damaging to their agriculture, industry, or domestic well being - some with plants (or animals (endangered)) which displace or interfere with agriculture, industry, or domestic life. The population as a whole and especially those few who produce our essential goods and services should not be penalized with the scientific (so called) experiments of a few preservationists. Let only those in favor of such experiments and legislation pay all!
2572, SW, O - If I have trees along a stream they are my trees. I don't feel compensation is fair because I still have mature trees on my property is the government going to pay me rent. This is my property guaranteed to me by the constitution and the government has not got the right to legislate their opinion on private property owners.
2577, E, O - Paying the landowner for leaving trees or thinning a stand of timber to suite the government is not fair to the public or the landowner that takes care of his own responsibility.
2640, NW, O - Too much "beliefs" are replacing good science and "common sense", rampant hypocracy in application of rules, and the intents of their production(s).
2565, SW, O - Anytime the rules go too farm compensation should be paid.
No Number, SW, O - If the government is going to steal land or timber they should pay like any other thief would have to.

SECTION 3. Personal Data for Statistical Purposes

26. *About how many years have you, your family, or company owned the piece of land that was harvested?*

27. *How many forested acres, in total, do you own (singly or with others)?*
1855, E, N - 800 acres. Partially forested estimate about 150-175 acres of actual forested land.

28. *Which of the following describes your main reason(s) for owning land?*
1773, E, N - Don't own - manage for clients/
1 Income from timber
2 Long-term investment or as part of an estate to pass on
3 Pride of ownership or stewardship
4 Recreation, scenery, or aesthetic values
5 Wildlife habitat
6 Woodland is part of my residence or farm
7 Other (please specify)____________________________
1615, SW, N - Cattle, hay, tree farm
1641, NW, N - farm land
1712, E, N - Cattle grazing
1722, NW, N - 2 and 3 very closely related, 3 and 5 are closely related.
1747, SW, N - I like what I'm doing.
1809, E, N - Pasture
1814, NW, N - Trees were starting to die partly because of age and because of damage from harvest about 50 years ago.
1832, NW, N - We need to protect private property rights.
1849, E, N - Cattle pasture.
1963, E, N - Livestock grazing.
1972, NW, N - Development (was 2½ acres zoning when purchased)
2014, E, N - Gold mine.
2024, SW, N - Retirement of growing forest.
2101, SW, N - Cattle
2743, E, N - Hunting

29. *What is the most important reason that you harvested this time?*
1 Needed income
2 Timber was mature
1152, NW, I - I wanted to plant hybrid poplars
3 Salvage dead and diseased timber
4 Stand needed thinning or improvement
5 Prices were good
6 Uncertainty about future harvest restrictions
1149, E, I - I see this happening alot!
1653, NW, N - But because of the new rule I would never have harvested, like my brother next door. I did not need the money. Timber had good growth but needed thinning management. NOW: at least 5 acres is gone forever to a huge gauge for a road in the hillside, and forever worse erosion plus 10 times the

erosion in the valley. There was no stream, but listed as a stream so I cut. Too Bad

1768, SW, N - Land not suitable for timber, converted to cranberry bog 5 acres.

1801, NW, N - The only reason at this time.

7 Other (please specify) ____________________

1083, NW, I - city ownership plan to even flow income.
1022, SW, I - Stand conversion, hardwood to conifer.
1051, NW, I - Property being sold.
1104, E, I - Landowner put up timber sale and set conditions of harvest.
1113, SW, I - Public forest revenue
1122, NW, I - Targeting hardwood conversion stands --> low productivity
1129, NW, I - And it was a underproductive stand and needed to be concerted.
1138, SW, I - Forest fire killed all timber.
1146, SW, I - Timber deeds were expiring.
1641, NW, N - Wanted to protect stream bank
1686, NW, N - Divorce - needed to split assets
1722, NW, N - To pay off mortgage.
1745, NW, N - Convert under productive land to better conifer stocking.
1855, E, N - Built road to access 2½ miles of land and were uncertain whether I could get this approved in future years.
2101, SW, N - Log it or lose it.

30. *Have you ever participated in any of the following forestry-related information, education, or assistance programs*

	Participated	Didn't Participate
a. *Extension Service (County or University)* . . .	Y	N
b. *OR Dept. of Forestry Owner/Operator Training*	Y	N
c. *OR Small Woodlands Assn. program*	Y	N
d. *Cost-share programs (ODF, ASCS)*	Y	N
e. *Other (please specify)*__________	Y	N

1014, NW, I - Training by implementing
1020, SW, I - Given tours to private landowners
1073, E, I - On site tour with Board of Forestry
1096, NW, I - FIR Program
1121, SW, I - Society of American Foresters meetings on the new rules.
1122, NW, I - Self taught
1129, NW, I - Helped write the new rule.
1156, NW, I - Workshops, COPE, etc.
1643, SW, N - Site Improvement Program
1674, SW, N - Local forest fire protection district 1954-1975.
1722, NW, N - Perhaps letters to woodland owners informing them of availability of classes/info community colleges, newspapers, forestry department office.
2101, SW, N - Talk with FPO.
1324, E, O - LEAP Program.
1383, NW, O - Personal experience in logging and good forest management.
1441, NW, O - Private landowning

1461, NW, O - ODF employee at time of 1972 Forest Practice Act rules which were very good rules, served their purpose well, and were fair to landowner and the public.
1491, NW, O - 28 years of hands on logging.
1513, NW, O - ACP, SIP
1517, SW, O - ODF&W
2132, SW, O - Forest Service education.
2240, NW, O - Weyco and Simpson.
No Number, SW, O - Work program.

