COMPLEXITY AND ADAPTIVE MANAGEMENT IN WASHINGTON STATE FOREST POLICY, 1987-2001

by

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ABSTRACT

This case study evaluates and recommends improvements to the adaptive management programs within Washington State forest policy. I focus on the Watershed Analysis program, 1992 to 1997, a program for cooperative landscape assessment and forest practices rule-making at the watershed scale. However, I also take a longer-term history of Washington State forest policy, from 1987 to 2001, as essential context for understanding the functioning and outcomes of Watershed Analysis as a tool for social learning. I use the concepts of complex adaptive systems theory as a heuristic for understanding program and context as an integrated social system.

My findings put in question the value of science-based management and formal program design – called "scientific adaptive management" – as a means of improving social learning in complex cases. The case history demonstrates that, given time and some basic formal arrangements, remarkable policy learning can also arise from informal and ad-hoc processes. The relevant dynamics include social processes that span many more levels of social structure than can be captured in a formal system.

Complex adaptive systems theory captures many social realities that the scientific adaptive management model neglects. However, this heuristic provides only limited help in developing concrete recommendations for policy action. Ultimately, we need the insights provided by both perspectives on adaptive management, as well as the many other perspectives that exist. Perhaps most important is that adaptive managers develop a large store of policy ideas and arenas that provide adaptive capacity – a set of alternative mechanisms and "lenses" that can be deployed as appropriate to assess, probe, and work with the novel conditions of complex problems.

Recent events in the case of Washington State forest policy constitute a movement towards the scientific adaptive management model, with a dramatically more formal and rigorously specified process for policy feedback and social learning. While the hazards of this approach are laid out in my study, the social networks of the policy domain may also learn a great deal by collectively undergoing this high-level trial. They have already learned plenty from the fascinating trials of the period that I analyze here.

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Several key sources of financial support allowed me to complete this study. A C.D. Nelson Memorial Graduate Scholarship made my first year of graduate study worry-free. A Small Research Grant from the Social Sciences and Humanities Research Council of Canada paid for my expenses as an assistant to Dr. Evelyn Pinkerton.

Facilitators and companions on this intellectual path are many, but Dr. Pinkerton stands as the most beneficent among them. Without her help and professional reputation, my access to case participants and my depth of understanding would be much less. Our collaboration has yielded a broad and comprehensive understanding of Washington State forest policy as it has evolved since the mid-1980s.

Equally impressive is the generosity of the case participants that Dr. Pinkerton and I interviewed over the course of about two years. Each demonstrated a high level of intelligence, sensitivity, and commitment to improving forest management. Their willingness to share their time and their openness of expression is unmistakable and memorable.

I also thank my REM community for its forbearance and support, both within and outside the classroom. In this department, a generalist like me benefits immeasurably from easy access to in-house specialists like Dr. Ken Lertzman, Dr. Murray Rutherford, Dr. Randall Peterman, Dr. Mark Jaccard, Dr. Tom Gunton, and Dr. Chad Day. In addition, the wide range of student backgrounds ensures that discussions in the common room and in the pub frequently gallop across multiple fields of study, endlessly searching for a way to make sense of the complexities of ecosystem management. It is impossible to hide in one's own discipline. And through it all, the REM staff – Bev Hunter, Rhonda Keleher, Mary Ann Pope, Laurence Lee, and Sarah Keleher – provide the steady logistical support without which students like me would obviously starve to death in some Burnaby basement suite.

Finally, I thank my colleagues at CSFS – Claire Hutton, Audrey Roburn, Saleem Dar, Laurie Flahr, and Josie Hughes. No one knows what the acronym stands for, but the true meaning is of course good friends, desperate late-night phone calls, and greasy breakfasts.

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LIST OF ABBREVIATIONS

CAS:	Complex adaptive systems (theory)
CMER:	Cooperative Monitoring, Evaluation, and Research Committee
CSSP:	Clayoquot Sound Scientific Panel
CWA:	United States Clean Water Act
DFW:	Washington State Department of Fish and Wildlife
DNR:	Washington State Department of Natural Resources
DOE:	Washington State Department of Ecology
ENGO:	Environmental non-government organization
ESA:	Endangered Species Act
FEMAT:	Forest Ecosystem Management and Assessment Team
FFR:	Forests and Fish Report
FPA:	Forest Practices Application
FPB:	Washington State Forest Practices Board
ID TEAMS:	Interdisciplinary teams
LWD:	Large woody debris
NWIFC:	North West Indian Fisheries Commission
RCW:	Revised Code of Washington
SFR:	Sustainable Forestry Roundtable
TFW:	Timber/Fish/Wildlife Agreement of Washington State
USFWS:	United States Fish and Wildlife Service
WAC:	Washington Administrative Code
WAU:	Watershed Administrative Unit
WFPA:	Washington Forest Protection Association

> Nothing succeeds as planned.
>
> – Heller (1976)

> Instead of asking why the process of implementation was faulty, we ask why too much was expected of it.
>
> – Pressman and Wildavsky (1973: xxii)

> . . . adaptive management has had more influence as an idea than as a way of doing conservation.
>
> – Lee (1999: 5)

> It is emphasized that the discovery of such strategies is a matter of luck and imaginative synthesis, not of mechanical systems analysis.
>
> – Walters (1986: 334)

1. INTRODUCTION

Over the past twenty-five years, the idea of adaptive management has received much attention from natural scientists and others as a way of improving the efficiency and reliability of social learning in environmental policy and natural resources management (Röling and Wagemakers 1998, Gunderson et al. 1995a, Lee 1993, Walters 1986, Holling 1978, and many others). However, to date the practice of adaptive management has generally failed to meet expectations (Lee 1999, Gunderson et al. 1995a, Lee 1993, Halbert 1993). Both program development and program implementation are continually faced with political, social, and economic challenges, some having their source in the adaptive managers themselves. Complexity and change are the rule. Interdisciplinary understanding is both crucial and elusive.

The goal of this study is to assess and recommend improvements to adaptive management programs within Washington State forest policy. In the face of great uncertainty about ecosystem response to logging-related activities, the participants in this case have repeatedly affirmed the importance of "adaptive management" as a strategy for continually improving forest policy through scientific research (USFWS et al. 1999, WFPB 1997, WFPB 1993, WFPB 1992 [WAC 222-22], TFW 1987). However, both the degree of success in the past and the appropriate structure for adaptive management programs in the future are topics of much debate.

My study focuses on the Watershed Analysis program, 1992 to 1997, a program for cooperative landscape assessment and forest practices rule-making at the watershed scale. However, I take a longer-term history of Washington State forest policy, from 1987 to 2001, as essential context for understanding the precursors, functioning, and outcomes of Watershed Analysis. I use the judgement of case participants across stakeholder groups and functional roles to identify successes and failures. I use the concepts of complex adaptive systems theory as a heuristic for understanding program and context as an integrated social system. My findings challenge previous assessments of adaptive management success in the case (Collins and Pess 1997a, Halbert 1993).

My challenge to previous assessments expresses a difference in theoretical perspective as to how adaptive management programs should be structured and evaluated. I contrast two alternative perspectives (other perspectives exist). In the first, many ecosystem scientists view adaptive management as a call to a more rational and deliberate approach in designing management actions as experiments that yield efficient ongoing learning. In this view, adaptive management requires strong formal structure and rigorous use of the scientific method. In contrast, other theorists, particularly social scientists, emphasize the limits of scientific control for optimal outcomes when a program is embedded in the complex political, economic, and social realities of ecosystem management. These thinkers seek a way to account for complex, unpredictable social dynamics in their management recommendations.

The history of the Watershed Analysis program is an opportunity to contrast the analytic utility of these two alternative perspectives on adaptive management – *scientific adaptive management* and *complex adaptive systems*. I focus on the *policy feedback* functions of Watershed Analysis – evaluation and policy adjustment. From the analysis I derive lessons and recommendations for future policy and management. I also highlight the strengths and weaknesses of each of the two theoretical perspectives.

2. MY PERSPECTIVE

I came to this study as a graduate student at the Simon Fraser University School of Resource and Environmental Management (REM). I had no previous experience of the case. At first, my interest was in the principles of scientific adaptive management (Section 3.1), growing out of previous work in auditing small forest operations against international standards for management. However, over the course of my Master's degree program, I found widespread disillusionment with the promise of scientific adaptive management in both the published literature and the case of Washington State forest policy. At the same time, interviews with Washington State forest policy participants also revealed a long list of learning *successes* that fall outside the scope of scientific adaptive management. Accordingly, my approach to analyzing the case evolved over a period of almost 2 years as I moved away from the perspective of a scientific adaptive manager and into the daunting realities of social learning.

I was daunted by the inertia of institutions and organizational cultures in the case. I was confused by the variousness and unpredictability of social interactions during policy implementation. I was impressed that so much important learning had occurred in spite of this messiness. The literature of social learning theory helped me to bring shape to these realities. In particular, complex adaptive systems theory (CAS) showed promise as a way of understanding and more fruitfully acting to advance social learning processes.

The following analysis tends to emphasize the limitations of scientific adaptive management and to downplay its value. In this respect, it is a record of my own personal disillusionment with that approach. However, I find value in reporting this personal event to my fellow researchers and practitioners in adaptive management. While scientific adaptive management offers many useful ideas, the ecosystem science literature tends to accept the epistemological and practical assumptions of this vision without sufficient critical examination. My study challenges the assumptions underpinning scientific adaptive management and seeks alternative ways of viewing the case. At the same time, I hope I have succeeded in pointing out many useful ideas that scientific adaptive management has contributed to the discourse on social learning.

The personal progress described above has – unintentionally – provided me with a strong grounding of theory in empirical data. The study's iterative cycling between analytic framework design and data collection has forced me beyond the assumptions of scientific adaptive management in order to account for the actual behavior and perceptions of case participants. For qualitative research of complex cases – and forest management for multiple values is among the most complex management problems – such iterative design is recommended (Locke 2001, Miles and Huberman 1994). Throughout this paper I quote interview data that illustrate both the sources and the confirmation of my interpretations.[1]

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[1] While I have not adhered strictly to the methods of grounded theory (e.g., Strauss and Corbin 1998, Glaser and Strauss 1967), I share a similar conviction that to approach a case with a ready-made analytic framework is to risk overlooking the components of the social system that loom largest in the perceptions of the participants themselves. These largest-looming components are key sources of motivation for observed behavior.

3. THEORETICAL BACKGROUND

Among ecosystem scientists, “adaptive management” became the dominant vision of the late twentieth century for integrating science and policy in a learning system (Lee 1993, Walters and Holling 1990, Walters 1986, Holling 1978). Yet interpretations of the adaptive management idea differ enormously. This variability in perspective points to a history of rapidly evolving theory as natural scientists have struggled with the messy and ambiguous social dynamics that constitute the human environment of the policy process (Lee 1999, Dovers and Mobbs 1997, McLain and Lee 1996). In this section, I provide a brief overview of some major streams of thought that fall under the rubric of adaptive management.

3.1. Scientific adaptive management and social learning

Adaptive management originally developed within the tradition of applied systems analysis for optimization, specifically under the leadership of C.S. Holling at the University of British Columbia and International Institute for Applied Systems Analysis (Holling 1978). The team’s work built on the key insight that, due to high uncertainty in our models of resource management systems, almost all management actions are properly described as experiments with uncertain outcomes. That is, rather than implementing “best management practices,” resource managers are actually acting on a “working hypothesis” – whether they realize it or not. Unfortunately, the design of policies, and the collection of information to evaluate the effects of those policies, is seldom adequately designed to produce reliable, timely new understandings. For example, inferences about causes and effects are vulnerable to confounding alternatives, and important changes in the system frequently elude early detection by managers and policy makers (Lee 1993, McAllister and Peterman 1992). These problems are especially acute in large ecosystems such as the Columbia Basin and the conifer forests of New Brunswick (Carpenter 1998, Lee 1993, Walters and Holling 1990).

By bringing the technical tools of quantitative systems analysis and experimental design to the evaluation of management policies, scientists sought to improve the reliability and efficiency of knowledge accumulation (Leamann and Stanley 1993, McAllister and Peterman 1992, Walters 1986, Holling 1978). In addition, scientists prescribed formal institutional arrangements that would ensure appropriate and timely use of new knowledge to adjust policies in a continual, iterative fashion (Figure 1). In particular, systems modeling techniques enabled analysts to begin the daunting tasks of integrating information from multiple disciplines and attacking the problems of complex ecosystem dynamics across multiple scales of organization.

Thus, the emphasis of early adaptive management theory was on formal analytical tools such as quantitative system models, economic optimization, quantitative objectives and hypotheses, experimental design at the scale of large ecosystems, statistical power analysis of monitoring programs, and formal decision analysis (Walters 1986, Holling 1978, Walters and Hilborn 1978, Hilborn and Walters 1977). If communicated effectively, the high-quality information yielded through the use of these tools was expected to form a convincing argument for decision-makers to adjust policies. Today, many ecosystem scientists continue to emphasize the formalistic vision and techniques of adaptive management (McLain and Lee 1996).

However, many of the early adaptive management theorists also show a strong concern for the messy, emotional, values-laden dynamics of the policy/science interface. For example, adaptive management was first presented as a framework for interdisciplinary, cross-functional (scientist/policy-maker/manager) modeling workshops that were designed expressly to overcome human and social barriers to embracing uncertainty and recognizing the need for policy adjustments (Walters 1986, Holling 1978). Hilborn and Walters (1977) note that forcing parties to quantify their objectives not only enables rigorous modeling and analysis, but also helps to clarify and explore differences among stakeholder values. Walters and Hilborn (1978) discuss barriers to adaptive management such as incentives that discourage admission of uncertainty and failure, emotional commitments to pet theories, and risk aversion. Clearly, the non-technical and non-rational aspects of social systems were present in the ruminations of even the early adaptive management writers.

Among these early works, perhaps Walters (1986) is most emphatic in acknowledging the social and political realities of adaptive management. This book is best known for its technical guidance on numerical modeling techniques. However, in Walters's vision, simulation models serve as gaming tools to stimulate "discovery learning" in managers and resource users who would not accept the same information in a technical report or a policy document. Model *outputs* are much less important. Frustration and conflict act not only as barriers to implementing technical procedures, but also as necessary emotional preludes to inductive breakthroughs. Natural curiosity and enthusiasm sustain commitments to long-term monitoring programs. In consideration of these and other socio-political realities, Walters is clear in identifying limits to the value of technical tools in complex policy situations. Hilborn (1987) summarizes the state of thinking in the mid-1980s:

> The past 10 years have shown that our vision was but a chimera and that systems analysis and computers will not subdue the pack of hounds baying at the door. The computer models and statistical analyses have failed to provide reliable predictions, and managers increasingly recognize that many important uncertainties are political or social and beyond the scope of current modeling and statistical efforts. (Hilborn 1987: 1)

Despite this early attention to the limits of technical tools, it is the scientific, rational-planning elements of the adaptive management literature that continue to receive emphasis in many circles. The positivistic epistemological assumptions of this vision are deeply entrenched in many scientific fields, as we search for generally applicable laws of system functioning that will help us to predict and control the systems for optimal outcomes (Brunner and Ascher 1992, Brunner 1991). Researchers are rewarded in their careers for claiming objectivity, independence, and high confidence in the outcomes of their recommendations. Such claims appear stronger when supported by formal quantitative analysis. When natural scientists evaluate cases of applied adaptive management, the perspective is often one that frames social factors as "barriers" to the implementation of experimental management and rational planning, rather than as positive, complementary learning processes that provide for important human needs. McLain and Lee (1996) term this perspective "scientific adaptive management," and I follow their usage here.

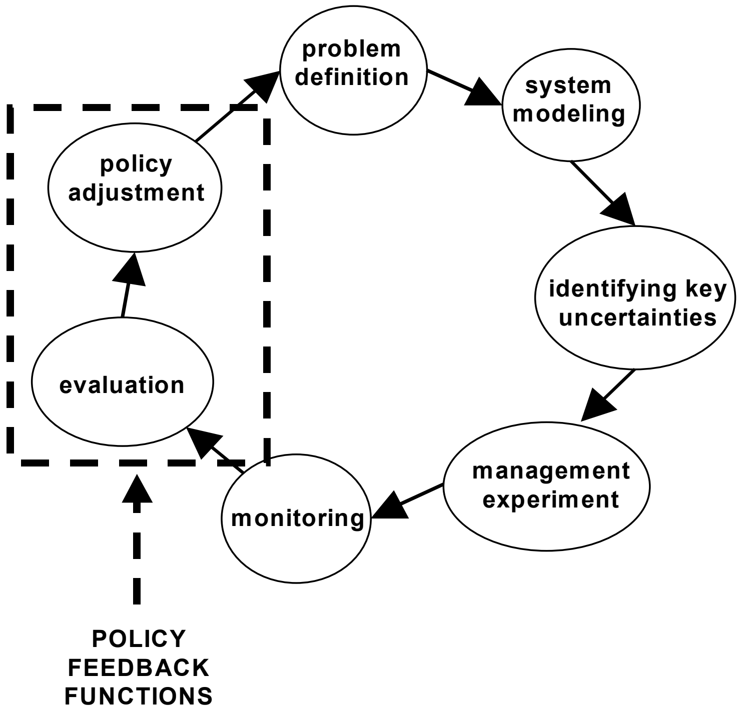

Figure 1. Learning functions of adaptive management.
The author's figure is derived from Taylor et al. (1997), Lee (1993), and Walters (1986). "Scientific adaptive management" emphasizes quantitative, formal approaches to this process wherever possible.

Alternatively, we can frame adaptive management as an attempt to *balance* our ideals of quantitative science, rational planning, and efficiency with the ongoing socio-political need for conflict resolution among only partially rational humans – a process called social learning (Röling and Wagemakers 1998, McLain and Lee 1996, Lee 1993, Korten 1981). Social learning processes are neither strictly scientific nor within the control of managers and policy makers. For example, "monitoring" in scientific adaptive management (Figure 1) is generally understood to mean rigorously designed sampling of quantitative parameters such as stream water turbidity. However, a social learning perspective also considers the value and influence of less rigorous "monitoring" activities such as incidental observations by a citizen as she takes a daily stroll along that same stream (MacDonald and Smart 1993). Similarly, while ecosystem scientists may imagine the "system modeling" phase ideally to involve quantitative modeling exercises (e.g., Walters 1986), social scientists point out that qualitative and heuristic conceptual models may serve a similar function at less cost and greater flexibility (e.g., Walker et al. 2002, Checkland

1999a). In fact, less formal approaches may have a far greater *emotional* impact on participants than tabulated data, making them more likely to influence actual policy-making and behavior. This rooting of convictions in emotionally lived experience is, again, the phenomenon of "discovery learning" (Röling and Wagemakers 1998, Walters 1986). As Lasswell notes, empirical case studies suggest that the policy process is an effort to find "not the 'rationally best' solution, but the emotionally satisfactory one." (Lasswell 1960: 184)

Social learning theory also recognizes that the adaptive management functions depicted in Figure 1 seldom follow a neat sequence of technical steps. The functions may occur in a fragmented, opportunistic way as funding or political will becomes available. They may occur both formally and informally. In particular, *implementation* of policies remains a major locus of unpredictability (Bardach 1977, Pressman and Wildavsky 1973).

These social processes are too complex, messy, and unpredictable for the command-and-control aspirations of scientific adaptive management to bear much fruit (Stacey 2002, Stewart and Ayres 2001, Lee 1999, Röling and Wagemakers 1998, Holling and Meffe 1996, Gunderson et al. 1995a, Ludwig et al. 1993). In addition, social processes are also subject to multiple valid interpretations (Checkland 1999b, Woodhill and Röling 1998, Brunner and Ascher 1992, Brunner 1991). Accordingly, recent directions in adaptive management theory have begun to explore the self-interpreting and *self-organizing* properties of environmental policy domains (Gunderson and Holling 2002, Gunderson et al. 1995a).[2]

In this perspective, the enduring social structure of a policy domain – goals, policies, power relationships, culture, and so on – *emerges* from semi-chaotic informal interactions among individuals as they negotiate shared interpretations of previous events in order to act further in a collective manner (Stacey 2002, Woodhill and Röling 1998, Feyerabend 1993, Giddens 1984). For example, the concept of "variable retention" of forest structure within logged areas (Mitchell and Beese 2001, Franklin et al. 1997, CSSP 1995) (1) emerged through discussions within an informal network of forest scientists of the U.S. Pacific Northwest and British Columbia, (2) was enshrined in a high-visibility and formal planning report authored by many of the network

[2] A similar theoretical movement applies to the study of ecosystems, but here I focus on social systems. I use the term "domain" to refer to the system scale whose boundaries are coterminous with a case under study. Dynamics and structure beyond those boundaries are often called "exogenous" variables in the literature.

members, and (3) now has become a basic planning option shared among many forest management professionals and taught in universities throughout the region.[3]

At the same time, emergent patterns of behavior tend to be self-reinforcing and resistant to disruption by new ideas and behaviors (Gunderson et al. 1995a, Giddens 1984, Kuhn 1970, Schumpeter 1950). This phenomenon is called "path dependence" (Ostrom 1992) or the "competency trap" (Levitt and March 1988). For example, as variable retention becomes enshrined in formal policy and laws, and as careers are built around its technologies, more and more resources may be captured by its teaching and implementation. Competing approaches may find it difficult to divert the attention and funding required to become established in their own right.

More fundamentally, as habits of thinking become established, they begin to shape the ways in which adherents "see" the world, so that new and competing approaches "just seem wrong." Although these formal and informal patterns can become highly entrenched and ritualized, at another level these stable social structures are subject to ongoing reinterpretation and adaptation. The processes by which reinterpretation and adaptation create *new* entrenched patterns of thinking and acting are very difficult to track empirically.

In short, scientific adaptive management, as with any attempt to control human behavior for optimal outcomes, is constrained by forces acting from a range of levels in the social system, both higher and lower (Figure 2). Bottom-up forces put implementation in doubt and yield important new practice-derived (rather than science-derived) information that often cannot be ignored. Top-down forces constrain program design through allocation of resources, and policies fail to respond to scientific findings due to entrenched power relationships, cultural unacceptability, or conflict among competing policy goals. When these high-level structures do shift, the timing and direction of such shifts can be highly unpredictable.

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[3] Dr. Ken Lertzman, personal communication, April 28, 2002.

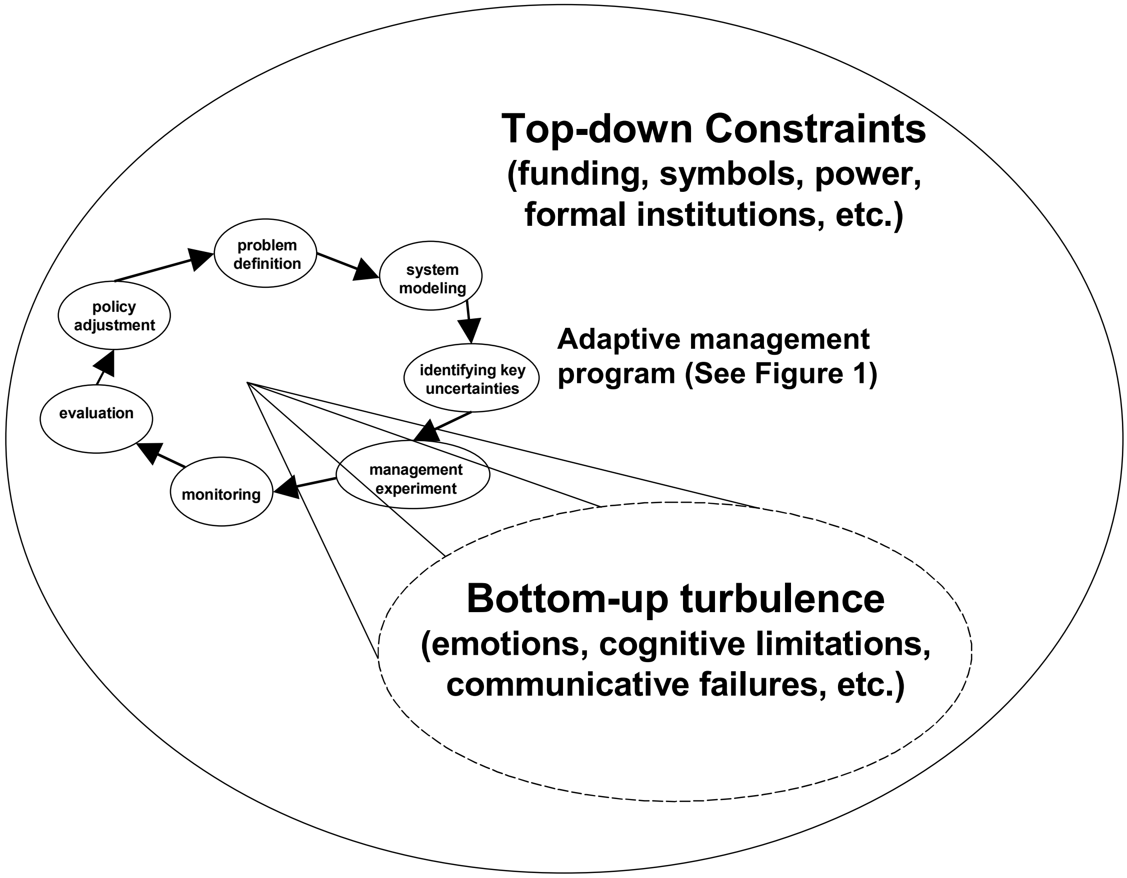

Figure 2. Adaptive management within a social learning system.
Author's figure. Implementation of scientific adaptive management (Figure 1) is constrained and disrupted by complex interactions with other social phenomena. Taking the level of a formal adaptive management program as the "reference level," we can categorize these social processes as either "top-down" or "bottom-up" influences.

In struggling directly with these social constraints on scientific adaptive management, adaptive management thinkers have moved in at least two complementary directions. First, some managers embrace a *practice-based* approach that seeks to be more comfortable with the chaotic moments of social processes, to be more willing to dialogue with non-scientist actors as knowledge actors, and to design projects that directly address socio-political needs as well as needs for understanding ecosystems (e.g., Bormann et al. 1999, Brunner and Clark 1997). Second, some theorists seek ways of conceptualizing the dynamic complexity of self-organizing systems in a holistic way. This is the theory of *complex adaptive systems* (Gunderson and Holling 2002, Levin 1999, Bella 1997, Holland 1995, Kauffman 1993, Waldrop 1992).

The purpose of complex adaptive systems theory is to generate insights – however broad, metaphorical, or heuristic – that can take us beyond the context-dependent, practice-based approach. These thinkers often emphasize the "art" over the science of management, thus converging on the stream of organizational behavior thinking represented by authors like Bolman and Deal (1991), Morgan (1986), and Allison (1971). Over the past few decades, adaptive management practitioners have generated a wealth of options for designing projects that trade off rigorous design against social feasibility (Bormann et al. 1999, Lee 1999, Walters and Holling 1990, Walters 1986, Walters and Hilborn 1978,). The well-known distinction between "active" and "passive" adaptive management is but the earliest and simplest characterization of these options. But what general guidance can we find regarding when and where each of these options is appropriate?

3.2. Complex adaptive systems

> Nonlinearities mean that our most useful tools for generalizing observations into theory – trend analysis, determination of equilibria, sample means, and so on – are badly blunted. The best way to compensate for this loss is to make cross-disciplinary comparisons of *cas* [complex adaptive systems], in hopes of extracting common characteristics. (Holland 1995: 6)

Westley (1995) warns that rigorously specifying a scientific adaptive management structure for clear and efficient social learning usually serves to rule *out* important sources and forms of information even as we "rule in" others. Therefore, redundancy of policy arenas and informal linkages among management levels and functions may be necessary in order to ensure inclusiveness and system responsiveness. However, Westley also warns that formalization of knowledge may be necessary in order to capture and retain lessons gained in informal processes such as personal inspiration, implementation, and social networking. That is, there are obviously good reasons why the ideals of scientific method and rational planning have gained broad acceptance in many modern cultures. From this perspective, the question of adaptive management is how to overcome the rigidity of formal rules and entrenched ideologies yet also provide a program design that avoids excessive chaos and "leakage" of knowledge. This is a basic tension implied by the adaptive management idea – the need for the social system's structure to be both *open* to new knowledge and *closed* for transparent, reasonably efficient, reasonably predictable action on existing knowledge. Some characterize this new ideal as a critical state at the "edge of chaos" (Waldrop 1992).

The theory of complex adaptive systems (CAS) seeks to address the tension between open and closed structure in social learning by overlaying the multifarious social processes discussed above with simple unifying concepts. It provides a framework for escaping assumptions of formal control and disciplinary boundaries. Heuristic analogy is preferred over mechanistic analysis, especially by comparing the functioning of "human environments" to that of natural environments (Levin 1999, Gunderson et al. 1995a). The aim is to describe properties and structural features that enable a CAS to persist in a turbulent environment through continual self-(re)organization.

The state of current theory characterizes CAS by a handful of properties and structural features (Figure 3). The basic property of CAS is to (1) combine stability and change simultaneously. This combination is achieved through (2) a diversity of agents that (3) self-organize without central direction in a manner that is (4) usually strongly dependent on the previous history of the system. Change in structure is dominated by (5) non-linear dynamics among variables, which produce emergent structures that can break the constraints of history and trigger abrupt shifts from one stable state to another.

The term "structure" as used in this study encompasses both formal and informal repeated patterns of behavior and understanding (Giddens 1984). The overarching structural feature of CAS is (1) the nested hierarchy (Figure 3). This is not a bureaucratic hierarchy dominated by top-down, command-and-control dynamics. Rather, it incorporates both top-down and bottom-up causality.[4] Within this hierarchy, different variables (2) cycle from stable to unstable (closed to open) configurations at different speeds.[5] For example, national cultures and constitutions change over centuries, laws and balances of power among interest groups change over decades, and operational practices and interpersonal relationships may change over just a few months (Westley

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[4] To distinguish the two types of hierarchy, Gunderson and Holling (2002) have coined the term "panarchy" to describe the CAS heuristic.

[5] Gunderson and Holling (2002) use a *four*-phase cycle. However, they usually discuss the phases as pairs — two stable, two unstable. There are important differences among all phases, but for the purpose of this exploratory analysis I have chosen to simplify the sequence, approximating the cycle of Bella (1997).

et al. 2002, Gunderson et al. 1995b). The unstable phase of the cycle is often much shorter in duration than the stable phase.

(3) Slower-cycling variables form relatively stable "higher-level" constraints ("remember signals" – Gunderson and Holling 2002) within which faster-cycling variables may generate novel structures (Figure 3). In evolutionary terms, these constraints are the "survival landscape" to which the lower levels must adapt (Waldrop 1992). In scientific terms, they are the assumptions that underpin lower-level analysis. In cultural terms, these can be the beliefs and symbols that structure our perceptions and responses to the world around us. Since Kuhn (1962), we have called some of the most basic of these assumptions "paradigms." Again, formal structures are not necessarily more meaningful or constraining than informal structures.

> Another of Jay Forrester's systems sayings goes: It doesn't matter how the tax law of a country is written. There is a shared idea in the minds of the society about what a "fair" distribution of the tax load is. Whatever the rules say, by fair means or foul, by complications, cheating, exemptions or deductions, by constant sniping at the rules, the actual distribution of taxes will push right up against the accepted idea of "fairness." The shared idea in the minds of society, the great unstated assumptions – unstated because unnecessary to state; everyone knows them – constitute that society's deepest set of beliefs about how the world works. There is a difference between nouns and verbs. People who are paid less are worth less. Growth is good. Nature is a stock of resources to be converted to human purposes. Evolution stopped with the emergence of *Homo sapiens*. One can "own" land. Those are just a few of the paradigmatic assumptions of our culture, all of which utterly dumbfound people of other cultures. Paradigms are the sources of systems. From them come goals, information flows, feedbacks, stocks, flows. (Meadows 1997)

Over time, the higher-level structure captures ever more resources, until few resources – such as attention, funding, and emotion – are available to respond to bottom-up signals (path dependence). The structure loses resilience and grows vulnerable to catastrophic disruption by sufficiently strong bottom-up signals. Thus, (4) the constraints of the higher-level structure are periodically destabilized by "revolt signals" (Gunderson and Holling 2002) from the lower-level (faster) variables. A crisis occurs, and a "policy window" of opportunity opens (*sensu* Kingdon 1995). This moment is characterized by disorder and a search for solutions. Ideas generated in social networks at lower levels may emerge through the policy window and form the seeds of a new pathway of higher-level policy development – a new stable state. Chance events may also play a role in determining the new pathway, and timing appears crucial. Whether lower levels are successful in injecting revolt signals at higher levels depends largely on the strength of the signal, where the slower (higher-level) variables are located in the stable-unstable cycle, and chance events (Gunderson and Holling 2002).

Through the above structures and processes, both stability and change are achieved simultaneously in a hierarchical system of nested variables. Semi-independent cycling of multi-speed variables means that learning and adaptation can emerge without total system chaos. Information generated in lower levels can be retained and propagated throughout the system by higher levels. Again, as the Meadows quote above indicates, these higher-level structures are not necessarily formal or deliberate.

This concept of a "hierarchy with a difference" is not unique to CAS theory. The literatures of organizational behavior, political science, and institutional economics have made extensive use of similar concepts such as the "holographic organization" (Senge 1990, Morgan 1986) and sets of nested enterprises for self-governance (Ostrom 1995, 1992). Within the field of ecosystem management, Brunner and Clark (1997) advocate "prototyping" a diversity of small-scale practices (faster variable) while a higher-level institution such as a government agency (slower variable) selects the most successful practices for propagation. Thus, reconciling higher-level stability (coordination, oversight, dispute resolution) with lower-level implementation and experimentation is widely recognized as a key challenge for ecosystem management (Lee 1993). Yet CAS theory is perhaps most focused on exactly this challenge.

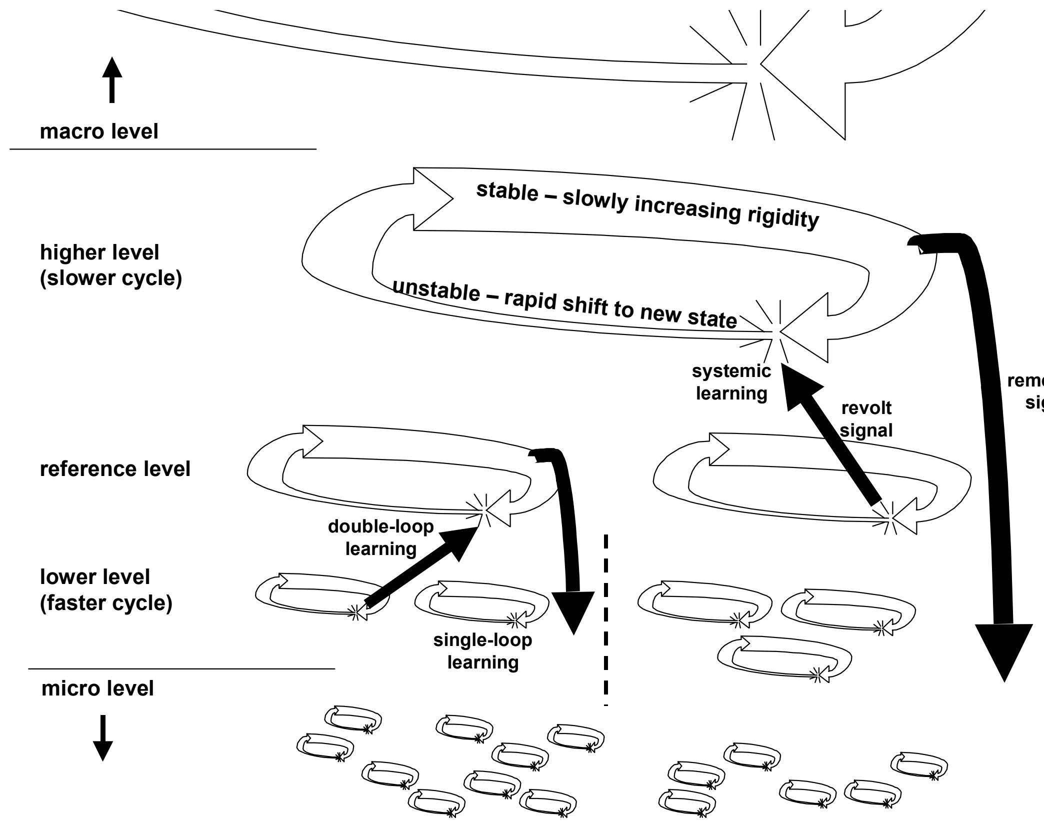

Figure 3. A complex adaptive systems (CAS) heuristic.
Author's figure derived from Gunderson and Holling (2002), Bella (1997), Holland (1995), and Argyris and Schon (1978). Each level experiences an internal stable-unstable cycle as partially determined by signals from other levels. The higher levels cycle more slowly and provide stability within whose constraints (remember signals) the faster-cycling levels introduce novelty. Over time, higher-level stability becomes more rigid and vulnerable to catastrophic disruption by revolt signals from lower levels. We can distinguish any number of levels, depending on where we locate the "reference level". In this study, the reference level is the Watershed Analysis Standard Methodology (Section 6.3).