31. *How would you rate your knowledge of:*

	High	Average	Low	No Opinion
a. *Forest management for timber* . . .	**1**	**2**	**3**	**?**
b. *Stream habitat management*	**1**	**2**	**3**	**?**
c. *Ecological functions of riparian areas*	**1**	**2**	**3**	**?**

1722, NW, N - Compared to whom? Urban-rural demographics.

32. *What is your age?*

No Number, NW, O - Worked in the woods for 65 years.

33. *What is the highest level of education that you completed?*

1 Grade school

2 High school graduate

1819, SW, N - 10th grade
1398, NW, O - 11th, junior year of high school.
2577, E, O - A lifetime of working in the forest.

3 Some college

1644, SW, N - Forestry school, took classes from T.J. Starker, 10 US forestry fire schools.
1722, NW, N - 2-3 years

4 2-year degree or technical school

5 4-year degree

1729, E, N - BS in Fish and Game Management, OSU, 1938.

6 Graduate degree

7 Other (Please specify)______________________

1004, E, I - 59 years in timber industry, horse logging to skyline
1033, NW, I - 21 years of practical forest management
1111, SW, I - Post graduate work
1121, SW, I - Post-bac degree (soon)
1173, SW, I - Graduate work
1597, E, N - Brother Rod a boshor degree in Forestry from OSU.
1414, NW, O - 38½ years working in the woods.
1461, NW, O - BS in forestry and OSU, BBA at University of Oregon.
1475, NW, O - 33 years logging.
1523, SW, O - Business school
2649, NW, O - 30 years logging +
2565, SW, O - 2 years college pre-forestry

34. *What was your total household income before taxes in 1994?*

1 Less than $20,000

2 $20,000 to $39,999

1809, E, N - With a 24,000 mortgage payment

3 $40,000 to $59,999

4 $60,000 to $79,999

1918, NW, N - Sale of stumpage.

5 $80,000 or more

1046, NW, I - None of your business

1229, E, O - Does not apply.

Please feel free to add any comments about the rules or this questionnaire here or on the back of the page.

1014, NW, I - There are a few items in the rules that I don't understand the reasoning or goals for particular situations. I guess I could get the "opinion/interpretation" from the FPF and discuss how that differs from my own opinion or interpretation.

1015, NW, I - Many of your questions/choices were difficult to respond to because of the lack of definitions; i.e. what is compensating what are incentives, credits? Number 23 really has one over-riding answer and that is regulation. In the absence of regulation, the other factors become much more important, but if you violate the law you're in trouble. Landowners need assurances that they will be able to risk their capitol and, if successful, enjoy the rewards. Moving the regulatory goal-posts creates a lot of frustration and uncertainty.

1021, NW, I - Question 18 only counts along small "F" and "N" streams for in-unit wildlife trees.

1022, SW, I - Before additional restrictions are added with more rules in the future. I would like the current rules to be left alone for a period of 5-10 years and then have the results reviewed to see if the objectives have been obtained.

1033, NW, I - A study should be made to show who really pays for infrastructure in this state: ie, 1/3 dollars that are generated from ag, 1/3 timber. (Latest Beuter report for OFRI) - high tech doesn't bring much money into this state but uses lots of infrastructure. Encourage this discourages the rel money maker or money generator which is the land. Land is taken out of production because of lack of assurance farming and forestry can continue. When you can't make money with the land one way, then you develop it and make money another way. The high tech is making a short term windfall by cheap infrastructure due to farming and forestry. Within 15 years the honeymoon will be over and we will look like Santa Clara Valley in California and the Coast Range will look like the Santa Cruz Mountains. Al Gore's comment in Portland last week said the U.S. has entered an information based economy. ABC news shows how high tech has replaced timber in Oregon. Wrong. High tech doesn't bring in the dollars for infrastructure. They're using Ag and Timber dollars for that. Conversion of raw material to finished products pays. Worldwide raw material conversion has and always will pay for everything. Information services the basic conversion process and is not a stand alone economic entity by itself. We need both but currently the cart's before the horse. There, I feel much better. ☺