If communication linkages (especially revolt signals) among levels of a CAS are too few or too weak, then systemic adaptation and learning will not occur. Yet the density, variety, and variability of communication linkages are difficult to depict in a graphic model and to detect in an empirical study. A single phone call or a carpool to a meeting can make a difference if conditions allow an idea expressed there to "snowball" in a non-linear fashion, spreading and reinforcing itself through social networks and, eventually, more formal structures. A chance event, such as a family tragedy that distracts a key actor at a key time, can also make a difference. Diagrams such as Figure 3 suggest more order than is often the case. Therefore, some complexity authors emphasize the more general overarching property of "connectedness" as a locus of intervention for maintaining the edge of chaos (Stacey 2002).

To speak about "the degree of connectedness" in a system is to summarize the *number* of connections among variables and the *strength* of those connections. To measure the strength of every social connection among individuals and organizations in a reasonably complex policy domain is obviously impossible. Some authors interested in connectedness and complexity criticize the CAS heuristic for clinging to a doomed hope that complexity can be simplified and leverage points identified for reliable, if counter-intuitive, achievement of desired results (Stacey 2002). Highly variable micro-interactions among individuals are the irreducible substance of social structure. It is inappropriate to analogize, however heuristically, from ecosystems to social systems.

The following list summarizes the main points of my interpretation of CAS theory:

CAS properties

- stability and change simultaneously
- diversity of agents
- self-organization through emergent structures
- history dependence of system structure
- non-linear dynamics producing emergent structures

CAS structural features

- hierarchy of nested variables
- variables cycle between stable and unstable states
- remember signals: higher levels cycle at a slower speed, and constrain change
- revolt signals: lower levels cycle at a faster speed, and introduce novelty that can trigger change
- connectedness at the "edge of chaos"

3.3. Single-loop, double-loop, and systemic learning

The CAS heuristic overlaps most strongly with classic social learning theory in the distinction between "single-loop" and "double-loop" learning, first expounded by Argyris and Schon (1978). This distinction is among the simplest and most adaptable versions of the general observation that policy change may occur at many levels, from the trivial adjustment of rhetoric to a fundamental "paradigm shift" (as in Lertzman et al. 1996, Sabatier and Jenkins-Smith 1993, and many others).

Single-loop learning is ongoing incremental adjustment of behavior in response to detected failures in meeting one's objectives. For example, a timber company may take on new contractors when post-operational monitoring shows that riparian forest buffers on streams are not meeting regulations. At a second, higher level, a government agency may revise the regulations themselves in response to lobbying and research showing that they impose excessive financial costs or pose unacceptable risk to salmon populations. The first level of learning is well-suited to a scientific adaptive management design, including monitoring efforts that compare actual buffer widths with those specified in regulations. The second level of learning, double-loop learning, is messier and more ambiguous.[6] For example, the politcal will to change forest management regulations may emerge from an intense power struggle among parties with conflicting goals. Personal relationships among policy makers, managers, and stakeholders may play a key role in moving information throughout the system.

Gunderson and Holling (2002) identify these two types of learning with different phases in the stable-unstable cycle of a "reference level" (my own term) – the level that one uses as a

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[6] Argyris and Schon (1978) more often use the term "double-loop learning" to talk about qualitatively more distinct levels of change than those represented in my example – involving "modification of an organization's underlying norms, policies, and objectives." (page 3) Since the original presentations of the concept, the term "double-loop learning" has been adapted repeatedly to refer to a very wide range of learning phenomena. Throughout this history the main value of the term has been to distinguish among types of learning that differ in the ease with which they are achieved by conventional organizational structures. In my study I borrow this more general usage, using the term to distinguish among learning processes at different levels of a complex adaptive system (Figure 3). In my interpretation of CAS theory, differences in variable speeds are as important as qualitative differences for determining level. When we are mapping system levels at a relatively high resolution, different levels may have significantly different speeds of change without being qualitatively different (e.g., the state forest policy level and the watershed analysis program level in Figure 7). At this resolution, "systemic learning" (or the occasionally heard "triple-loop learning") may be the term that captures qualitatively different levels of change.

heuristic point of orientation in the many levels of a system's structure (Figure 3). In the example above, the reference level is the stream buffer regulations, and single-loop learning is the forester changing her practices to meet the constraints of the regulations. The regulations remain stable. Double-loop learning is the agency revising the regulations – a brief unstable phase in the regulations.

Gunderson and Holling (2002) describe a third type of learning that involves "system-wide" adjustments (i.e. involving more than two levels) due to destabilization of high-level or macro-level structures (Figure 3). In this study I will call this type of learning "systemic learning."[7] It is analogous to some authors' extension of Argyris and Schon (1978) to include "triple-loop" learning (e.g., Maarleveld and Dangbégnon 1999). Systemic learning constitutes another increase in causal complexity and evaluative ambiguity. For example, how can science and rational decision-making help us to agree on what constitutes "excessive financial costs," when weighed against the financial, cultural, and ecosystem health benefits of protecting the salmon? What role does science play in creating the value of salmon as a widely shared *symbol* of healthy, productive ecosystems and societies in the Pacific Northwest?

Because systemic learning, and to a lesser degree double-loop learning, depends in part on the dynamics of slower variables, this kind of learning may require decades or even centuries to emerge. Therefore, Sabatier and Jenkins-Smith (1993) emphasize the importance of taking time frames of at least a decade to evaluate social learning processes. Similarly, Gunderson et al. (1995a) deliberately select cases of applied adaptive management that span several decades. While it is not unusual for policy analysts to consider the role of "system-level" or "exogenous" variables (e.g., Sabatier and Jenkins-Smith 1993, Emery and Trist 1965), CAS theory emphasizes *integrating* the case and its environment in the concept of a self-organizing, coevolving system (Gunderson and Holling 2002, Stacey 2002, Levin 1999, Kauffman 1993).

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[7] Gunderson and Holling (2002) call it "transformational learning." However, I wish to avoid confusion with another usage of this term by social scientists to refer to a type of personal learning at the level of small groups and individuals (Pinkerton 1999, Röling and Jiggins 1998).

To summarize, the three types of social learning compare with the CAS heuristic (Figure 3) as follows:

- Single-loop learning is incremental adjustment at a lower level to better meet stable constraints at a reference level.
- Double-loop learning is adjustment of reference-level constraints in light of unexpected feedback.
- Systemic learning is destabilization of high-level structure that eventually cascades through the system and results in a fundamental shift in system state.

4. METHODS

4.1. What is successful learning?

What exactly will I deem "successful social learning"? Not all improvements will match our conventional conception of learning, which implies achieving better substantive outcomes relative to original goals. In CAS, the idea of goals as a standard for measuring outcomes is problematic.

First, as discussed in the Section 3.3, social learning involves more than simply improving our performance relative to established goals. It also involves adjustment of our goals and objectives themselves — double-loop and systemic learning. Second, the diversity of agents in CAS often implies a diversity of competing goals, from which it may be impossible to develop a self-consistent definitive set. *All* actors are loci of learning, embodying a variety of perspectives, constraining relationships, and goals (Woodhill and Röling 1998). Moreover, most of this variety is informal, unspoken, and often unrecognized even by the actors themselves. Under such conditions, "The specifics are in the . . . rules that govern how the system changes in response to past and present conditions, rather than in some goal-seeking behavior." (Levin 1999: 12) Sections 7.2.3 and 7.2.4 provide an example of ambiguity in the goals of the Watershed Analysis program.

Given ambiguities in goals of complex adaptive systems, some authors (e.g., Clark et al. 2001) emphasize that assessments of social learning must focus on cognitive change rather than on improvements in instrumental effectiveness in producing pre-defined outcomes. While I follow this approach in leaving the question of substantive outcomes outside the scope of this study, I do look for more than merely cognitive change. There are strategic reasons for case participants to misrepresent their cognitive processes – for example, where negotiations in the Washington State forest policy domain have claimed to be "science-based," any bargaining position must be supported by claims of responsiveness to new information (Section 5.1). Actual change in practices appears to be the only way to avoid the pitfalls of a purely cognitive approach.

In the absence of definitive goals for the program, by which success or failure might be relatively clearly guaged, I elect to evaluate learning success by collecting participant accounts of behavioral change through in-depth, semi-structured interviews and a collection of formal reports. By carefully designing my participant sample to capture a diversity of perspectives, I have ensured thorough testing of my interpretations. By summarizing the interview data in "confidence fractions" (Figure 4) and more conventional academic means, I provide the results of the testing: evaluations of learning success vary widely on many specific points and as regards the program as a whole.

The analysis often pauses to explore the reasons for participant disagreements about learning outcomes: Do the disagreements follow interest group lines? Do the disagreeing parties define "learning success" differently? Are they in possession of different sets of key information and experiences? As I will note repeatedly, the latter question is especially important if one wishes to evaluate not only formalized changes in behavior, but also the informal daily adjustments of behavior by individuals in a turbulent environment. The insights that come from asking these sorts of questions in turn suggest novel ways of understanding the task of social learning in the case. The conclusions are neither objective nor definitive – their value is in the attempt to grasp the functioning of Watershed Analysis as a social learning tool in a more comprehensive manner than is common in evaluations of adaptive management programs.

4.2. Scope of analysis

Figure 1 shows a typical set of learning functions in the adaptive management literature. In this analysis I focus on the "policy feedback" functions – evaluation and policy adjustment – of the Watershed Analysis program. Policy feedback is perhaps the most difficult aspect of adaptive management to understand and predict, and, as Section 3.3 explains, some outcomes in policy feedback may take decades to be realized. While the formal Watershed Analysis program was active only from about 1992 to 1997, the social structures of the policy domain within which it arose and to which it contributed extend for many years before and after. Therefore, I devote significant space to understanding the larger context within which the program functioned. As a whole, the case constitutes an extreme example of rapid policy change through complex multi-stakeholder collaboration. Such extreme cases are among the most valuable type of single-case studies (Yin 1994).

4.3. Analytic framework

The concepts discussed in Section 3 serve as a guide in my search for ways to achieve effective policy feedback (evaluation and policy adjustment) in Washington State forest policy.

Section 3 describes two broad ways (among many other ways) of viewing these functions – scientific adaptive management and complex adaptive systems. The research questions are:

1. How can we deliberately design Washington State's adaptive forest management programs to improve the effectiveness of policy feedback functions?
2. Do the concepts of scientific adaptive management help to identify and understand learning successes and failures in the case so far?
3. Can complex adaptive systems (CAS) theory help to identify and understand important learning successes and failures that the scientific adaptive management model misses?
4. What do the findings regarding each of these two perspectives suggest about answers to Question #1? That is, how does each hold up as a basis for strategic policy-making?

My analysis proceeds as follows. After briefly describing the larger policy context and the Watershed Analysis program (Sections 5 and 6), I examine successes and failures in the Watershed Analysis policy feedback functions as perceived and defined by diverse participants. In Section 7, I organize this material by (1) **formal structures** for policy feedback and the origins of these structures in social processes and (2) **policy feedback outcomes**, including both formal agreements and the informal structures that emerged around them. This organization allows me to evaluate the relative significance of formal and informal structures in enabling policy feedback – that is, an empirical test of the assumption of scientific adaptive management that formalization of a program makes success more likely. Note that the outcomes described here do not address ultimate impacts on the resources being managed – that is, trends in fish abundance, water quality, or timber values. Rather, the outcomes are changes in the behavior of people. Evaluating ultimate resource impacts is beyond the scope of this paper and peripheral to my interest here in how science can or cannot be used to change human behavior through the policy feedback functions of an adaptive management program.

In Section 7, I also organize policy feedback outcomes by hierarchical level – a preparation for the CAS-based analysis of Section 8. This second analysis compares the accounts in Section 7 with the properties and structural features of CAS . In Section 9, the findings of Sections 7 and 8 yield conclusions and recommendations regarding adaptive management in the Washington State forest policy domain, as well as consideration of theoretical implications and transferable lessons.

The following outline summarizes my analytic framework:

Section 7: Successes and failures of policy feedback in Watershed Analysis

- formal program evaluation structures and where they came from
- program evaluations that actually happened and the informal structures that influenced them
- formal policy adjustment structures and where they came from
- policy adjustment outcomes and informal structures that influenced them

Section 8: Application and comparison of scientific adaptive management and complex adaptive systems perspectives on the outcomes

- relative importance of informal and formal structures
- single-loop, double-loop, and systemic learning in the case
- Watershed Analysis as a complex adaptive system
- connectedness in the Washington State forest policy domain

Section 9: Conclusions and recommendations

- conclusions about the case
- recommendations for the case
- theoretical implications and research needs
- lessons for other policy domains

4.4. Data collection: participant interviews

In-depth, semi-structured interviews with case participants (per Yin 1994) form the core source of data about the case. Together with Dr. Evelyn Pinkerton, I conducted the interviews between March 2001 and October 2002. Dr. Pinkerton's extensive previous work in Washington State (Pinkerton and Baril 2001, Pinkerton 1998, Pinkerton 1992, Pinkerton 1991, Pinkerton and Keitlah 1990) was enormously helpful in selecting the case, identifying focus watersheds, and gaining interview access to a wide range of participants from all sides and all levels of this contentious policy domain. By building on Dr. Pinkerton's existing professional relationships and personal archive of records, we were able to achieve understandings that are grounded in a long-term experience of the case. Such long-term understandings are a crucial part of this study.

The semi-structured interviews allowed us to understand the Washington State forest policy domain from the various perspectives and experiences of the participants themselves – an essential understanding when the basic purpose of analysis is to compare the roles of formal design and informal, emergent social structures at a wide range of system levels. Interviews also allowed us to understand the policy domain's development over time.

Semi-structured participant interviews are also an important guard against "strategic" answers. For example, the standardized survey of Sullivan et al. (1997) found that 15-20% of survey respondents were consistently "disappointed" with various aspects of the Watershed Analysis program. In contrast, analysis of my interviews reveals that participants tend to compartmentalize their evaluations of the program, demonstrating deep appreciation for the successful aspects, yet also urgently advocating key improvements. For example, a Department of Fisheries and Wildlife scientist offered the following strong assessments, one very negative and one very positive:

> . . . as far as a routine method of doing regulations, it was a huge bureaucracy that accomplished very little. (DFW scientist)

> [Watershed Analysis provided] an integrated way of looking at what's happening in a watershed. We've got a whole generation of scientists trained by that. That's one thing we stand a chance of losing if we drop Watershed Analysis completely. It's a real powerful training tool. (DFW scientist)

The semi-structured interview method allows a researcher to fully explore, over the course of a lengthy discussion or multiple contacts, how participants apply and integrate multiple criteria in their assessments of a program's performance.

Participants may also consciously shape messages for the sake of achieving individual policy objectives. Sullivan et al. (1997: 29) themselves found evidence of this kind of strategic behavior: in focus groups to follow up their survey, they found that timber companies had consciously exaggerated their degree of satisfaction with the "rule call" mechanism (Section 6.3.3 and Table 3), because they feared it would be replaced by "something even worse." The spontaneous nature of the semi-structured interview makes it more difficult for participants to prepare consistent in-depth strategic reports. In addition, because accounts were collected by a single research team in sequence over time, we gained the opportunity to challenge what might be strategic statements by raising conflicting participant accounts.

4.4.1. Sampling

We define case participants as anyone with personal experience of any aspect of the Watershed Analysis program, its origin and development, or its subsequent effects throughout the policy domain. In designing a sample of this population, we faced time and budget constraints and uncertain availability of potential interview subjects. Accordingly, we selected a “stratified purposeful sampling” approach, striving to obtain maximum variation in participant opinions (Miles and Huberman 1994). We deliberately sought to challenge our developing interpretations by interviewing participants who seemed likely to disagree. We identified interview candidates through “snowball sampling,” which entails asking each interviewee to recommend other participants that would satisfy our sampling needs (Miles and Huberman 1994). This non-random approach to sampling is best suited to the richness and complexity of the case: “. . . selecting informants randomly makes as much sense as seeking information in the library by randomly selecting a book from a randomly selected shelf.” (Stern, unknown date)

Table 1. Participants interviewed by stakeholder type.
An asterisk indicates a tally that includes an individual who is counted under two different categories. One asterisk indicates that only one of the individuals included in a category is double-counted. Two asterisks indicate that two individuals within the category are double-counted. Asterisks are placed only next to an individual's "secondary" category tally. Totals for interest groups (Tribal, industry, state, ENGO) and for the entire set do not double-count. DNR = Washington Department of Natural Resources; DOE = Washington Department of Ecology; DFW = Washington Department of Fish and Wildlife; ENGO = environmental non-government organization; NWIFC = North West Indian Fisheries Commission.

PARTICIPANT GROUP	NUMBER OF PARTICIPANTS INTERVIEWED
Tribal total (4 different Tribes and NWIFC)	**12**
staff scientists	8
policy workers	4
Industry total (4 different companies)	**15**
public companies total	11
operations managers	2
scientist-consultants	2*
staff scientists	6
Lawyers	3**
policy workers	2*
family-owned companies total	4
operations managers	1
scientist-consultants	2
Lawyers	1
policy workers	2**
State agencies total	**9**
DNR total	6
policy workers	1
field staff	4
staff scientists	1
DOE total	1
policy workers	0
staff scientists	1
DFW total	2
policy workers	0
staff scientists	2
ENGOs total	**8**
policy workers	3
Lawyers	2*
field staff	1
consultant-scientists	0
staff scientists	0
other	3
Other scientists	**2**
TOTAL	**46**

Our sampling approach produced the distribution of 46 interviewees detailed in Table 1. Average interview length was approximately 1.5 hours, totalling approximately 110 hours of interview time (not including brief email exchanges). Assurances of confidentiality – crucial to the quality of the data – preclude more specific identification of interviewees. In order to gain in-depth understanding of the social processes of the case, interviews focused on three "sub-cases" (introduced in Sections 7.4.2 and 7.4.4). The three sub-cases are represented by 10, 13, and 9 interviews. To protect confidentiality, these sub-cases are identified below only with generic labels like "Basin A." It is important to note that all sub-cases are located west of the Cascade Range. While they are not representative of the specific outcomes in other regions of the state, they are indicative of the wide range of processes and outcomes that characterize the case of Watershed Analysis as a whole.