1037, NW, I - #23 should have read: "what methods would be most effective....."
1046, NW, I - Implementation of stream rules caused extensive harvest along streams. This caused greater damage to streams than leaving old rules in place.
1048, SW, I - The Rules are very much headed in the right direction. They are far above what we were using before. A common interpretation of the Rules coupled with more ease of use would greatly help in the implementation of the Regulations.
1051, NW, I - If the streamside rules are necessary to protect non-timber resources, so be it. The public should pay since the landowner has no legal requirement to house and feet the state's creatures. Payment should be in full, not a partial payment. And incentives can only be called "incentives" when they are voluntarily undertaken to provide protection over and above regulation. There are no incentives with the possible exception of the stream log placement rules. Are these rules both necessary and sufficient. "Sufficient" seems well assured although many environmentalists would agree no - "Necessary" has not been proven to me. I suspect much less protection could provide as good an effect, especially if coupled w/active management.
1056, NW, I - The rules are unreasonable for intermittent streams in Western Oregon. When a slight depression is called a draw, something needs to change. The issue of consistency needs to be addressed in the DOF FPF, all have their own interpretation of the rules. This is not good. Personality conflicts between landowner and FPF, should have nothing to do with stream rules. On the plus side, the alternate plan has been very helpful, and has given us some flexibility in streamside management.
1061, NW, I - Question 23 unclear - assume you meant public acceptance of government influence.
1064, NW, I - I believe it is important to protect streams and water quality. The older rules were easier to understand and implement, but didn't leave enough large conifer. The new rules have fixed this problem and may have gone farther than needed. But, enough is enough - if the restrictions go any farther, then I think the public should pay for any increase in protection.
1067, SW, I - Beware of skewed responses to your questions - my colleagues here in the company did not take this survey very seriously. Good luck to you!
1070, E, I - Where do I start? Many dry streams in Eastern Oregon classified as fish streams. Logs in creeks tend to be washed on sand or gravel bars in spring during high water, then are left high & dry the rest of the year. It makes no sense to leave high value trees (such as a 300+ year old ponderosa pine) then have it fall down and maybe miss the creek. Some of these streams are 6 feet wide and less. It doesn't make sense to have huge trees fall across the canyon and not ever touch the stream or contribute "large woody debris" to the channel. Shade and streamside vegetation such as older are more important on headwater streams than "large woody debris". I've already noticed a difference in administration of the rules among F.P.O.'s.
1077, E, I - If a private landowner is doing a good job environmentally, he should be left alone and not dictate by the state. The first state forester we had to work with was insulting and rude. He should understand that our taxes pay his salary. Is this type of survey necessary? Are we spending more tax dollars.
1083, NW, I - Good questions.
1104, E, I - Most landowners are interested in properly managing the natural resources on their land but must also be able to maximize their return on investment in order to

continue farming, ranching and/or timber growing. The Forest Practice Rules go far beyond the reasonable protection of fisheries, water quality, wildlife, etc. and require measures which cannot be proven to be needed - or perhaps better stated, do not allow some practices which biologists would be hard pressed to prove are damaging to various resources - stream crossing regulations are a good example. At issue here is the underlying principal of private property rights which until recent years was recognized as something very basic to our way of life. We are seeing these rights undermined at an alarming rate and must turn this trend around.

1108, SW, I - The rules require a considerable amount of information gathering to determine if any harvesting can take place within the RMA. My company completed a demonstration area in a 60 year old second growth stand in the summer of 1994. For the volume we were able to remove from the RMA we incurred management costs of nearly $50/MBF. Because of an overall management objective of uneven aged management all the other logging jobs near streams we have stayed outside the RMA. I anticipate this practice will continue until growth within the RMAs is significant enough to warrant management activities. I am concerned that smaller landowner/operators may cut more within the RMAs and the State Forestry would not have the available resources to gather the necessary information to prove a violation.

1115, SW, I - BA/1000 ft is a complex unknown and hard to work with tool. No harvest zones are not good proven science. Rules that delay harvest are more acceptable the new rule allows too little harvest. Too much rule making in too short of time overwhelmed the Board of Forestry and the FPF and the landowners.

1125, NW, I - I feel the new rules provide good protection for fish and water quality. There is a need to consider the cost of maintaining fish passage in all cases. In some cases a crossing structure may need to be installed within 100' of natural barrier. The cost difference (assuming a greater than 12% stream gradient) could be $30+ M. How much is 100' of habitat worth? There should be some exceptions.

1133, E, I - I deeply resent the cookbook, formula drive, legislative approach to land management. Witness the lousy job the feds do. Every piece of land and every stream is unique. Each plan should be custom tailored to best protect and enhance the specific resource. I resent some ill-informed west side person dictating land and forest management policies to me on the eastside.

1134, SW, I - Thanks for asking - except for #24 - a good survey.

1136, NW, I - I believe that ODFW (and ODF) are abusing the classification of the small streams. I have had two situations where an intermittent winter runoff stream was reclassified to a small fish bearing stream. These streams have water only after heavy winter storms and flow only for a few weeks of the year. They have obstructions and gradients of 10-35%. I have twice requested from both agencies proof of the change of classification - ie, name of biologist who physically conducted the stream survey, date, data regarding species of fish found, stream profile, gradient, etc. I have talked with the FPF and biologist in charge of the area and have received no answers! The FPF says "its ODFW's responsibility we only enforce the rules and we will cite you for any violation." The biologist for ODFW said "yes that is our responsibility but I don't know any of the details." He was not willing to pursue it any further to answer my questions - he was just too busy to help me! On one stream the landowner has lived on the property for over 30 years and spends a lot of time working on various projects. He constructed a stock pond 20 years ago which is fed by an underground spring - the creek channel. He even stocked the pond with fish ten years ago. He has never seen a fish above the pond even tho he has made the effort to find them. The fish he planted either succumbed to predation, or moved downstream. Today this stream is classed as small fish for over ½ mile above the pond to the ridge top. Approximately 2/3 of this distance is on a 30+% hillside with obstructions and no holding pools. I strongly suspect someone in ODFW sat down with a topog map last winter and highlighted every possible stream they could and reclassified them as fish bearing this person(s) probably sat back afterwards and said something like "there, I've done my part to protect the stream resources, it is now up to the landowner to disprove me and time plus the law is on my side!" Most landowners I work with basically support the intent of the streamside protection rules. However, they believe the in-house administrative rule making process (the "fine" print) substantially changes the way the laws can be administered, challenged, change, interpreted, and enforced. Even though landowners may have the opportunity to voice their opinion no longer matters - they are going to get screwed, they just don't know how badly until well after the rules are in place.

<u>1151, NW, I</u> - The rules should be simplified and the state needs to provide more current information on fish use. If the state is using their current information on fish counts and fish use for listing salmon or trout, then I believe the numbers to be grossly underestimated both in number and distribution.

<u>1152, NW, I</u> - For someone who does a lot of logging jobs, I am sure the regulations are understandable, but I only do a few and only read regs if forced to - I just work it out with the forester.

<u>1156, NW, I</u> - I generally support the new rules however I feel that many people see this as a stepping stone to increased regulation. For example, the interim rules for determining fish presence are very broad and therefore class streams as Type F when field observations and common sense would show otherwise - but the stream remains a Type F until proven not to be by the landowner a recent memorandum concerning fish passage guidance at road crossings contained 14 pages of what I consider additional regulations. My point is that in clarifying the statutes new regulations are spawned.

<u>1167, SW, I</u> - Rules should be simplified. I agree with their intent but they are time-consuming to implement especially in the brushy coast range. Do not understand why the forest industry is held to a higher standard than other streamside users (e.g. farmers, homeowners). I have seen numerous examples where my company did an excellent job of protecting a stream but downstream farmers trash RMA's and landowners spray to streambanks or clear vegetation. Doesn't seem fair. Streams need more uniform protection from all users not just foresters.

<u>1174, E, I</u> - What has total household income got to do with this survey? Do you feel that more well-to-do individuals will answer questions or manage timber differently than those who don't make as much? When I came to this question this whole questionnaire almost went into my round file.

<u>1176, SW, I</u> - The key to setting the industry on board is tax incentives!

1894, E, I - The standards I used to harvest timber before the new rules, went above and beyond the existing rules at that time. By changing the rules flexibility was lost. No harvesting within 20' of a "F" stream caused many owners to cut the trees along streams before the new rules went into affect and lowered the values by the trees being harvested before they were mature.
2414, SW, I - The Company (IP Co.) Was providing same or greater protection prior to new stream rules. Rules made or took the question out of what actual requirements are - measurable - allow FPF to cite non-protectors as to exactly what was not complete with.
1601, SW, N - 1. Questionnaire is good. 2. Written plans required in all cases is a disincentive SB160 should solve this if it ever passes. 3. Question 3 would be marked "strongly support" if there was some compensation. 12e. From what perspective, for stream protection, no, for cost to the landowner, yes. 12j. I stayed 100 feet away, so needed no help. If I had worked within the 100' buffer, I would have needed a lot of help.
1615, SW, N - Most of our troubles started in late 1950 and 1960 when the college foresters came out with the idea of clearcut plant and harvest like a crop of corn. We can thank the professors for the idea. Now they are going to the other extreme.
1644, SW, N - Because I have not had a copy of the new rules can not respond. I probably have been practicing good forestry longer than you are old, some 62 years. Have inserted 2 articles to prove this point. I probably could agree with most of your rules, but the one thing I disagree with most is that I have owned most of this property for over 60 years. I worked extremely hard and long hours to acquire it. I have paid taxes on some of it for over 30 years. Have paid harvest patrol taxes for many years. One 160 has some 30 acres under these stream rules. I agree to protection of the stream, but you are asking me to pay all the costs. By law you cannot take away property rights without due compensation.
1653, NW, N - If people of the city make rules of the country - how about country people making rules for the city. Country people are not stupid enough to even think of making sidewalk or sewage rules for city people to live by. But city people are ignorant and arrogant enough to tell country people how to check soil erosion, help wildlife etc. in the country. I am far from anti wildlife and a conservationist. 1994 I hauled 3 truck loads of hay to winterize deer and elk. One load of mixed alfalfa and grass baled. Spend hundreds of dollars every year on soil erosion, wildlife protection for that government rules steals my trees. After all I can't have them than they are stolen. Because of this new rule, prior to Sept. 1 I cut a valley and a hole 5 feet deep 8 feet wide eroded. Fault of the rule.
1674, SW, N - 10 - Why doesn't Portland, Eugene, Salem, let me sit on their Councils and let me tell them how to run their city? 21 - I can't see how it would be easier for me to lose my land and money by taking someone else's land and money, you don't help any one by pulling another person down to their level - THAT'S COMMUNISM. 24 - public resources are never on private land unless they are trespassing! So keep the things off my land and we'll both be happy! 25 - if the people that want anything that other people have had to pay for it their want list would get smaller. To me there is no difference between what they are doing and me going

into a grocery store and filling a shopping cart, taking it out (without paying) and giving 10, 15, 25% to some one I said was needy and keeping the rest for my troubles of filling the cart. P.S. my mother told me this was stealing. I'm getting mighty tired of giving Welfare to all the people that won't work for what they want (not need). 26 - at the age of 21 I bought my first piece of land and paid for it with money that I worked for. This is my life's investment and now I feel I made a horrible mistake. 29 - I will not be surprised if logging on all land is stopped, all you have to do is change the kind and width of the buffer (from 100' to 1000' or 10,000' on to top of the last ridge).

1675, SW, N - We believe trees that are growing in the stream bed should be removed to stop obstruction to the water flow.

1685, NW, N - Sorry if I got a bit preachy! Timberland and logging is all I know and all I have. 100% of my ability to support my family comes from timber land.

1697, E, N - I am not allowed to build on my land. Although I own the land, paying taxes on the land, and paying taxes on the timber that I sell, with NO financial assistance from anyone. I do not understand where the State of Oregon has the right to tell me how to maintain and improve my land.