4.4.2. Instrumentation

Interviews were open-ended but guided by a protocol (per Yin 1994). I conducted all but eight of the interviews collaboratively with Dr. Evelyn Pinkerton. Of the remaining eight, Dr. Pinkerton conducted seven and I conducted one alone, always in close consultation about interview content. A sample protocol for my own contributions to the interviews is provided in Appendix B.

From the protocol we selected only a subset of questions appropriate to the position and experience of each interview subject. Many questions in the protocol approach similar issues from different perspectives, in order to ensure that question wording would fit as well as possible with the sensibility of each interviewee. We revised the protocol continually as the study progressed.

A more rigorous instrumentation was neither possible nor desirable – in a single-case study of poorly understood, very complex social dynamics such as this, research design must be flexible and sensitive to the inevitable elements of discovery and surprise (Miles and Huberman 1994: 36). Design relevance depends on integrating data collection and data analysis in an iterative manner (Miles and Huberman 1994: 50-89).

4.4.3. Triangulation

Because all interview data reflects the motivations and biases of the participant, and because an analyst's interpretation of this data reflects his or her own motivations and biases, methodical "triangulation" is essential (Stake 1995, Yin 1994, Berg 1989). In this study, I achieved triangulation by comparing participant accounts and my understanding of them with (1) other participants' accounts; (2) historical documents and records; and (3) the understandings of other researchers of the case – especially Dr. Pinkerton, with whom the debate over interpretation was continual and intense. The methodological literature considers corroboration of an account by two other sources to be a threshold for acceptable confidence in one's findings.

4.5. Data collection: document and record review

In addition to participant interviews, Dr. Pinkerton and I have collected data through review of documents and records of laws, regulations, programs, policies, policy evaluations, management plans, meeting minutes, and correspondence. These sources provide both a means of triangulation (Section 4.4.3) and a description of formal arrangements within the Washington State forest policy domain.

4.6. Report review

Drafts of this study report have been reviewed in whole or (almost always) in part by a wide range of participants in the case: 5 Tribal scientists, 1 industry lawyer, 3 industry scientists, 2 industry scientist-consultants, 2 ENGO policy workers, 1 ENGO lawyer, and 1 DNR scientist. This review process has provided a valuable check on the interpretations to follow.

4.7. Data presentation, the confidence fraction, and the interviewee quotes

Confidentiality assurances and space limitations preclude attachment of full interview transcripts to this report. In what follows I summarize the interview data in a quasi-narrative format. Narrative is the mode in which participants make sense of the complexities of the case, and it is the form of most interview data. In fact, the activity of storytelling has much in common with formal and quantitative modeling: assumptions are inevitable, and some questions must be neglected in order to move forward in a complex reality. By sharing our stories and our models with each other, we engage in a process of shared sense-making through mutual critique. Such critiques are facilitated by documenting the method of developing a story or model. The foregoing sections address this need.

Story and model critique is also aided by clear indications of uncertainty surrounding interpretations and conclusions. I use the following conventions to indicate the confidence levels of my narrative. First, where a statement is supported by three or more sources (participants or documents/records) and contested by none, I make no mention of the degree of support. Triangulation is achieved (Section 4.4.3), and confidence is high. Where this condition is not satisfied, I explicitly record in a footnote the number of participants that support a statement as a fraction of the total number of participants with whom we discussed the issue (Figure 4). I also provide a breakdown of the *supporting* opinions by stakeholder groups defined in Table 1. The non-supportive component of the confidence fraction is often impossible to sort into categories of "neutral" and "in disagreement."

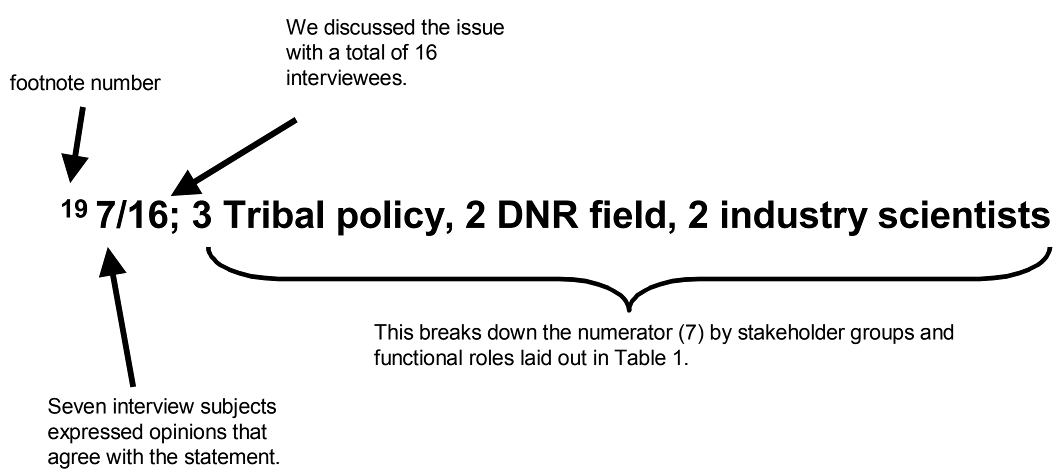

Figure 4. Interpreting the confidence fraction.
Where a statement summarizing the interview data is contested by some sources or supported by less than three sources, I indicate in a footnote the degree of support for the statement.

Direct quotations of participants form an additional mode of data presentation. These quotations follow no systematic design, but rather are intended simply to add to the richness of the narrative. For example, it is fascinating to note the various and contrasting ways in which participants use words like “adaptive,” “adaptive management,” and “learning” when evaluating their experiences in the case. At the request of the participants, I have used the “former” label to indicate when a quoted individual has switched stakeholder categories since the time period addressed by the quote. However, in confidence fractions and elsewhere I omit the “former” label.

5. POLICY CONTEXT: THE TIMBER/FISH/WILDLIFE AGREEMENT

5.1. A major shift in values and strategy, 1987

The Washington State Watershed Analysis program emerged within the Timber/Fish/Wildlife Agreement (TFW 1987), a larger policy framework for cooperative management of about 12.5 million acres (5 million hectares) of state-owned and private forests. Negotiation of TFW in 1986-1987 was triggered by a power deadlock among various groups interested in state forest policy (Flynn and Gunton 1996, Pinkerton 1992, Halbert and Lee 1990).

The power of environmental non-governmental organizations (ENGOs) and First Nations (called "the Tribes" in Washington State) had grown dramatically throughout the 1970s and 1980s. Several key court cases – particularly the "Boldt decision" (*United States v. Washington State* 1974) and its implications for Tribal rights to protect habitat ("Boldt Phase II") – confirmed this shift (Singleton 1998, Pinkerton 1992, Cohen 1986). Based on interpretation of treaties signed in the late 1850s, the 1974 Boldt decision secured Tribal rights to harvest 50% of the fish in the state and to co-manage the state fisheries with government agencies. This decision also acted as a catalyst for broad changes in the capacity of the Tribes to assert themselves in many other issues:

> No one is suggesting that the Boldt decision has solved all the problems in Indian country, but the opportunities created directly or indirectly from the legally-secured right to fish are the difference between staying and leaving for many young Indian families. Today, when young Indians leave the reservation for college or to learn a skill, most intend to return and use their knowledge close to home. (Andy Fernando in Introduction to Cohen 1986: xxv)

Furthermore, while "Boldt Phase II" never reached a definitive court decision, its outcome nonetheless indicated that, given an appropriate "test case," the Tribes might also gain full legal rights to protect the *habitat* of the fish they harvest (Pinkerton 1992). That is, among other land uses, forest practices that posed a risk to salmon habitat in streams and estuaries were vulnerable to legal action by the Tribes. Thus, by the mid-1980s, none of the non-governmental parties – land-owning timber companies, the Tribes, and ENGOs – could predict the future success of their lobbying strategies and court actions. Enormous sums of money were being spent on court cases to pursue the demands shown in Table 2, yet the returns on these investments were small for all parties.

TFW charted a way out of this crisis by bringing the non-governmental and state parties together in a policy structure that was dramatically different from the 1974 Forest Practices Act (State of Washington 1974 [RCW 76.09]). Six months of negotiations produced a ground-breaking consensus agreement among the parties. Several important new forest practices rules were agreed, such as minimum riparian forest buffers on fish-bearing streams and a mandatory review process for activities on potentially unstable slopes. However, the major achievement of TFW was to establish a *cooperative process* for ongoing resolution of management questions and conflicts. The shift also incorporated a symbolic dimension, as two visionary leaders – Billy Frank of the Northwest Indian Fisheries Commission (NWIFC) and Stu Bledsoe of the timber companies' Washington Forest Protection Association (WFPA) – publicly embraced a slogan of "going where the truth leads us." The parties explicitly disavowed political strategies:

> This agreement describes an historic shift in the way we manage natural resources, resolve problems and make changes in our future management . . . . It is the culmination of nearly six months of intense, difficult work. It represents the knowledge, hopes and aspiration of a group of dedicated men and women who decided to try a new way. They chose to resolve their differences through education, negotiation and respect for each other's views. (TFW 1987: 2)

"Respect for each other's views" included collectively embracing five broad goals:

> The *wildlife resource goal* is to provide the greatest diversity of habitats (particularly riparian, wetlands and old growth), and to assure the greatest diversity of species within those habitats for the survival and reproduction of enough individuals to maintain the native wildlife of Washington forest lands.
>
> The *fishery resource goals* are long-term habitat productivity for natural and wild fish, and the protection of hatchery water supplies.
>
> The *water quantity and quality goals* are protection of water needs of people, fish and wildlife.
>
> The *archeological and cultural goals* are to develop a process to inventory archaeological/cultural spaces in managed forests; and to inventory, evaluate, preserve and protect traditional cultural and archeological spaces and assure tribal access.
>
> The *timber resource goal* is the continued growth and development of the State's forest products industry which has a vital stake in the long-term productivity of both the public and private forest land base. (TFW 1987: 3; emphases mine)

Thus, TFW represents a major achievement in formal construction of new shared values and beliefs. Perhaps most fundamentally, the parties embraced the notion that competing goals can be reconciled by developing new formal cooperative institutions. Of course, the groups continued to differ in their *in*formal prioritization of the goals (Table 2).

Formally, the TFW management process initiated in 1987 was open to participation by any party having sufficient resources and organization to do so. The agreement included provisions to improve the technical capacity and access to information of the Tribes and ENGOs. The Tribes also obtained substantial funding from federal Congress to implement TFW ($6 million in 1987-1990; Halbert and Lee 1990). Regional ENGOs raised rather less funding to support their participation in TFW – about $750,000 in grants for 1987-1989, almost two-thirds of which was in-kind contributions (Halbert and Lee 1990). The effects of funding disparities on social learning in the case are potentially profound. In addition, several observers have questioned the de facto exclusion of parties such as labor organizations, tourism operators, county agencies, and the general public (Flynn and Gunton 1996, Halbert and Lee 1990, Fraidenburg 1989).

Table 2. TFW participants and their demands.
Derived from Halbert and Lee (1990). In addition to the demands specified here, all non-governmental parties sought to increase their power to influence decisions.

PARTICIPANTS	DEMANDS
Tribes	• protect fish habitat • conserve cultural resources
ENGOs	• protect old growth forests • regulate harvest in unprotected areas • address basin-scale cumulative effects of logging • protect critical wildlife habitat
Timber Companies	• ensure regulatory stability • ensure operational flexibility • improve public image • ensure timber viability
Washington State Agencies (led by Department of Natural Resources)	• enforce existing forest practices laws • encourage a non-conflictual climate • clearly distinguish regulatory role from proprietary role on state-owned lands

5.2. A multiplicity of arenas

The TFW agreement explicitly recognizes that understandings of forest and stream ecosystems are very uncertain. The agreement assumes that conflict will be reduced and resource outcomes will be improved through consensus-based cooperative development of new understandings according to high standards of scientific research (TFW 1987: 4).

In order to implement this strategy, the TFW participants rapidly developed a wide range of arenas in which they interacted to develop policy-relevant scientific information (Figure 5). Participants mixed freely in a "TFW community." Few of the new arenas, including the main TFW Policy Group, held formal decision-making authority. Rather, the promise of the processes lay in the power of broad and organized consensus to promote specific proposals submitted to the state rule-making authority, the Forest Practices Board (FPB). Key arenas of interaction included the following. Appendix D provides a more complete diagram of the *formal* structure as of 1990 (prior to Watershed Analysis):

- **TFW Policy Group**: Directed TFW activities through strategic planning and funding allocations, and developed consensus recommendations to the FPB about new forest practices rules.
- **Cooperative Monitoring, Evaluation, and Research Committee** (CMER): Provided scientific research and technical support services under the direction of TFW Policy. Recommended research priorities and identified impacts of existing or proposed forest practices.
- **Interdisciplinary Teams** (ID teams): Called on an ad-hoc basis by the Department of Natural Resources (DNR), often at the request of other parties, as part of the state permitting process for forest practices on potentially sensitive sites. Technical specialists or other representatives of local parties met in the field to evaluate site conditions and negotiate recommendations to DNR foresters about protective measures. While TFW Policy handled state-wide, longer-term policy questions, the ID teams handled site-specific, short-term operational management questions. Both are consensus-based and without direct formal authority to make rules or conditions on permits.
- **Watershed Analysis** program (from 1992): Convened interested local parties on a watershed-by-watershed basis to carry out data collection, watershed process modeling, and basin-specific rule making on a consensus basis. Thus, three scales of consensus policy-

making existed within TFW by 1992 – the state-wide scale (TFW Policy), the watershed scale (Watershed Analysis), and the site scale (ID teams). Watershed Analysis is the focus of this study and is described further in Section 6.

- **Annual TFW reviews**, where policy and technical people performed joint assessments of progress. The process was relatively informal and short-lived. These annual reviews received almost no mention in the participant interviews for this study.
- **Regular networking events**, including monthly regional "TFW Breakfasts" and annual state-wide "Watershed Stampedes": Facilitated informal information-sharing and relationship-building.
- **Ad-hoc state-level arenas**: Addressed specific emerging issues. For example, lawsuits forced initiation of the Sustainable Forestry Roundtable (SFR) in 1989 (see Section 6.1). More recently, negotiations towards the *Forests and Fish Report* (FFR) redesigned the entire state forest policy system (see Section 7.4.6).

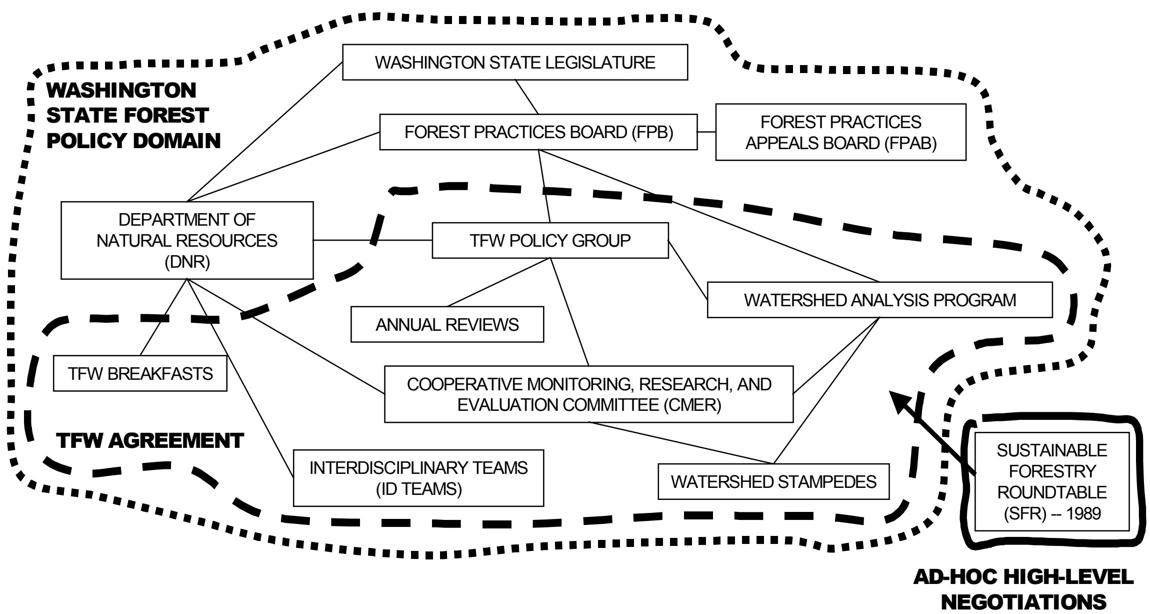

Figure 5. The TFW agreement in the Washington State forest policy domain.
Author's figure. Forest policy was influenced by a wide range of cooperative arenas of varying degrees of formality. This figure shows the major formal and semi-formal arenas in the case. Other formal bodies and instruments existed (Appendix D), but had little influence and are not cited in this study. Directive and feedback linkages among the arenas were many and complex – this figure shows only the most basic formal linkages. Complexities are treated in Sections 7 and 8.

5.3. Adaptive management and Watershed Analysis

5.3.1. Adaptive management in early TFW

Dovers and Mobbs (1997) emphasize the unique importance of adaptive management in the theory and practice of science-based environmental policy: "Crucially, *it is the only approach to policy and management where ecology has played and is playing a core role* [italics in original]." As a science-based policy process, all major TFW-era policy documents include commitments to implement adaptive management mechanisms (TFW 1987: 7, WFPB 1992 [WAC 222-22-010], USFWS et al. 1999: 62). However, early implementation of adaptive management relied largely on informal and ad hoc mechanisms. As noted above, linkages among TFW arenas and formal forest policy-making was usually advisory. In fact, before 1997 the "TFW program" did not even have a dedicated phone number or address. Many observers doubted the effectiveness of such an informal system (Flynn and Gunton 1996, Halbert 1993, Lee 1993). The policy feedback functions – linkages between ID teams and DNR, and between TFW Policy and FPB – were especially unclear.

5.3.2. Adaptive management in the Watershed Analysis program

Against the background of this early TFW history, the Watershed Analysis program, fully operational by 1992, constitutes a major attempt to implement adaptive management in a more thoroughly and formally specified process of ecological assessment and forest practices rule-making (WFPB 1993: vi-vii, WFPB 1992 [WAC 222-22-010]). Substantively, the program addressed the potential for forest practices throughout a watershed and over time to produce cumulative effects on fish populations, water quality, and public capital developments (WFPB 1992 [WAC 222-22-010(1)]). The standard Watershed Analysis procedures were described in a technical manual (the "Standard Methodology") of about 365 pages (WFPB 1993), and these procedures were supported by state legislation (WFPB 1992 [WAC 222-22]). The scale of implementation was the "watershed administrative unit" (WAU), of which there are about 800 in the state measuring between 19 square miles and 77 square miles (50 km^2 and 200 km^2). Watershed Analysis teams produced watershed-specific "prescriptions," and these prescriptions were processed and approved by DNR as binding rules for the WAU.