1703, SW, N - I think that we are not using common sense with the rules and I think if a stream is to clean we should let mother nature put debris back in. I don't want to see our stream destroyed but sometimes new regulations cause more damage than they help. Like 1994 when the forest practice act came into effect every person who owned a tree along creek, cut it. In fear of losing it. This put more mud in the creeks in one year than I had ever seen which I think hurt the streams and fish population more than if it would have been left alone.

1722, NW, N - Why is Columbia county allowed to fill in a wetland area near the intersection of Canaan road and Merrill creek road? Why are they not stopped or fined. Are governments immune to whatever rules they choose? Obviously I know little or nothing about stream rules practices but am very opinionated about my ignorance. All the rules are good or bad depending upon your point of view. Unfortunately the urban areas are where the votes, money and power exist also an unrealistic perspective and understanding of reality and nature (old mother nature). Those of us who live in rural areas give up a lot of conveniences, money and time to live where we do. It seems we are inconveniently located for many cultural things yet not too inconveniently located to be regulated by various governments and agencies. I was a city kid but not anymore except the umbilical cord of work and money in Portland. I wish I could be completely independent and a hermit, however it sure is nice to take an ambulance to a hospital when you are having a heart attack, (too much city living), two heart attacks so far. So much for being a mountain man, reality sucks. I'll still take the country though. As another side there is gold in Merrill Creek, not that much. When I mine it with a suction dredge, I hope I don't violate any rules that pertain to logging. Actually it might improve the creek bed and the spawning gravel which is covered with mud. I wish I had the time and money to improve the creek because supposedly there are salmon and steelhead and trout in there. In spite of my responses to the questions I hope that 80 or 120 years from now someone can look at my land and think that someone did a good job of restoring the land and conserving various resources and basically making it a little bit better than it was when he got it.

1745, NW, N - Assistance in understanding and applying rules was helped by service of consulting forester and state F.P.O.

1758, NW, N - In my case, we live on Foster Creek. Several years ago the highway department removed a small bridge on Bakers ferry road over foster creek and installed a metal culvert. Since then no fish has been able to go up foster creek, ie. trout, salmon, etc. On my property I have a large cedar tree with several woodpecker holes. I was told not to cut it however it no endangers my neighbors home. Who is responsible seeing how I was told a heavy fine would be levied against me if it was cut. Please let me know.

1763, NW, N - These rules are reprogessive. No landowner is going to replant or care for stream areas not knowing if there is going to be any return on the investment.

1768, SW, N - With 70" of rain in this area, there is no reason to have a shortage of water in our area. We need holding pond programs similar to the program they have in the East!

1785, NW, N - Your people are too quick to insist that every little water course needs their ______. They aren't realistic about the impracticalities of making each little water course a future fish breeding growth.

1801, NW, N - We understand the need to promote sustainable resources, habitat areas. We do not support over regulation of individuals and under regulation for developments so that masses can be packed into urban growth boundary (i.e. total clearcut for subdivisions next door to our land, which is over regulated with no compensation). We do not trust the people making the rules, nor the reporting of statistics gathered - e.g. metro's reports do not reflect what actually happens at the hearings. I know I've been there.

1809, E, N - I did not know the rules existed. Mr. Pirelli, the state forester rep., never told me about them. He also never met me or called me. He somehow gained access through a locked gate without my knowledge, then sent me letters telling what we were doing wrong.

1819, SW, N - I know very little about forest management, but I do like the forest.

1849, E, N - The rules and regulations were made to reduce production and have very little common sense logging and livestock have very little effect on fish.

1855, E, N - I believe in H20 quality and fish and game habitat. I also believe the rules cause unnecessary financial hardships. Example - skid a log across a small side draw (2-4" pipe volume of H20) which causes some milkiness in small creek (bearing fish). But if we have a very heavy rain the same small creek is a dark muddy brown. Both cases the fish seem to survive. The rules can be and are interpreted too narrowly at times.

1918, NW, N - I don't approve of leaving any standing trees or snags over 10 or 12 inches in clearcuts. I think most trees left standing will be down in less than 10 years. Each tree will demolish 15 or 20 replanted trees when they go down. A needless waste, the birds and bees can fly that 1/4 or ½ mile to standing timber or regrowth.

1963, E, N - I am a believer in maintaining growing and healthy forests. We may be able to assist in tree planting to maintain them and increase them. I question the riparian agenda along streams it could increase brush and diminish water. Perhaps