Because our understandings of cumulative watershed effects include a high level of uncertainty (Dunne et al. 2001, Benda et al. 1998, Reid 1998, Everest et al. 1987), continual re-evaluation and adjustment of WAU prescriptions and the Standard Methodology was an obvious policy need. However, while some adaptive management functions (Figure 1) received quite detailed specification in the Standard Methodology (e.g., system modeling), the policy feedback functions were weakly specified (Sibley and Bolton 1999, Collins and Pess 1997, Sullivan et al. 1997). Among other topics, Sections 7 and 8 investigate the effects of this apparent "underformalization" of policy feedback structures.

6. THE FORMAL WATERSHED ANALYSIS PROGRAM

6.1. Origins and development of the Watershed Analysis Program

It is through political and legal action that cumulative watershed effects gained priority on the state forest practices regulation agenda. The process immediately precipitating the Watershed Analysis program is documented and analyzed in Pinkerton (1992) and Halbert and Lee (1990). Concern for cumulative effects raised doubts about whether DNR's site-by-site evaluation of Forest Practices Applications (FPAs) could adequately account for the FPAs' interactions with other activities occuring across the landscape over time. Detecting the combined impacts of multiple activities (e.g., logging and agricultural development at many different sites) on public resources (e.g., salmon spawning gravels and connectivity of old-growth wildlife habitat) requires assessment at a larger scale than the site level. While cumulative watershed effects had been on the table during the original TFW negotiations, the parties deferred this very difficult issue to later negotiations. In 1989, the "Lake Roesiger case" (*Snohomish County and Washington Environmental Council v. Washington State* 1989) reactivated the issue, as actors external to TFW – local activists and the county government – appealed a Forest Practices Application (FPA) and eventually won a court order for the Forest Practices Board (FPB) to develop state-wide rules addressing the cumulative effects at issue (Pinkerton 1992). The FPB delegated this task, along with several other urgent questions, to the "Sustainable Forestry Roundtable" (SFR). SFR convened the TFW parties, counties, and several new ENGOs, meeting several times throughout 1989-1990.

SFR considered many innovative options for a cumulative effects rule package, yet final agreement was elusive. Eventually, the cumulative effects issue returned to the FPB, which struck a committee to further develop the options generated to date (Pinkerton 1992). This committee in turn brought in the expertise of TFW's Co-operative Monitoring, Evaluation, and Research committee (CMER). After intense negotiations among the Tribes, industry, and state agencies, the 1991 Watershed Analysis rule package (WFPB 1992 [WAC 222-22]) was promulgated. About one year later, the FPB adopted the Watershed Analysis Standard Methodology (WFPB 1992).

The Watershed Analysis Standard Methodology took its specific form through a history of technical and scientific developments that paralleled the political and legal processes just described. In the mid- to late 1980s, several timber companies prototyped watershed assessment approaches for mass wasting hazards. The triggers for these various prototypes were either (1) the threat of lawsuits in the event of damage to private property or (2) the threat of Tribal appeal and consequent delay of forest practices applications (FPAs), based on likely damage to the fish values secured by the Boldt decision (Section 5.1). The development and success of such assessments as a tool for (preventive) conflict resolution appears to have arisen more or less at the same time in the minds of several key visionaries on both the Tribal and the industry sides.

Following these examples, CMER held a workshop called "basin analysis" in 1989 and commissioned several papers by top watershed scientists to develop the conceptual framework and specific methods of Watershed Analysis (Benda and Rodgers-Miller 1991, Dunne et al. 1991). However, one person in particular is universally credited with translating these early innovations into a viable tool for addressing current or potential forest policy conflicts. This was a geomorphologist working for one of the largest timber companies in the state. Using both personal charisma and access to the resources of a large private company, this visionary wielded enormous influence over the social processes that developed Watershed Analysis.

Thus, the Watershed Analysis program developed by both political and rational paths. The scope of the program was limited due to (1) the historical sequence of ideas that arose in response to specific political and legal events, and (2) explorations and extensions of the current state of watershed science through a "conversation" among multiple disciplines, multiple levels of authority, and multiple stakeholders. The following sections summarize the formal program structure.

6.2. Program incentives to collaborate

Formally, Watershed Analysis was a voluntary program. Neither participation in the process nor compliance with the prescriptions was required in order for companies to receive permits to operate on state and private lands. However, several formally guaranteed incentives ensured the program's high priority for parties' full participation and compliance.

First, the program promised considerable gains for timber companies in the efficiency of DNR's forest practices permitting process. Without Watershed Analysis, applications to operate on potentially sensitive sites were (1) subject to cooperative field assessment by ID teams and (2) at risk of a permit appeal by the local Tribe or other stakeholders. Delays could cost over

$100,000 per appeal,[8] and in many regions ID teams were highly uncertain as a path to conflict resolution:

> Once you do Watershed Analysis, there's more predictability . . . instead of having to take a little bit of a roll of the dice each time you put in an application. . . . [because] ID teams . . . just ended up in conflict. (former Tribal scientist)

In contrast, in WAUs where Watershed Analysis was completed, FPAs were exempt from site-level assessment and concomitant delays so long as they complied with the Watershed Analysis prescriptions (WFPB 1992 [WAC 222-22-090(1)(d)]). In addition, Watershed Analysis would provide better information about a specific site's relationship to watershed-scale processes. As noted in Section 5, the TFW agreement assumed that improved scientific information would reduce conflict and avoid appeals.

Second, while landowners were free to develop alternatives to the Watershed Analysis prescriptions, the alternatives would be both costly to develop and uncertain to be approved. Meanwhile, either DNR or any landowner with more than 10% ownership in the WAU was authorized to initiate a Watershed Analysis. There was a strong incentive to initiate a process or, if another party initiated it, to participate fully.

6.3. Watershed Analysis: the Standard Methodology

The most comprehensive and detailed formal description of the Watershed Analysis program is the CMER-designed and FPB-approved Standard Methodology manual (under continual revision in the mid-90s; my analysis relies mainly on two versions – WFPB 1997, 1993 – though I have reviewed all other versions). The most recent version of this manual is available online at <http://www.wa.gov/dnr/htdocs/forestpractices/watershedanalysis/> (accessed September 23, 2003). Montgomery et al. (1995) provide a good overview of this material and its scientific rationale. Still more briefly, I summarize the Watershed Analysis process below and in Figure 6. In subheadings I note each phase's correspondence with the adaptive management functions in Figure 1. I take up the policy feedback functions that are the focus of this study in Section 7.

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[8] 1/1; 1 industry scientist. See Section 4.7 for an explanation of this and following "confidence fractions."

6.3.1. Start-up (problem definition)

As with all TFW arenas, Watershed Analysis was formally open to full participation by any local stakeholders with sufficient resources and training. The Standard Methodology included formal educational and experience standards for technical analysts – for example, "channel module" analysts were required to have at least a Bachelor's degree, with specific course work in fluvial geomorphology, and at least two years of field or research experience in channel assessment or fluvial geomorphology. In addition, DNR provided mandatory training specific to the program. These provisions promised some certainty of product quality.

Usually the main limitation on participation, then, was a group's funding and human resources.[9] In practice, levels of participation varied widely across organizations and regions. Large and mid-size timber companies and DNR almost always participated in all phases. Tribes usually participated, but they were limited in resources. Due to severe scarcity of resources, ENGOs seldom participated. The Standard Methodology includes a vaguely described "start-up" phase, where WAU-specific participants and special issues could enter the process.

Watershed Analysis did not assess potential impacts to non-fish wildlife or cultural resources – thus neglecting two of the TFW Agreement goals (Section 5.1). In addition, only a subset of all watershed processes is included in the assessment phase. The most commonly heard justifications for these limitations are (1) to bound the analysis at a tractable scope[10] (Montgomery et al. 1995) and (2) that existing long-standing cultural traditions and high-level policy or legal precedents provided no basis for wildlife habitat protection as clear as the basis for Tribal rights to fish habitat or the public's rights to acceptable water quality.[11] However, many participants contend that if such important elements of TFW are excluded from the analysis, then timber companies should not be exempted from further site-level assessments for environmental impacts (as described in Section 6.2).[12,13] Certainly it has always been clear that the Watershed

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[9] 13/17; 1 ENGO field staff, 2 Tribal scientists, 5 industry scientists, 3 DNR field staff, 1 industry scientist-consultant, 1 industry lawyer.
[10] 6/16; 1 Tribal scientist, 1 Tribal policy worker, 1 industry scientist, 1 industry lawyer, 1 industry scientist, 1 industry scientist-consultant.
[11] 6/16; 1 Tribal scientist, 1 DFW scientist, 1 industry scientist, 1 industry policy worker, 1 DNR policy, 1 industry scientist-consultant.
[12] 5/16; 1 ENGO lawyer, 1 ENGO policy worker, 1 other ENGO, 2 Tribal policy workers.

Analysis program is far from comprehensive in scope. Yet the dominant argument was for making progress on certain issues supported by court decision and for making a start at thinking in a more holistic way about these and other issues.

The start-up phase was intended (1) to ensure proper coordination of the various module analyses and (2) to provide opportunity for participants to refine the problem definition elements of the Standard Methodology. Occasionally, important additional analyses were proposed at this stage (see the ENGO role in "WAU A," Section 7.4.2.1), but usually the coordination and identification of participants were the focus of start-up.

6.3.2. Assessment (system modeling)

The assessment phase is organized in seven (later eight) modules. These technical modules provide much more detailed procedures than any other part of the Standard Methodology, constituting about 270 of the 1993 manual's 365 pages. Four modules evaluate watershed **processes** – mass wasting, surface erosion, hydrologic change, and riparian function. The riparian function module includes assessment of both (1) the effect of tree cover on stream temperatures and (2) large woody debris (LWD) recruitment to streams. The remaining modules evaluate the **vulnerabilities** of specific resources – the stream channel, fish habitat, public works/water supply, and, from 1996, water quality – to impacts from change in the watershed processes caused by forest practices.

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[13]In fact, impacts on wildlife are not only part of the TFW agreement, but also the 1984 State Environmental Policy Act (State of Washington 1984 [SEPA; RCW 43.21C]) that regulates forest practices assessments in the absence of a completed Watershed Analysis. Thus, some claim that completing Watershed Analyses gave timber companies a "free ride" on many key issues. On the other side of the debate, some participants note that many common prescriptions for protection of fish habitat, such as riparian forest buffer strips, provide significant "incidental" benefits to many terrestrial species. CMER literature reviews and field studies support this statement in general, although many questions remain about coverage of species (O'Connell et al. 2000, O'Connell et al. 1993). Other state policy initiatives attempted to address wildlife impacts during the 1990s, including CMER's draft "wildlife module" for Watershed Analysis and several pilot "landowner landscape plans" at a larger scale. In addition, the listings of wildlife such as the spotted owl (*Strix occidentalis*) and marbled murrelet (*Brachyramphus marmoratus*) under the federal Endangered Species Act have required private and state forest owners to protect some areas of old-growth and late-seral forest. However, none of these initiatives produced any state-wide policy for conservation of a wide range of wildlife species on forest lands.

The modules were conducted by formally qualified scientists. In some cases, the analysts were drawn from a number of local parties (often the Tribes) and government agencies. In other cases, the assessment team was almost entirely sourced from a single dominant landowner.

6.3.3. Synthesis (system modeling, identifying key uncertainties)

In the synthesis phase, the module analysts present their findings to each other and collaborate in a multi-disciplinary, semi-quantitative model of the basin (a "watershed story" [WFPB 1993: 29]). A "routing module" aids the analysts in describing material and energy flows among changeable processes and vulnerable resources. Table 3 is used to determine "rule calls" – broad qualitative management objectives for "areas of resource concern." A standard-format Causal Mechanism Report, summarizing rule calls and relevant supporting analyses, provides the primary guidance to managers in the prescription phase.

6.3.4. Prescriptions (management experiment)

For each Causal Mechanism Report, the prescription team develops area-specific rules by consensus. The prescription team includes multi-disciplinary forest management professionals, as well as some local stakeholders in either a full or an observer capacity. Operational and field representatives of DNR and major landowners usually play a strong role in this phase, but the team is encouraged to include representatives of all relevant landowners, state agencies, First Nations, ENGOs and other interested parties. The threat of appeals and court cases generally served to keep the process open to parties who could fund an appropriately qualified representative.

Watershed Analysis prescriptions are forest practices rules designed to prevent, avoid, or minimize threats to vulnerable resources identified in the assessment modules and any other analyses added during the start-up phase. Road building might be banned in areas of high mass wasting hazards. Partially cut or untouched forest buffers might be established to maintain acceptable stream temperature and to supply LWD to streams. Timber companies might be required to assess the entire road network and fix problem areas (e.g., surface erosion sites or blocked culverts) within a defined time period. The hydrologic change module seldom resulted in prescriptions (Collins and Pess 1997b, Sullivan et al. 1997).

6.3.5. Wrap-up

Following the prescription phase, the WAU coordinator assembles a standard-format report, including all maps, analyses, and decision documents. DNR coordinates a review of the report by local landowners, Tribes, ENGOs, and other interest groups. The report is also opened to public review under the provisions of the State Environmental Policy Act (State of Washington 1984 [RCW 43.21C]). Based on the results of these review processes and in ongoing consultation with the WAU participants, DNR revises, rejects, or approves the report and prescriptions contained therein. The TFW participants and DNR then use the report to regulate and provide an informational context for reviewing all site-level forest practices applications (FPAs) on state and private lands in the WAU.

6.3.6. Monitoring (monitoring)

In the early 1990s, there was consensus in the TFW community that Watershed Analysis prescriptions should be monitored for their effectiveness in meeting objectives. However, resources to implement monitoring were scant. Therefore, cooperative monitoring activities were made optional. A monitoring module (only 7 of 365 pages in WFPB 1993) and technical support from CMER (Schuett-Hames et al. 1999b, Schuett-Hames and Pleus 1996) were available to assist the design and implementation of monitoring plans.

Throughout the 1990s, almost no rigorous monitoring of Watershed Analysis prescriptions occurred, and most participants consider this a major failing of the program (Collins and Pess 1997, Sullivan et al. 1997).[14]

6.3.7. Five-year review (evaluation and policy adjustment)

The Standard Methodology and state legislation require review of each WAU's condition and the effectiveness of its prescriptions every five years or less. The five-year review procedures are part of the formal structure for policy feedback functions (evaluation and policy

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[14] 10/14; 1 ENGO lawyer, 1 ENGO policy worker, 1 ENGO other, 1 Tribal scientist, 1 industry scientist-consultant, 4 industry scientists, 1 other scientist

adjustment), which are the focus of this study. I examine the policy feedback structures of Watershed Analysis in Sections 7 and 8.

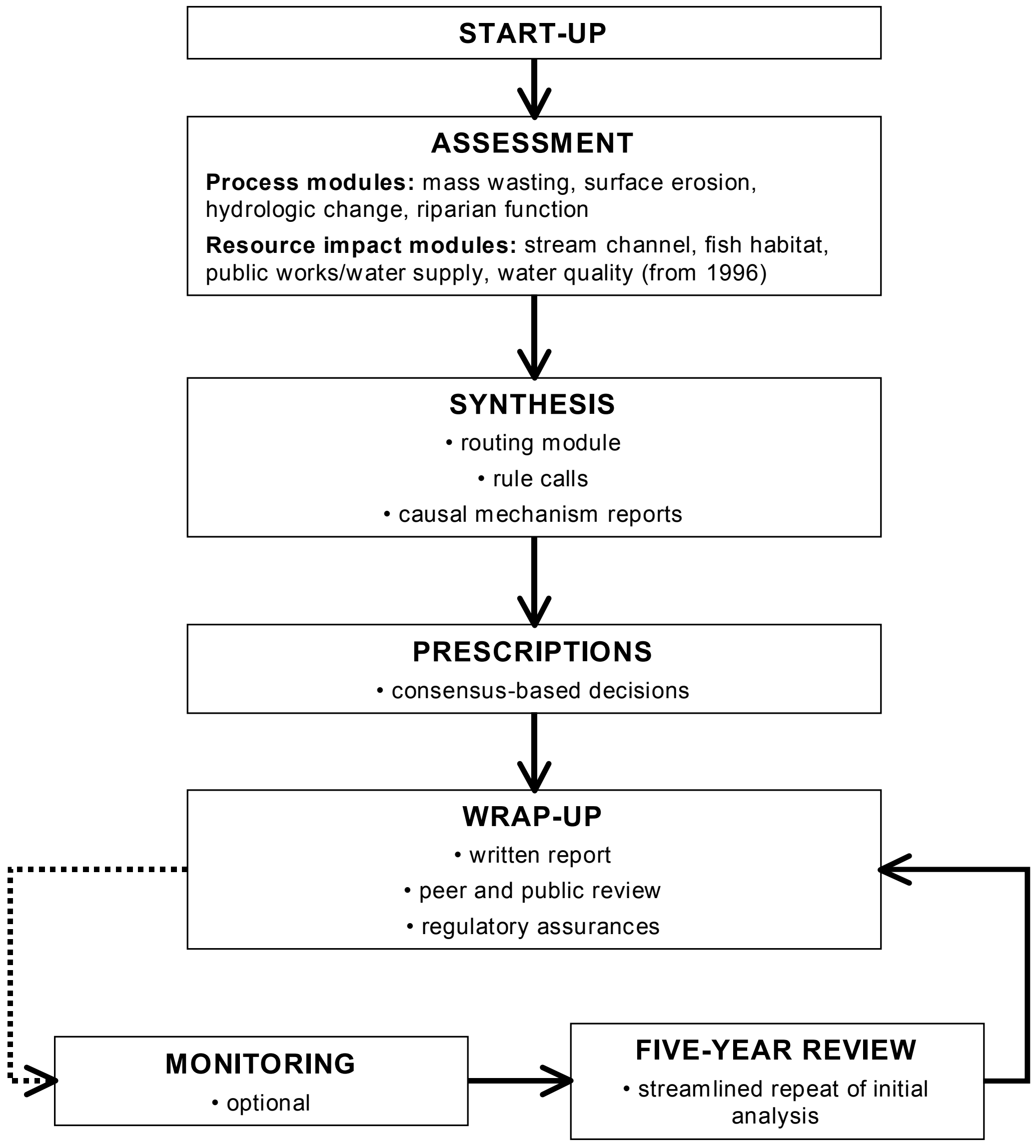

Figure 6. The formal Watershed Analysis process.
Author's figure derived from WFPB (1993). Because the monitoring phase was optional, the link with prescriptions is a broken line.

Table 3. Areas of resource sensitivity and management response (the "rule calls"). Reproduced by permission: WFPB 1992 (WAC 222-22). "Standard rules" means the assessment team believes that the standard state-wide forest practices rules, existing outside the Watershed Analysis program and based on the Forest Practices Act and ongoing revisions thereof, are adequate to protect resources of concern. "Minimize impacts" and "prevent or avoid impacts" indicate that the standard rules are inadequate and need to be replaced by area-specific rules.

		LIKELIHOOD OF ADVERSE CHANGE AND DELIVERABILITY		
VULNERABILITY		**Low**	**Medium**	**High**
	Low	Standard rules	Standard rules	Prevent or avoid impacts
	Medium	Standard rules	Minimize impacts	Prevent or avoid impacts
	High	Standard rules	Prevent or avoid impacts	Prevent or avoid impacts

7. FORMAL AND INFORMAL STRUCTURES AND OUTCOMES OF POLICY FEEDBACK IN WATERSHED ANALYSIS

This section describes the structure and outcomes of the policy feedback functions relevant to Watershed Analysis, using the framework described in Section 4.3. I analyze how lessons learned from implementing the Watershed Analysis program were incorporated in new policies and other social structures, both formal and informal. Figures 7 and 8 summarize this information.

7.1. Formal structure of evaluation (what was supposed to happen)

7.1.1. Low level: WAU five-year reviews

The state Watershed Analysis legislation includes the following vaguely worded requirement for a "five-year review" (Figure 6). The five-year review process repeats Watershed Analysis procedures for a fraction of the total WAU area. This is the main formal mechanism for policy evaluation in Watershed Analysis:

> Where the condition of resource characteristics in a WAU are fair or poor, the department [DNR] shall evaluate the effectiveness of the prescriptions applied under this chapter to the WAU in providing for the protection and recovery of the resource characteristic. If the department finds that the prescriptions are not providing for such protection and recovery over a period of 3 years, the department shall repeat the watershed analysis in the WAU. Aside from the foregoing, once a watershed analysis is completed on a WAU, it shall be revised in whole or in part upon the earliest of the following to occur:
>
> (a) Five years after the date the watershed analysis is final, if necessary;
>
> (b) The occurrence of a natural disaster having a material adverse effect on the resource characteristics of the WAU;
>
> (c) Deterioration in the condition of a resource characteristic in the WAU measured over a 12-month period or no improvement in a resource characteristic in fair or poor condition in the WAU measured over a 12-month period unless the department determines, in cooperation with the departments of ecology, wildlife, and fisheries, affected Indian tribes, forest land owners, and the public, that a longer period is reasonably necessary to allow the prescriptions selected to produce improvement; or
>
> (d) The request of an owner of forest land in the WAU which wishes to conduct a watershed analysis at its own expense.

> Revision of an approved watershed analysis shall be conducted in accordance with the processes, methods, and standards set forth in this chapter [i.e. the entire Watershed Analysis rule, WFPB 1992 (WAC 222-22)], except that the revised watershed analysis shall be conducted only on the areas affected in the case of revisions under (b) or (c) of this subsection, and may be conducted on areas smaller than the entire WAU in the case of revisions under (a) and (d) of this subsection. The areas on which the watershed analysis revision is to be conducted shall be determined by the department and clearly delineated on a map before beginning the assessment revision. Forest practices shall be conditioned under the current watershed analysis pending completion of any revisions. (WFPB 1992 [WAC 222-22-090(4)])

The Standard Methodology (WFPB 1997, 1993) adds no further guidance for evaluating prescriptions and policies. While the five-year review requirement appears to assume formal effectiveness monitoring in intervening years (Schuett-Hames and Pleus 1996), the monitoring function itself and its status relative to other sources of policy-relevant information remains almost completely unspecified (Section 6.3).

7.1.2. Reference level: evaluating the Standard Methodology

Although the Standard Methodology makes no mention of the five-year review process, it does refer briefly to a higher-level evaluation arena, the Cooperative Monitoring, Evaluation, and Research Committee (CMER):

> To date, the reliability of the procedures provided in the manual have [sic] not been determined. It is the hope that the CMER research program will provide improved scientific knowledge so that gaps can be bridged, eventually leading to more balanced but simultaneously reliable decisions (WFPB 1993: 23).

This role of CMER receives little more formal structure than the above passage. The state legislation (WFPB 1992 [WAC 222-22]) is silent about CMER as an evaluation arena for the Watershed Analysis program.

Thus, two formal arenas for evaluating new information in the Watershed Analysis program address two different levels of rules, encouraging both single-loop and double-loop learning (Figure 7). The five-year review evaluates the effectiveness of *watershed-specific prescriptions*, while CMER evaluates the effectiveness of the *larger program structure that produces the prescriptions*. The five-year review is moderately well-specified by a passage in the legislation, a timeline, and a reference to adaptations of the Standard Methodology. In contrast, the formal CMER process for revising the Standard Methodology consists only of commitments to do so.

Of course, the mere reference to CMER in the quote above constitutes reference to the formal structure of that body in its *full* scope of activity (Section 5.2), and so the formal TFW "ground rules" for decision-making (Appendix C) apply here. In addition, CMER included a "Cumulative Effects Steering Committee" (CESC) that had taken the lead in developing the first versions of the Standard Methodology. The CESC received approximately $0.2 million out of CMER's $2.7 million budget in the 1991-1993 biennium, but it appears to have received no funding at all in subsequent years.[15] CMER planning documents also include project proposals, totaling about $1 million in the 1993-1995 biennium and $1.8 million in the 1995-1997 biennium[16] for monitoring, basic research, and literature reviews not specifically aimed at the Watershed Analysis program but which might indirectly suggest revisions to the Standard Methodology (e.g., TFW 1993, TFW 1991). However, no detailed protocols for linking this research to revisions of the Watershed Analysis program were specified.

7.1.3. High level: state-wide rules

Changes to rules at a level above the Standard Methodology would depend on action by TFW Policy and the Forest Practices Board (FPB). These bodies developed the constraints within which the Standard Methodology and CMER operated – for example, the TFW agreement and its ground rules (Figure 7). This policy feedback structure is not described in specific relation to Watershed Analysis anywhere in the formal documentation. Even the roles of TFW Policy and CMER in relation to state-level rule-making *in general* are specified weakly in the original TFW agreement and successive planning documents (Flynn and Gunton 1996, Halbert 1993). The TFW participants expected that inclusive consensus recommendations would carry an *inherent* power to influence the Forest Practices Board. This expectation of informally ensured influence over high-level policy was supported by policy feedback successes of the early TFW period (prior to 1992). CMER scientists had in fact played an important role in developing both the state Watershed Analysis legislation and the Standard Methodology (Section 6.1).

[15] CMER meeting minutes, April 21, 1992, December 16, 1994, and June 30, 1997.
[16] CMER meeting minutes, December 16, 1994, and September 21, 1995.

To encourage both informal and formal improvements in Watershed Analysis, CMER supplemented its usual meetings with an annual "Watershed Stampede," a networking arena where participants could socialize and hear presentations ranging from the technical to the whimsical. While the Watershed Stampede began as a very informal gathering of the familiar TFW community, over time it grew to include many new technical consultants and to focus increasingly on analyst training.[17] No formal linkages existed between Watershed Stampedes and policy adjustment arenas.

7.2. *Evaluation outcomes (what actually happened)*

7.2.1. Ad-hoc and informal arenas

In order to understand the actual outcomes for policy feedback in Watershed Analysis, we also need to understand the many ad-hoc and informal evaluation arenas that played a role in policy feedback.

As discussed in Section 6.2, completing and adhering to Watershed Analysis prescriptions exempted timber companies from certain DNR permitting procedures at the site level. However, in many completed WAUs the ad-hoc "interdisciplinary team" (ID team – Section 5.2) continued to be used as an arena for scientists, stakeholders, and managers to interpret prescriptions in light of new information about either the site itself or the watershed context.

> If it needed some further review, we'd use the ID team process, just like we do for any of the permanent [standard] rules. . . . You always have some interesting, challenging conversations when you do an ID team. . . . What you learn through Watershed Analysis helps you in ID teams. The new and current science you pick up in ID teams. You pick up lots of little pieces that you wouldn't find out about otherwise. (DNR field staff)

Another relevant arena dating from before 1992 and never explicitly linked to the Watershed Analysis program is the "TFW Breakfast." This event, occurring as frequently as every month in some areas, had a purpose similar to the Watershed Stampedes, although rules interpretation and

[17] 2/2; 2 industry scientists.

enforcement presentations tended to replace the scientific presentations. DNR organized TFW Breakfasts on a regional basis (incorporating dozens of WAUs), and the event generally included a higher proportion of local managers and other local stakeholders – a "local/operational" network whose members included only a small number of the Watershed Stampede's scientist-policy worker network. Like Watershed Stampedes, TFW Breakfasts had no clear linkages to policy adjustments at any level, and assessing these arenas' informal influence on policy adjustments is difficult. Yet both of these arenas typify the special character of the Washington State forest policy domain.

Thus, a wealth of arenas existed at a wide range of scales for TFW participants to communicate and assess the management significance of new information. Some of these arenas (the five-year review and CMER) were formally identified as feedback linkages to the Watershed Analysis program. Other arenas were linked to Watershed Analysis only on an ad-hoc or informal basis.

The new information passing along these various pathways might arise from personal experience in implementing Watershed Analysis, or it might arise from other research and operational activitites. Watershed Analysis, as a multi-scale, cooperative, interdisciplinary program, could be improved in one way or another through the influence of any of these sources. As Section 7.4 documents, the Watershed Analysis program did indeed improve over time. However, it is difficult to determine the *relative importance* of these various arenas in triggering improvement.

7.2.2. Dissatisfaction with evaluation arenas

In the opinion of many, the lack of transparent information standards and clear (formal and mandatory) linkages to the actual activity of adjusting policies and prescriptions is a major weakness of the arenas discussed above (Sibley and Bolton 1999, Collins and Pess 1997a, Flynn and Gunton 1996, Halbert 1993, Lee 1993).[18] Even the most fully specified and mandatory arena, the five-year reviews, failed to meet expectations: According to DNR reports, only eight reviews

[18] 9/21; 2 DFW scientists, 1 Tribal policy worker, 2 industry scientist-consultants, 2 Tribal scientists, 1 other scientist, 1 DNR policy worker.

commenced and only one was completed between 1993 and 2001 (WDNR 2001).[19] During the same period, twenty-five WAUs passed their five-year deadline. Five-year reviews suffered from two problems: (1) The parties' resources simply were not sufficient to implement the reviews while continuing to initiate new WAUs, and (2) unless a major storm or other major disturbance occurs, many watershed components are unlikely to show detectable change within five years. However, it is also likely that more five-year reviews would have been completed if the various conflicts discussed elsewhere in this report had not arisen in 1996-1997 and caused the Watershed Analysis program to be suspended (Section 7.4.6).

> We put a lot of effort, a lot of time into it . . . and then in five years you've got to do it all over again! . . . for riparian stuff it might be a long time before we get real answers because it takes a lot for trees to grow. For landslides it might be a function of storm events . . . and culverts it's the same thing. So the time intervals would vary. Of course, that doesn't sit very well if you're a legal person or a policy person, because it's like, "Well we need to know in three years." Well, you may not. It may take twenty-five years. (former Tribal scientist)

CMER – the most broadly active, long-lasting, and well-resourced collaborative evaluation arena – comes under criticism from participants most frequently (Collins and Pess 1997a, Lee 1993, Halbert and Lee 1990). However, in many cases criticisms nominally directed at "CMER" are in fact criticisms of TFW Policy's poor response to CMER work. CMER was designed, in the spirit of the original TFW agreement, to eschew formal rigidity in favor of mutual respect, openness to new ideas, and consensus decision-making (TFW 1991). The TFW Ground Rules (Appendix C) formed a basic agreement about how business would be conducted. There were few formal procedures for resolving persistent disputes, except to identify other bodies (such as TFW Policy) as the proper forums for such. However, over time a very real *informal* structure appears to have developed. Many participants found CMER to harbor an idiosyncratic culture, built on intensive collaborative work on innovative programs, that sometimes formed resistance to criticism and new information from outside.[20] Some scientists impugn the overall quality of CMER's self-generated scientific studies, few of which have been published in peer-reviewed

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[19] Our interviews encountered frequent claims that certain companies completed more than one five-year review. The reliability of the DNR tracking lists is certainly doubtful.
[20] 5/6; 2 Tribal scientists, 1 Tribal policy worker, 2 other scientists.

journals.[21, 22] Some Tribal scientists also claim that CMER perpetuated a "double standard" by which their work was treated much more skeptically than that of industry scientists.[23]

Furthermore, most participants believe that timber companies in fact dominated CMER decision-making by virtue of greater funding, greater technical support, and, occasionally, employee personalities.[24] Many CMER members participated on a volunteer basis, and little of this activity translated to journal publications or other ways of building outside credibility as a scientist. Over the course of the 1990s, volunteer involvement waned considerably – some due to exhaustion and some due to frustration.

> It was just so hard to change it. . . . the only people who were proponents of [making changes] were the Tribes. [ENGOs were largely absent due to scarce funding.] And you'd go to a meeting and there's eight of them and one of you. . . . And that would get tiresome, so I gave up trying to change Watershed Analysis. . . . They just have more money and bodies to throw at it. (former Tribal scientist)

7.2.3. Major evaluation product: Collins and Pess (1997a, 1997b)

Dissatisfaction with CMER led some parties to seek alternative pathways of policy feedback. The largest-looming non-CMER evaluation of the Watershed Analysis program, cited by many as a milestone in the program's demise,[25] is a pair of papers written by two scientists that worked mainly for non-industry clients (Collins and Pess 1997a, 1997b). Both scientists had been well respected on all sides as problem solvers and conscientious researchers. The papers were commissioned by an ENGO, Washington Trout, using funding from the federal U.S. Environmental Protection Agency (EPA) and several small recreationist and ENGO organizations. The papers were to function as a rigorous scientific evaluation of the first 20 completed Watershed Analyses. The claim to scientific authority was eventually bolstered by publication in a peer-reviewed journal.

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[21] CMER study reports are currently available at <http://www.nwifc.wa.gov/cmer/> (accessed September 22, 2003).
[22] 6/16; 1 industry scientist, 1 DFW scientist, 2 other scientists, 2 Tribal scientists.
[23] 2/2; 2 Tribal scientists.
[24] 9/13; 1 DFW scientist, 1 DNR policy worker, 2 ENGO policy workers, 2 Tribal scientists, 2 Tribal policy workers, 1 other scientist.
[25] 4/6; 1 Tribal scientist, 2 industry scientists, 1 industry scientist-consultant.

Collins and Pess (1997a, 1997b) noted important successes of the Watershed Analysis program but focused on a long list of failures, causing great controversy in the TFW community. Differences among TFW participants in crediting or objecting to the evaluation fall clearly along industry/Tribal-ENGO lines. Objectors (generally industry and many government agency staff) consider the papers an unbalanced attack on an innovative and still-developing program.[26] They claim that the papers' evaluative criteria, although representative of some key concepts and methods in *scientific* watershed management, do not represent the full set of standards and goals of the TFW community. Objectors also claim that the papers overlook many major though unexpected and indirectly linked achievements.[27] Some of those messier successes are described in the sections that follow.

The public nature of the Collins and Pess papers – which received some attention in large newspapers[28] – also led some participants to view them as a power play, seeking to sway public opinion and higher-level policy makers by deploying the symbolic trappings of "objective science." "Science-based" management is a fundamental symbol and strategy of the TFW agreement (Section 5). The papers were enlisted (against the explicit wish of the authors[29]) in the Alpine Lakes Protection Society's formal appeal of the Alps WAU Watershed Analysis. This event and other similar uses of the papers probably played a major role in shaping perceptions of the authors' intentions. Emotions ran high, and the authors were accused of betraying the "TFW spirit."

Collins and Pess (1997a, 1997b) base their evaluation on criteria of environmental protection only. From the perspective of scientific adaptive management, this may be a valid approach, because these are the only criteria addressed formally in the Watershed Analysis Standard Methodology. Nonetheless, this picture is incomplete. The original TFW agreement certainly included a timber industry viability goal (Section 5.1), and that goal is reiterated briefly in the Watershed Analysis legislation (WFPB 1992 [WAC 222-22-010(1)]). While environmental

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[26] 7/19; 4 industry scientists, 1 industry policy worker, 2 industry scientist-consultants.
[27] The incompleteness of the picture presented by these papers is part of the motivation for the current study of Watershed Analysis.
[28] 1/1; 1 industry scientist
[29] 2/2; 1 Tribal scientist, 1 ENGO field staff.

protection and timber viability may not be incompatible, Collins and Pess give no evidence on this issue.

Collins and Pess (1997b) also evaluate WAU-level prescriptions by comparing them to (1) the assessment data compiled in the final WAU reports and (2) relevant scientific literature. Local knowledge of operational managers and residents – local history, operational feasibility, site-specific conditions, and so on – is not examined closely as a justification for prescriptions. Justifications based on local knowledge were seldom documented in the WAU reports, and thus these arguments were unavailable for review without extensive field work. The authors acknowledge this missing information briefly and recommend that relevant local knowledge be documented (Collins and Pess 1997b: 990-992), yet the impression they leave is that the problem is relatively unimportant. Others disagree:

> You can pull up [documented] data from the Idaho batholith, but is that better than someone's ten years of field experience that's never been documented in the local area? It comes down to local knowledge, and how well those things stack up against something that's maybe more rigorous or published but coming from a different environment. So that was one thing I remember being a little bit uncomfortable with, how they critiqued it on that standpoint. (former industry scientist-consultant)

Similarly, in evaluating improvements in forest practices due to Watershed Analysis only by examining written prescriptions, Collins and Pess (1997a, 1997b) fail to acknowledge informal and ad-hoc adjustments that many participants have observed during implementation. Section 7.4.4 provides more detail on these successes.