planting evergreen trees and fast growing poplars could be a better program.
2013, SW, N - I feel that the people who initiated the present land use legislation are made as the actual application and effect of their laws. They are too far removed from the situation and are trying to operate under ideals rather than practicality.
2024, SW, N - I believe college education in forest management is good. But to get the full picture you need someone with timber harvest experience and a long background in timber management.
2065, NW, N - The stream forming our North Boundary is a tributary of Chehalem creek and is fed by a spring or springs. It forms a man made lake on another farmers property which is used for irrigation. At times the stream below the dam dries up, no fish can inhabit that stream under those conditions. There are numerous other trees besides fir along that creek and fir is the only saleable trees on our property. Because of rulings we had to leave at least $6,000 worth of fir timber uncut. That serves no purpose whatsoever. We have already arranged to replant 5 times as much as we harvested. The best fishing I ever had was when I was a boy on my fathers farm. It was on a creek running for a mile thru his property. There were no trees along that creek - but there were deep holes so who says you have to have trees to form dams for the fish? If they are going to have strict rules it should be on a stream by stream basis not over rules that applies to everything. The property on the other side of this stream was clearcut years ago so the ruling had no effect on this property owner. We were the only ones effected.
2085, SW, N - The only compensation I am for in areas that have a loss of use/value would be a reduction in property tax for that given area.
2101, SW, N - We need rules but they need to be flexible to individual stream or soil type.
2691 & 2687, NW, N - This parcel of land has been owned and held or recently traded for recreation and recreational/residential development purposes. It is a declining old growth timber type; the overstory is 300+ years and very defective. Excess basal area (up to 10 times required) exists within 20' of streams. Therefore this thinning harvest was to prepare the site for development not timber management purposes. The streams, RMZ and adjacent old growth are highly valued for their collective value on the site. Protecting them was of greater importance than extracting as much volume/value as possible. Written plans were submitted and stream corridors laid out and measured as a precaution to "cover our bases" in the event of adverse public reaction.
1263, NW, O - The new stream rules have allowed each FPF to play God when they are on the sight and what one FPF will allow may very well earn you a citation on a different sight from a different FPF.
1329, SW, O - We saw a lot of land removed from timber production when 1994 rules came on. 1991 rules allowed some entry - 1994 ruling went too far. For years, industry has logged mature trees, salvaged dead and dying, thinned and fertilized. Heavy handed riparian rules have taken millions of acres of land out of production. Loss of timber to the public, O&C receipts, job loss and taxes (payroll and corporation) are the results. I support a light foot entry on all timber land. Including riparian, scenic corridor, buffers and national parks. Millions - even a few billion

feet, is available in salvage alone, generating plenty of wood for the nation which increasing the forest health, and maintaining beauty that we have always loved as part of our heritage. Unfortunately colleges have done the most to curtail timber production in the Northwest (including good practices).

1398, NW, O - No matter how careful loggers and farmers on water purity and wildlife, fisheries, etc. The city run off from their sewers and street (storm sewers) do more damage to the water. And if they don't get rid of seals in bays, there will n ever be many salmon.

1441, NW, O - It really bothers me that we in the forest products industry have all of these regulations on water quality against us, but our neighbors in the farm, livestock, or urban areas do not. It doesn't make any sense to me, to have to work my ass off to protect water quality at my expense, to water downstream, and have cows shit in it or a private landowner push dirt into it. I see it every day and I get pissed. If water quality is so important then we all can share in the job of keeping it clear. Thank you for letting me voice my opinion very briefly. Good luck to you on this project.

2186, SW, O - I am a landowner and contract logger and I feel that the rules are fair and sufficient as they are now.

2236, NW, O - I am a logger managing private landowners recently we started logging a parcel requiring an extensive written plan requiring a rail car bridge on a Type F stream. We went through the whole process taking about 45 days to get things going. We were required to steam clean equipment before crossing. Stream 1 time with 3 pieces of equipment. Taking all precautions to protect the stream banks and water quality. While the City of Scappoose is cleaning out their reservoirs dumping tons of silt down Scappoose Creek and getting away with this. Why don't rules apply to everyone. I thought this was meant to improve water quality and fish habitat.

2239, SW, O - Stand characteristics to be achieved should consider future growth. Hardwood conversion could easily be abused creating increased stream temperatures and sedimentation. Compensation to create public resources will only enhance future value. You get what you pay for. If the public wants healthy streams they will achieve there objective more rapidly by compensating owners for their losses. Please address high % reading with tractor logging on steep ground. The rules are inadequate and those who terrace log are giving all of us a bad name.

2353, SW, O - I think we have a pendulum effect in play concerning the watersheds. Due to poor regulations and managements in the 1940's and 50's much damage was done, but the swing now is over emphasized. I believe most operators are conscientious and considerate of the watersheds. I see a trend now is to over regulate. There is a middle of the road practice we can all live by.

2354, NW, O - Though I only salvage down timber on logged areas, I find the rules do not apply to all. I treat all waters in my area as class A streams right down it even streams that don't run all year long. I have streams in my area where trees were left on the streams and the next property to it clearcut along the stream. I have farmers let cattle run in spawning grounds and all the calls in the world go unattended. If the law is for everyone, enforce it so my grandkids and rest of generations can enjoy. Wetlands have been allowed to be built on and destroyed. Homes on small tracts along the streams are apparently allowed to do as they please. If the state and county will allow homes built along the streams then the landowner should be made to attend a classroom on protecting this valuable resource. If I could I would love to be able to work on the streams improving them for my grandkids and future generations to come. I see the damage in my area and I'm deeply sadden. A person doesn't need a college degree to use common sense. Even our state government has taken programs away to help replace what has been taken, so even for me, I wonder why the rules.

2551, NW, O - Time loss revenue due to down time in association with survey of riparian area. Too costly to go in and remove a few trees, D.S.F. often cannot deviate from rules (no common sense). The rules can work out for large logging jobs, but make small jobs and operator's nonproductive.

2557, SW, O - It is important to preserve stream water quality with concern for water purity, temperature, sediment and streambank erosion. The new stream rules will have an almost insignificant effect on water quality improvement over old rules. They will however help to create crowded, suppressed, unhealthy forest conditions. As a logger I take pride in my work, generally leaving a forest in better condition and appearance than it was before the logging began. At the same time I abhor the mess and pillage made by some others in the industry but adding more rules to the myriad rules we already have will only add to the number of government agencies and employees with hands in the pockets of the few truly productive taxpayers we have left.