Appendix E includes a list of Collins and Pess's main recommendations. Despite the limitations of the evaluation as noted above, the recommendations are widely supported by all sides of the debate as a critique of the Watershed Analysis program's *scientific* basis.[30] That is, Collins and Pess are accurate in pointing out that this was by no means a thoroughly science-based process. Politics, timber values, convenience, personalities, and many other non-scientific considerations pervaded the program and determined its outcomes, and this fact indeed raises many sharp questions about the program's success in meeting TFW goals.

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[30] 14/19; 3 industry scientist-consultants, 2 industry scientists, 1 ENGO field staff, 2 ENGO policy workers, 4 Tribal scientists, 1 Tribal policy worker, 1 ENGO lawyer.

Although Collins and Pess raise sharp questions about the scientific basis of the program, they do not intend to discredit the program as a whole. They do note briefly many basic successes of the program. However, because the papers dwell on a long list of scientific doubts in a program that is more accurately described as a science/policy interface, many TFW participants have reacted only to the criticisms. They respond to the criticisms by pointing out that the papers tell only a part of the story of this complex program. The debate provoked strong emotions, and some apparently simple messages about the program came to represent a larger history of trust and suspicion, hope and frustration.

7.2.4. Major evaluation product: CMER review (Sullivan et al. 1997)

At about the same time that Collins and Pess were developing their evaluation,[31] CMER initiated its own review of the Watershed Analysis program (Sullivan et al. 1997). Funding was allocated through the cooperative process of CMER, but it originated with the timber companies' organization for policy coordination, the Washington Forest Protection Association (WFPA). A key force triggering the evaluation was the TFW community's collective experience in implementation, which had proven costly, slow, and vulnerable to heated and prolonged impasse ("train wrecks") in the consensus prescriptions process (Sections 7.4.2.2 and 7.4.3).

While the CMER review cites Collins and Pess (1997a, 1997b) on several issues, it is unclear to what degree the Collins and Pess articles triggered and informed the CMER review. CMER's conclusions regarding the use of science in Watershed Analysis are very similar to those of Collins and Pess. Yet the CMER review casts a wider net, looking at scientific questions in less detail and relying mainly on participant surveys and focus groups to develop a more complete picture of the program's outcomes. The CMER review also evaluates a longer time period than Collins and Pess, examining 39 WAU reports (1992-1996) while Collins and Pess reviewed 20 (1992-1995). This picture is somewhat more optimistic, describing many informal and non-scientific successes. However, the list of failures is again quite long.

One reason for the somewhat more positive conclusions of the CMER evaluation may be a low rate of survey return from Tribes and ENGOs (Sullivan et al. 1997: 9). These are the

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[31] CMER meeting minutes, January 25, 1996.

stakeholder groups most likely to be critical of Watershed Analysis. The CMER evaluation records concerns raised by the Tribes and ENGOs that the findings of the evaluation would be biased in favor of industry interests (Sullivan et al. 1997: 9). Yet none of Watershed Analysis participants interviewed disputes the findings of the report today.

In fact, the CMER evaluation, which did not move past a late draft stage before events suspended the Watershed Analysis program (Section 7.4.6), appears to have registered rather little in the collective consciousness of the TFW community. Had the draft been finalized and circulated widely, perhaps it would have served as a touchstone for debate in a manner similar to Collins and Pess's evaluation. Certainly the debate would have benefited from a systematic discussion of the less formalistic outcomes of the program.

Appendix E provides a full list of the CMER evaluation's main recommendations. Like Collins and Pess (1997a, 1997b), the CMER evaluation emphasizes the need for a more rigorously specified program. Both evaluations recommend a move towards what I have been calling scientific adaptive management: more specific (even quantitative) objectives, more formal monitoring programs, more detailed procedures and guidance for the synthesis and prescription phases, major revisions of some assessment modules, and so on. The CMER Evaluation (Sullivan et al. 1997) expects that greater specification and improved scoping of the formal program structure would improve both the program's cost-effectiveness and the participants' degree of satisfaction.

In addition to summarizing data about participant satisfaction, the CMER evaluation cites various WAU-level cases of implementation as potential prototypes for new standard procedures. The list of prototypes includes formal simulation modeling exercises during the prescription phase (see Section 7.4.2.1) and the streamlined administrative protocols of one particular DNR region (playing a role in Section 7.4.3).

The CMER evaluation also devotes attention to the exact next steps of debate, negotiation, and administration that would be required to convert its findings into actual revisions of the program. The authors note that developing program improvements would require considerable investment of resources at both the technical (CMER) and policy (TFW Policy/FPB) levels. The TFW participants would need to develop final options and undergo standard procedures for changing the state legislation.

7.3. Formal structure of policy adjustment (what was supposed to happen)

In the controversies surrounding the major evaluation products of the Watershed Analysis program, it is clear that the TFW community was sensitive to criticisms. This is especially true of feedback that was routed through the mass media. However, sensitivity to feedback does not guarantee a response that addresses the feedback in a substantive way. Response may take a largely symbolic form (Lertzman et al. 1996, Sabatier and Jenkins-Smith 1993, Bennett and Howlett 1992, Edelman 1970) – for example, actors may compete for status as "objective science" in the eyes of the public. In this and the following section, I describe changes of policy and *behavior* within the Washington State forest policy domain that are attributable (at least in part) to the influence of Watershed Analysis. The program evaluations discussed in Section 7.2 were not the only causes of adjustments, and the adjustments occurred at several levels of social structure that fall outside the scope of those program evaluations.

While the formal procedures of Watershed Analysis identify several arenas for evaluation, the link between evaluation and policy adjustment (Figure 1) is largely unspecified. Perhaps the clearest linkages to policy adjustment are found in the ID team process and the five-year reviews. However, as noted above, few five-year reviews actually commenced. In addition, the ID team process is frequently criticized for its lack of clarity about various parties' exact rights and responsibilities in the decision-making process (Flynn and Gunton 1996, Pinkerton 1992, Halbert and Lee 1990).

The designers of Watershed Analysis expected that ongoing revisions of the Standard Methodology would be only infrequent for the "critical questions" and basic analytic assumptions (WFPB 1997: 27). Both questions and assumptions are stated explicitly in the manual. These basic scoping and problem-bounding points were to be the stable agreed structure within which detailed methods of analysis could evolve more rapidly (Montgomery et al. 1995). However, experience betrayed this expectation. The history of program revisions turned out to be much more turbulent.

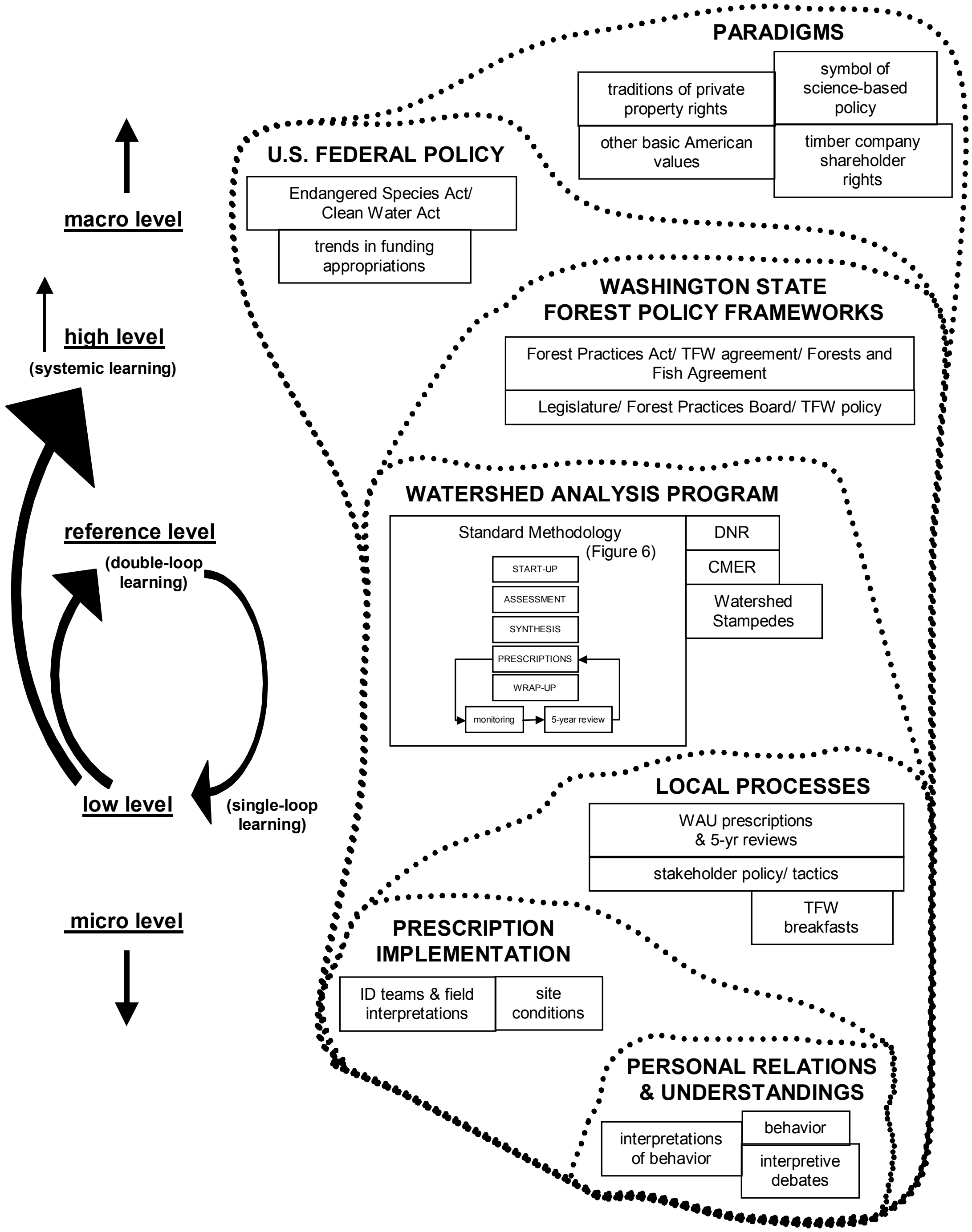

Figure 7. The Washington State Watershed Analysis program as a complex adaptive system (CAS).

Author's figure. In describing processes of social learning, we can distinguish many different levels of change. Higher levels tend to be more stable, while lower levels change more rapidly. Detailed treatment of "paradigms" and "personal relations and understandings" are beyond the scope of this study.

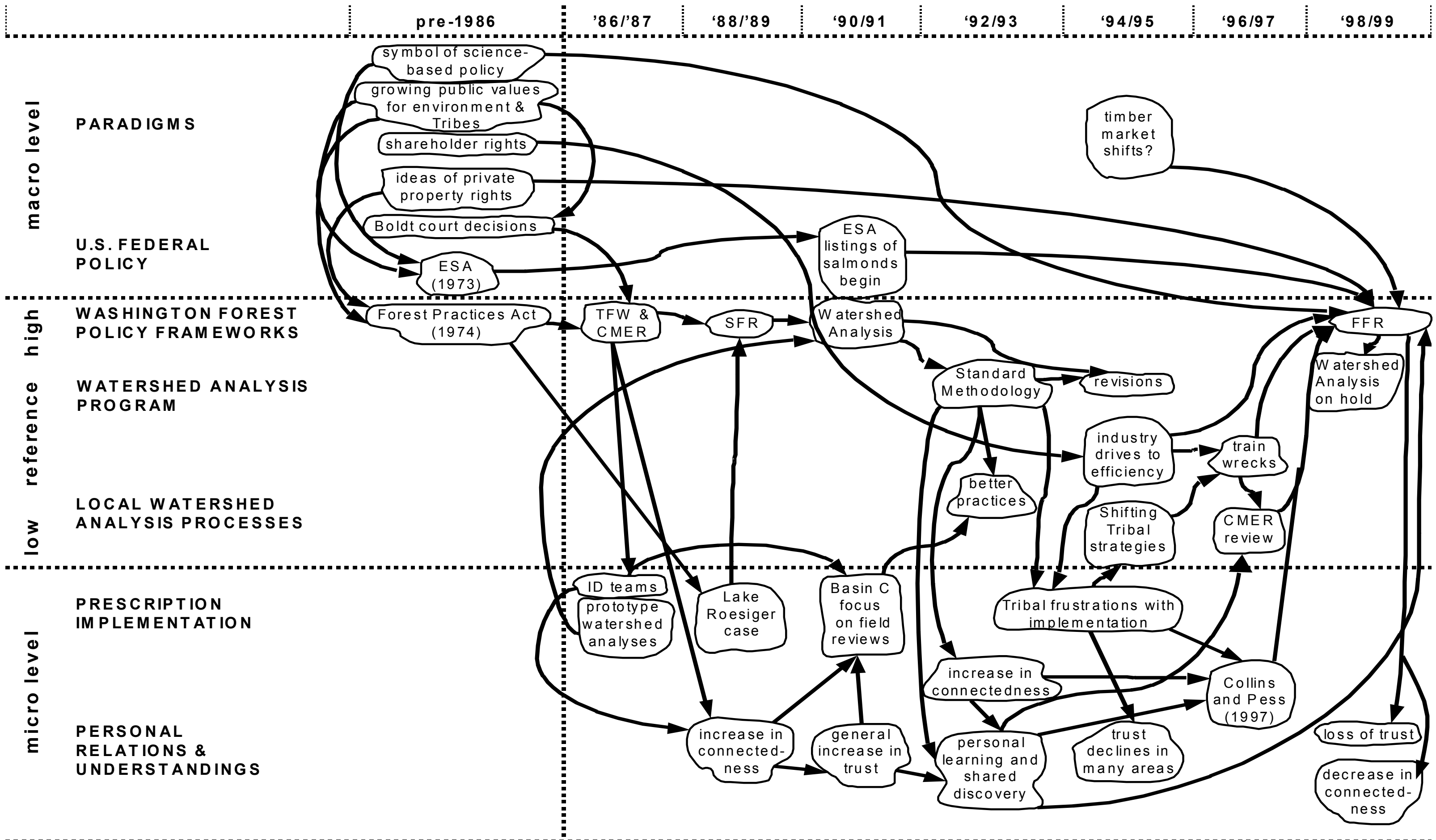

Figure 8. A tentative chronology of revolt and remember signals in Washington State forest policy, 1987-1999.
Author's figure. No diagram can depict all revolt and remember signals operating in the case. This figure shows some of the key feedback events described in the text as crossing various levels in a hierarchy of nested variables. The slower speed of change in macro levels is indicated by the low number of events depicted, while the faster speeds of lower levels is indicated by the larger number of events.

7.4. Policy adjustment outcomes (what actually changed and why)

Policy adjustments can be classified by the hierarchical level of social structure that they alter. In complex adaptive systems (CAS) theory, "level" is determined by the *speed* at which a variable changes (Section 3.2). Thus, in what follows I use the terms "high-level"/"slow-speed" or "low-level"/"fast-speed" more or less interchangeably. Accounts of specific policy and behavior adjustments are organized by a heuristic model of five qualitative levels: micro, low, reference, high, and macro (Figures 3, 7, and 8). Also in line with CAS theory, in using the term "policy adjustments" I refer not only to change of formal rules and procedures, but also to change of *in*formal social structures – organizational culture, shared perspectives within social networks, interpersonal "handshake agreements," the "national mood" of the U.S., and so on. Among other topics, my analysis explores the utility of such an all-embracing conception of policy adjustment for explaining and evaluating social learning in the Watershed Analysis program.

All of the outcomes discussed in this section must be understood in the context of the very short period of time within which they emerged. The Watershed Analysis program ceased to operate almost completely in 1997, because TFW participants' resources were suddenly redirected towards a new state-level arena that eventually produced the *Forests and Fish Report* (FFR; USFWS et al. 1999). FFR removed many key policy questions from the Watershed Analysis program (Section 7.4.6), and the program has not been revived since 1997. Today its future is very unclear. Thus, just five years elapsed between approval of the state Watershed Analysis legislation (WFPB 1992 [WAC 222-22]) in 1992 and the program's effective abandonment in 1997. We cannot know what policy adjustments "would have been" if the FFR negotiations had never happened and the Watershed Analysis program had persisted for many years more. While the evaluation outcomes in Section 7.2 clearly demonstrate that the program was still in need of substantial revision at the time of its abandonment, it is doubtful whether the political will and resources existed to achieve these policy adjustments without a triggering crisis. For almost a decade, CMER and TFW Policy had been subsidized through the volunteer time and energy of individuals whose formal job descriptions in their home organizations seldom included such work. Those volunteer resources had declined dramatically by 1997.

7.4.1. Low level: WAU prescriptions

Little adjustment of prescriptions occurred at the WAU level, because few five-year reviews were begun (Section 7.2.2) and almost no formal monitoring of Watershed Analysis prescriptions occurred. Almost all policy adjustment occurred at other levels in the Washington State forest policy domain. Thus, the most clearly specified path for policy feedback from Watershed Analysis experience (single-loop learning) functioned poorly, though it may have grown more reliable over time if the program had continued beyond 1997 (Section 7.2.2).

7.4.2. Low level: adjusting strategies for participation

Because Watershed Analysis involved participants in repeated interactions as the process commenced in one WAU after another, and because the Standard Methodology provided little guidance for the synthesis and prescription phases, there was ample opportunity for parties to adjust both their policy ideas and their negotiation strategies. Where watershed analysts had also been designers of the Standard Methodology, this tendency was stronger:

> The good thing about Watershed Analysis is you didn't have to be *limited* by [the Standard Methodology]. . . . we would say that as a mantra at the beginning [of a WAU], because people immediately said the channel module [for example] doesn't say you *have* to do that, therefore you *can't* do it. So that flexibility did survive. (former Tribal scientist and co-author of the Standard Methodology)

Prescriptions for later WAUs were generally much better than earlier WAUs, in that later prescriptions tended to be more protective of non-timber resources, more sophisticated and flexible, and clearer in their guidance to implementation personnel.[32] For example, over time managers learned that leaving only understory trees would seldom be acceptable as a way to maintain root strength on unstable slopes. For another example, the average riparian forest buffer width increased over time, and the rules for partial cutting within the buffers grew clearer. Documentation of linkages between prescriptions and accepted ecosystem science also improved. These improvements were shaped by at least two distinct learning processes. The first was within

[32] 7/9; 2 Tribal scientists, 1 DNR field staff, 2 industry scientists, 1 industry operations, 1 ENGO other.

individuals and stakeholder organizations (this section), while the second developed within social networks (Section 7.4.3).