2577, E, O - After reading and answering most of your questions they are I feel written to require an answer to suit your objective.

2586, NW, O - Leaving buffers on class II streams in Coast Range is a joke. It's been my experience that 70% of the buffer blows over and causes severe erosion in the stream we try to protect. Loggers for the most part want to preserve and protect the land, but there's got to be a better way. How about requiring landowners to replant with older seedlings right after clearing?

APPENDIX E: SUMMARIES OF THE 1995 STREAM RULES SURVEY AND RIPARIAN ASSESSMENTS MAILED TO PARTICIPANTS

Oregon State University, Department of Forest Engineering

Summary of Results: 1995 Oregon Forest Practices Stream Rules Survey

Surveys were mailed in July, August, and November 1995 to industry foresters, nonindustrial private forest owners (NIPF) and logging operators who had filed harvest notifications in Fall 1994. Results are tallied from only those who had harvested using the new 1994 Stream Rules (403 people). Return Rate: 67% of 848 surveys sent (not all had harvested). Respondents: 135 industry foresters, 95 nonindustrial private forest owners, 167 operators.

SUPPORT:

*A majority support the Stream Rules:
    61% generally supported or strongly supported,
    26% generally opposed or strongly opposed.
But: 45% believe that the rules have gone too far (and 45% believe they are about right).

*People support some of the broad goals of the Stream Rules more strongly than they do the Stream Rules themselves:

Water Quality:	82%	strongly supported or generally supported
Fish Habitat:	76%	" "
Wildlife Habitat:	64%	" "

*Many believe that the Stream Rules are rather effective in protecting resources:
    52% said very or mostly effective,
    24% said somewhat effective,
    16% said slightly or not effective.

*An objective of mature forest in the streamside area was considered very suitable by only 20%, somewhat suitable by 43%, and not at all suitable by 31% of the respondents.

*Most people thought that the forest rules were stricter than nonforest land use rules (industry 91%, operators 72%, and NIPF 49%), but only 36% of those would find the forest rules easier to support if the nonforest land use rules had equally strict streamside protection.

*The four most frequently chosen factors influencing support (or lack) for the Stream Rules were:
    1) whether the rules were flexible enough to do desired streamside management (14%),
    2) whether they were backed by good science (13%),
    3) whether compensation or incentives were included (13%),
    4) whether the rules help take care of land (12%).

Overall, people tended to disagree that the Stream Rules had these qualities, although industry foresters tended to agree that the rules were flexible enough. Complexity (6%), regulatory uncertainty (7%), the time needed to lay out the buffers (5%), and the need for rule interpretation by the agency (4%) had more limited concern.

RULE IMPLEMENTATION:

*Relatively few people (less than 10%) chose to actively manage streams (e.g., placing wood in streams) in order to get the basal area credit, allowing more trees in the riparian management area to be harvested; industry was twice as likely to be involved as NIPF owners.

*For most (69%), finding the stream classification was not a problem. Industry foresters (41%) reported the most problems, while operators (14%) reported the fewest problems.

*Lost harvest value: Overall, 10% reported no value lost, and 10% estimated that greater than 20% of the harvest value was lost due to meeting the Stream Rules. Most (46%) estimated less than 10% value lost;

73% industry foresters estimated 1-9% value lost, but only 38% operators & 21% NIPF did;
11% industry foresters estimated 10-19% value lost, while 21% operators & 20% NIPF did.

RULE-MAKING PROCESS:

*Did an advisory committee with diverse representation, which helped craft the final rule changes, affect support by rule users? Most people (49%) said that it did not affect support. 27% said that it increased support, while 13% said that it decreased support. Decreased support was more common for NIPF owners (20%) than for industry foresters (7%) or operators (14%). Comments noted dislike of including environmental groups.

*83% of industry foresters knew a lot or some about the process, but only 45% of operators and 30% of NIPF said the same. 29% of NIPF were not aware of it.

POLICIES:

*The government policies rated most effective for influencing private forest practices were:

Tax Credits:	70% thought it highly or mostly effective
Compensation:	69% " "
Capital Gains Taxes:	64% " "

Other common approaches had lower ratings:

Regulation:	46% thought it highly or mostly effective
Technical Assistance:	45% " "
Cost-share:	44% " "
Education:	42% " "

*47% support compensation if income or property value is reduced at all, 18% only after 10-20% value loss. 29% prefer tax incentives or credits to encourage forest management and investment.

More information: If you would like a copy of results from all the questions on the survey, please contact Anne Hairston or Paul Adams at Department of Forest Engineering,
213 Peavy Hall, Corvallis, OR 97331-5706 Phone (541)737-4952.

3-7-96

Summary of Effects of 1994 Water Protection Rules
Comparison of Riparian Conditions after Timber Harvest, 1992 and 1995

Oregon State University, Department of Forest Engineering
213 Peavy Hall, Corvallis, OR 97330-5706
Anne B. Hairston and Paul W. Adams

Data Sources: Data from 1992 are taken from the Riparian Rules Effectiveness Study (Mormon, 1993), conducted by the Oregon Department of Forestry. Data from 1995 are from a similar study conducted by the Oregon State University Department of Forest Engineering. The same regions were used for both studies. Data collection methods differed slightly, such as using fixed radius plots in 1995 and belt transects in 1992 to estimate exposed mineral soil. In 1992, the area sampled was 100 feet horizontal distance for all streams and in 1995, the area sampled was the Riparian Management Area (RMA) for the stream, between 50 and 100 feet slope distance. The 1995 study had narrower streams; the 1994 Water Protection Rules required buffers on smaller streams than previously. To make comparisons between the datasets as valid as possible, the 1992 dataset was trimmed to exclude the streams over 35 feet wide. Even with the trimmed dataset, stream widths were significantly different (average of 17 feet for 1992 and 12 feet for 1995); results such as stream shade would tend to be lower for wider streams. However, there were no significant differences in stream gradients or preharvest tree stocking.

Retention of Conifers after Harvest: Results of the Riparian Rules Effectiveness Study raised concerns that streamside conifers, desired as future sources of large, decay-resistant woody debris for instream fish habitat, were being greatly diminished during harvest. The 1994 Water Protection Rules increased the conifer basal area that was required to be left by streams. How might this actually affect retention of streamside conifers?

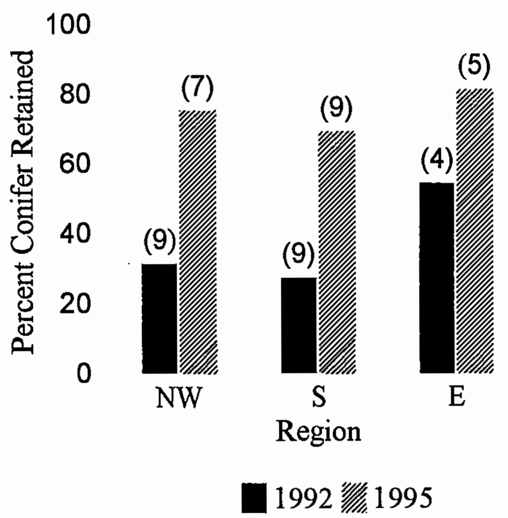

Figure 1: Percent of conifer trees per 1000 ft. of stream retained after harvest, 1992 and 1995.
(#) Bar labels give the number of sites in the average.

Basal Area of Conifer in RMA, Before and After Harvest ($feet^2/acre$)

Region	1992		1995	
	Before	After (%)	Before	After (%)
NW	63	18 (28)	85	57 (67)
SW	82	14 (17)	74	52 (70)
East	79	37 (47)	81	54 (67)

On these study sites, conifer percentages left by streams in 1995 in Western Oregon were over twice as large as the 1992 averages, both in tree numbers and basal area. On the sites east of the Cascades, conifer percentages were moderately higher than 1992 averages. For hardwoods, there was somewhat more basal area left in 1995, but no significant difference in numbers of trees per thousand feet of stream.

Future Large Woody Debris: One of the purposes in leaving trees by the stream, especially conifers, is to be able to provide large woody debris (LWD) to the stream. How many of the trees left in the RMA would be capable of delivering LWD to the stream? This analysis uses several assumptions: Minimum piece size is 8 inches diameter, 5 foot length; it compares slope distance to the stream with tree height to an 8-inch top; it considers only delivery by windthrow.

Potential of RMA Trees to Contribute 8-inch LWD, Trees/1000 ft of Stream, 1995

	Unable to Contribute		Able to Contribute		Percent of all Trees Able
Region	Conifer	Hardwood	Conifer	Hardwood	(Range of Site Averages)
Northwest (7 sites)	17	40	17	40	53% (33-82)
Southwest (9 sites)	24	28	21	39	60% (29-88)
Central/East (5 sites)	44	1	29	5	36% (3-74)

On the average, about 50% of the trees in the RMA could fall directly into the stream, adding at least the minimum-sized piece to the channel. Other mechanisms like landslides or downslope sliding would allow more trees to be delivered to the channel. Even trees that are unlikely to add future debris may have other functions like infiltration, slope stability and wildlife habitat.

Stream Shade: Percent Angular Shade (Range of Site Averages)

Region	1992		1995	
Northwest	**74** (64-91)	9 sites	**85** (74-91)	5 sites
South	**71** (37-96)	9 sites	**93** (87-96)	4 sites
Central/Eastern	**45** (23-71)	4 sites	**48** (0 & 96)	2 sites

The Forest Practices Rules went from requiring 75% of preharvest shade to providing shade via a 20-foot no-touch buffer and increased RMA tree retention. The narrower streams in the 1995 study would likely have smaller gaps in canopy cover, and generally greater shade. Angular shade (measured with the center strip of a densiometer oriented to the SW, simulating solar path) was higher in 1995 for all regions, especially in Western Oregon. Averages for Central/Eastern Oregon may not be representative due to low site numbers. Despite the differences in stream width, the shade results suggest that the 1994 Rules are functioning as well as or better than the previous rules for maintaining streamside shade.

Snags: Snags in the Riparian Management Area

	Snags/Acre (Range of Site Averages)		Snag Diameter (inches)		# of Sites	
Region	1992	1995	1992	1995	1992	1995
Northwest	2 (0-7)	12 (5-20)	25	16	9	7
Southwest	1 (0-4)	8 (3-15)	12	13	9	9
Central/Eastern	8 (3-14)	6 (1-14)	18	19	4	5

The average number of snags was markedly higher in 1995 in Western Oregon, and remained about the same east of the Cascades. Although the diameter of snags was lower in Northwest Oregon, it was about the same elsewhere, and was not detected as significantly different between the two datasets.

Other Measurements: No significant differences between the 1992 and 1995 data were found for: 1) distance from stream to harvest-related disturbance, 2) small conifers (under 8 inches DBH), 3) percent exposed mineral soil, and 4) existing instream large woody debris.