7.4.2.1. A formalistic strategy

Many organizations adjusted their assessment and negotiation strategies through trial and error over the course of several WAU processes. For example, the WAU in western Washington State that I shall call "WAU A," formally initiated by a major timber company in 1995, provided an occasion for representatives of the local Tribe and ENGO to try several new approaches to analysis and prescription development.

> By this time [we] had gone through at least four prescription processes, and I was reviewing all the prescriptions [in the state] . . . . we really knew that the important thing [to focus our energies on] was the prescriptions. (former Tribal scientist)

Tribal scientists in WAU A decided to devote their scant resources (two TFW staff) to the prescription phase and to play only an oversight role in the less controversial and more rigorously structured technical assessment phase. At the same time, the ENGO secured funding from the timber company to study and respond to two questions lacking in the Standard Methodology at that time: field-based stream typing for fish presence and identification of culverts that block fish passage. The timber company committed in advance to remedy all problematic culverts within their road system.

A final and key innovation in WAU A is that Tribal scientists promoted a quantitative modeling approach to developing prescriptions for ensuring an adequate supply of large woody debris (LWD) to fish streams. Together with the timber company's local operational managers and in-house research scientists, they developed a simulation model of riparian forest growth and LWD recruitment to streams.[33] The prescription team then used the model to explore alternative prescription proposals for their likelihood of meeting mutually agreed, stream-specific objectives ranging from 70% to 95% of potential LWD recruitment. For example, the team used the model to investigate timber managers' claim that thinning in riparian buffers would stimulate tree

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[33] This model was later developed further and published. In order to maintain confidentiality of the case sources, I do not provide this publication reference.

growth and produce functional-size LWD much faster than leaving the buffers untouched. According to the model's output, the claim is true for some streams and false for others. The model also permitted the team to explore both short- and long-term impacts on fish habitat.

All participants in the WAU A process that we interviewed now express general satisfaction with the process and outcomes. However, success came at a cost. The complex prescription process greatly exceeded the Standard Methodology's timelines, and participants found it emotionally draining. The quantitative modeling approach was not repeated by any of the participants in any other WAU.

Agreeing to fish habitat objectives in WAU A – giving locally appropriate, quantitative meaning to the vague qualitative objectives derived through the rule matrix (Table 3) – served to clarify the issue of trade-offs between fish habitat and timber values. The discussion could focus on technical means of achieving clear, simple objectives. On the other hand, it is unknown whether industry was willing to accept similar timber value losses outside of a few "showcase" watersheds – the riparian buffer widths for WAU A are among the largest and most restrictive in the brief history of Watershed Analysis. Throughout the state, the failure of the prescription phase to explicitly and clearly address trade-offs between fish and timber was a major problem:

> There were many times in the prescription process when we said, "Well if you want 50 foot buffers here, then just state your reason." "Well, we can't do that." "Why can't you do that?" "Well, we can't do it because we're trying to tell everybody this is purely scientific." (former Tribal scientist)
>
> [The timber value tradeoffs are] like a dirty little secret. (DNR scientist)

7.4.2.2. Industry costs and the train wrecks

At the same time that some Tribes were rapidly developing new approaches to secure adequate protection for fish habitat, many timber companies sought ways to streamline the Watershed Analysis process for efficient implementation. In some regions, DNR was eager to facilitate this streamlining process. One timber company assembled an in-house assessment team that would carry lessons from one WAU to the next. Most others used consultants only, although some kept their consultant teams relatively constant across WAUs:

> Within [our company], we had the need to make this a reliable process, something we could count on, we could deliver, we could reduce the cost on. The only way to do that . . . was to contain it and do it ourselves, and bring it

> internal. . . . So we composed a team and just started knockin' off the watersheds in Washington. And I think initially it was the intent that we would do all the watersheds in Washington ownership. (industry scientist)

"Knockin' off the watersheds" is not what many Tribes expected from Watershed Analysis, and wherever there were strong efforts to streamline the process, there were also accusations of "railroading" through prescription phases and excluding legitimate stakeholders. Yet Watershed Analysis was proving much more time-consuming and expensive to implement than its designers had expected (Sullivan et al. 1997). Participant estimates of the per-WAU cost to the initiating organization (timber companies or DNR) range from approximately $100,000 to over $300,000, depending on the size of the WAU (19-77 square miles [50-200 km^2]), in addition to any losses in timber value due to the prescriptions. This cost was partly due to persistent conflict among stakeholders, but it was also due to the sheer complexity of the cumulative effects problem. As of April 2001, only 61 of over 800 forested WAUs were "completed" – that is, formally approved by DNR following peer and public review (WDNR 2001). Those that were completed would soon require five-year reviews.

As noted above, financial considerations also affected the prescription phase of Watershed Analysis, as negotiating parties attempted to trade off fish habitat values against timber values in the absence of any structure for doing so explicitly. This trade-off was particularly challenging to make in the case of prescriptions for LWD recruitment to streams. Tribal representatives claim that by 1997, timber companies had proven unwilling to extend major improvements in forest practices, and the timber value losses they implied, beyond a few "showcase" watersheds in highly visible areas with strong Tribal presence.[34] Industry representatives, for their part, often describe the shift in Tribal strategy as a case of "give them an inch and they'll take a mile." That is, the Tribes are accused of neglecting the shared TFW and Watershed Analysis goal of a viable timber industry (WFPB 1992 [WAC 222-22-010(1)], TFW 1987: 3).[35]

For example, Tribal and ENGO representatives frequently recommend some management options of the U.S. federal Forest Ecosystem Management Assessment Team (FEMAT 1993) as

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[34] 6/9; 2 Tribal scientists, 1 Tribal policy worker, 2 industry scientist-consultants, 1 ENGO lawyer.
[35] 6/16; 1 industry policy worker, 1 industry lawyer, 1 DNR field staff, 1 DFW scientist, 1 industry operational, 1 industry operational.

examples of low-risk stream buffer prescriptions, designed by a blue-ribbon scientific panel.[36] However, others point out that FEMAT was designed for U.S. federal *public* lands, where the legal and public-interest basis is clearer for prioritizing fish habitat concerns over timber viability. This second view claims that on the private lands to which Watershed Analysis applied, timber viability should be as important as fish habitat. Certainly this is the implication of the list of shared goals in TFW (1987: 3).

> The joke always was that the fish on industrial [private] lands are tougher, they need less protection. But that was the big argument: Why do the buffers vary with ownership? If it's science-driven, we should have a consistent set of buffers across all types of land ownership. . . . The FEMAT report was a low-risk strategy. . . and when you get into private lands or state lands [with less protective policies], you get into increasing the risk. (other scientist)

The FEMAT economic impact assessments predict major impacts on timber viability within the lands under study. They project that the various options considered would reduce federal timber sale volumes over the following decade to only 8% - 67% of 1990-92 levels and 4% - 33% of 1980-89 levels (FEMAT 1993: II-48). It is true that these economic projections are based on more than just riparian protection, but Sedell et al. (1997: 380) state that the riparian reserve networks of FEMAT were expected to rule out logging in about 30-40% of the landbase in watersheds of moderately dense drainage networks. The FEMAT report softens the blow of these federal timber losses by assuming there would be no new restrictions on the logging of private and state lands: "The state of Washington is buffered [against disruptive reductions of timber revenues] by its large nonfederal forest land base which has, historically, provided over 80 percent of the state's timber harvest." (FEMAT 1993: II-52). These are precisely the lands to which Watershed Analysis was later applied.

FEMAT also provided protection for terrestrial plant and animal species, both well-known and less well-known (Sedell et al. 1997). Plants had never been included in any TFW goals, and while TFW (1987: 3) included a (non-fish) "wildlife" goal, this was not a formal goal of Watershed Analysis (WFPB 1992 [WAC 222-22]). See Section 6.3.1 for more information about the wildlife issue in Watershed Analysis.

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[36] 5/10; 1 ENGO policy worker, 1 other scientist, 2 ENGO lawyers, 1 Tribal policy worker.

Thus, accusations of deception and betrayal of formal goals and informal promises grew as individuals revisited the issues in successive WAU processes. Over time, the inadequacy of the Watershed Analysis program structure became clear not only through explicit, reasoned criticisms such as those in Section 7.2, but also through the increasing frequency of "train wrecks" during prescription writing. That is, it had become commonplace for consensus to fail during the prescription-writing phase, particularly with regard to LWD recruitment issues.[37] In many cases, these failures were acrimonious and threatened to lead to legal action. Worse, DNR was often indecisive or lacking in resources to move forward with conflict resolution efforts. The incentives to participate in Watershed Analysis (Section 6.2) disappeared.

7.4.3. Low level: spread of lessons through social networks

Adjustments in Watershed Analysis implementation strategy occurred not only *within* organizations, but also *among* them, as new ideas circulated informally within the TFW community. The paths of this circulation were many, including completely informal discussions among scientists and managers, the semi-formal Watershed Stampedes and TFW Breakfasts, the distribution of formal and publicly available WAU reports, and the recombination of experienced individuals in teams over successive WAU processes. As discussed in Sections 7.4.5 and 7.4.6, many of the ideas and practices that emerged in these processes of networking and face-to-face interaction eventually would become formalized in the Standard Methodology and the *Forests and Fish Report* (USFWS et al. 1999). The origins and early spread of many of these innovations are difficult to track empirically:

> It usually happens in CMER sub-groups, talking off the record. That happens a fair amount when people are walking to the car, or carpooling to a meeting, or something like that. And it also happens because we meet in other contexts, we may be at an ID team. . . . So we see each other fairly often, a handful of us on the technical side. . . . (industry scientist)

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[37] Sullivan et al. (1997: 26) find 17 of 56 WAUs in a "stalled" status.

This network learning process often has been equal parts information-sharing and power struggle.[38] For example, what I shall call “WAU B,” located in western Washington State, is the most frequently cited prescription team train wreck in participant accounts of the decline of the Watershed Analysis program. WAU B was initiated by the same timber company that initiated WAU A (Section 7.4.2.1), yet it involved a very different set of local company managers and DNR staff. The WAU is located in the DNR region that has completed more WAU processes than any other region in the state (WDNR 2001). However, before WAU B, almost none of this region’s processes had included significant participation by the poorly resourced “non-treaty” local Tribes.

This situation was disrupted in WAU B. For the first time, the local Tribe allocated scarce funding to contract two scientists to represent it in the prescription phase. One of these contractor scientists had extensive experience in both designing and implementing Watershed Analysis, and he had played a strong role in the innovations of WAU A (Section 7.4.2.1). Both were known as passionate advocates for fish conservation, and neither had worked previously with the DNR staff in WAU B. In addition, neither contractor had been present for the assessment phase of the WAU. While the local actors (not including the Tribe) had developed some local routines and informal standards for efficient completion of WAUs, the new personalities challenged the local standards with different understandings of both the ecosystems and the program’s proper implementation. The result was an acrimonious clash of regional cultures, ideology, and information.

One of the key prescription controversies was that in some areas the Tribal contractors demanded riparian forest buffers that were over twice the previous average width for the region. Another disagreement was that the Tribal geomorphologist demanded several field checks of the mass wasting analyst’s work that usually would not have been done as part of the prescription phase in this region. Local DNR and industry interpreted these field checks as costly obstructionism – they considered it more cost-effective to have the mass wasting hazard maps refined by timber company contractors as operations progressed over the landscape in the future. Yet the Tribal contractor had become critical of this latter approach through his experience of

[38] In fact, information and personal relationships themselves can function as sources of power (Bolman and Deal 1991, Stacey 2002).

Watershed Analysis in other regions. He believed that deferring field checks would provide a later opportunity for industry to undermine the intent of the method and the prescriptions, away from the scrutiny of Tribes:

> [Some analysts would delineate] a really big area and say there are areas within it that are really bad [i.e. high mass wasting hazard], and not use the method with all its power. You'd get a confusing mess, a very large area that you still have to [field check during operations by] send[ing] your expert out anyway. And . . . when that [industry] expert went out, they found everything was fine. (former Tribal scientist)

Although rational arguments had their place here, even today many of the participants show strong emotion when discussing WAU B. After six years, the prescriptions still have not been finalized.

Despite the negative fact of the prescription breakdown in WAU B, some participants point to *positive* learning elements of the experience.[39]

> [WAU B] had some good attempts at making more sophisticated prescriptions. . . . the team leader for the prescription team tried to set up a clear schedule for when things would happen in the roads prescriptions, and be more specific, and then to have a decision framework for evaluating roads and connecting that with best management prescriptions. . . . It sort of standardized and systematized how you go out and look at a road situation. . . . It's not just, "we'll send somebody out there and they'll use their best judgement, so trust us." (industry scientist)

The ambiguous results of cases like WAU B – both improvements in prescriptions and intense conflict due to the introduction of new approaches and new information – suggested the need for fundamental revision of the Watershed Analysis program. Sections 7.4.5 and 7.4.6 describe the policy adjustments that emerged in part out of these low-level interactions.

7.4.4. Micro level: implementation as continuous policy adjustment

Discussing a network learning process (Section 7.4.3) is in fact a way to discuss day-to-day interpersonal dynamics at an aggregated scale (Stacey 2002). As case participants attempted to

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[39] 3/6; 1 industry scientist, 1 DFW scientist, 1 Tribal scientist.

implement various levels of forest policy – for example, the Forest Practices Act, the TFW agreement, the Watershed Analysis Standard Methodology, and the WAU prescriptions – a "reflective conversation" (*sensu* Schon 1983) occurred between the policies and the immediate ecological and social contexts of daily work. The implementers were the translators in this conversation. This *micro*-level policy adjustment occurs informally and often invisibly, and so it is beyond the scope of the scientific adaptive management model.

One of the unusual features of the formal Watershed Analysis program is its flexibility at multiple scales. It is a voluntary program at the *state* level. The specific menu of issues and the forest practices prescriptions are developed for specific *watersheds*, and prescription teams are encouraged to provide multiple options for landowner flexibility at the *site* level (WFPB 1993: 67-68, WFPB 1992 [WAC 222-22-070(3)(a)]). The formal program design deliberately provides for micro-level adjustments based on site- and timing-specific information available only to implementation personnel. As described in Section 7.2.1, in addition to Watershed Analysis, ID teams also served as a forum for implementation-level adjustments during DNR's forest practices permitting process.

Outcomes in micro-level adjustments varied widely across watersheds and actors. One major condition explaining this variation appears to be the degree of Tribal participation in implementing prescriptions on a day-to-day basis (Pinkerton and Kepkay 2003). In watersheds where Tribal participation at this level was low, implementation tended to focus on meeting the letter of Watershed Analysis prescriptions. Mistrust and the consequent need for transparency encouraged this kind of formalistic approach. Prescriptions needed to be specific enough that the putatively biased judgement of industry implementation personnel could not play too large a role in directing operational activities (see Section 7.4.3).

Each Tribe made difficult and unique decisions in prioritizing various activities for scarce funding. Where a Tribe invested heavily in the Watershed Analysis assessment and prescription phases but not in the site-level implementation, the assessment and prescription phases were often time-consuming and complex. The process I refer to as "WAU A" is a good example of this (Section 7.4.2.1).

Where Tribal participation in implementation was high, the micro-level interactions could include extensive field inspection of proposed logging sites, both within and outside the ID team framework. An especially striking case of Tribal participation in implementation is found in "Basin C" of western Washington State,[40] where almost all actors downplay the value of Watershed Analysis except as a source of data to support ongoing micro-level negotiations. In this case, the formal prescriptions of Watershed Analysis are seen mainly as a codification of what had been happening in the basin since the original TFW agreement.

> What we got out of Watershed Analysis is that it helped solidify some of the things we were doing, it gave us some legitimate (if you will) science background to do some of the things we were doing. It didn't result in major changes in how stuff is done on the ground. (Tribal scientist)

Participants in Basin C emphasize the value of informal relationship-building and daily verbal communication among parties, backed up with the basic formal and legal rights granted by court cases. They claim it is not the Watershed Analysis program, but rather the provisions of the original TFW agreement – Tribal funding, access to information, and decision-making rights – that produced the major gains of the past 15 years (Figure 8).

This is not to say that micro-level learning was completely absent where Tribal participation in implementation was low. Participant interviews provide many anecdotes about timber company operations managers and engineers that used the data and ecosystem understandings gained in Watershed Analysis as a basis for tailoring their practices at the micro level[41]:

> I saw a lot of experimentation going on by the managers. That's adaptive management, I think. . . . [For example, one engineer] had this big mainline road that went along this creek, and the Watershed Analysis said . . . this road is a real problem. . . . He says all right, I'm going to give it a try and see if I can get this right. . . . I came back out there, and he had the road carefully textured to prevent runoff, and he even did something he called 'double-ditching'. He built two ditches on the roads. One would carry the water off the surface, and a second

[40] The geographical scale of Basin C (about 3000 square miles or 7800 km^2) is much greater than that of "WAU A" (about 54 square miles or 140 km^2), discussed in Section 7.4.2.1. Therefore, I have used different label categories to identify them. Below I introduce "Basin A," which is the larger basin that contains WAU A.

[41] 7/8; 1 DNR scientist, 2 DNR field staff, 2 industry scientists, 1 industry operational, 1 industry scientist-consultant.

> one would carry it around the culverts that went right into the stream. It cost him a lot of money. . . . [but] he's in charge of his budgets. . . . So again, I think that there's a lot more landscape-scale planning and experimentation going on than has ever gotten credit for in this thing. (former industry scientist)

There seems to be an almost innate drive in many operational managers to tinker with their operations as they learn more along the way. Even Tribal representatives tend to emphasize that the key barriers are *not* the ethics or motivation of operational managers. Where managers were granted a modicum of autonomy, their natural curiosity and pride encouraged innovation on a site-by-site basis.[42] This adjustment process was more effective where managers had experienced at least one Watershed Analysis process. However, most participants emphasize that the managers' inclinations to learn are restricted by the higher-level policies and performance criteria of large companies.[43] For example, in publicly traded companies, shareholder returns are a major performance indicator, and conservation of aquatic resources is usually important only insofar as it affects this bottom line.[44]

Self-motivated adjustments by operational personnel during implementation also appear to be much more common for some issues than for others. Specifically, all participant anecdotes about this kind of micro-level adjustment relate to the effects of roads and logging on surface erosion and mass wasting processes. These processes are often visible even to casual observers and financially costly to timber companies, providing direct and conventional feedback signals about performance. It costs companies money when private roads collapse. It also costs a timber company's reputation when the public can readily observe landslide scars or deposits of sediment in streams. In contrast, losses of in-stream LWD neither cost companies money nor occur in discrete, easily observed events. It is small wonder, then, that LWD recruitment issues have proven much more challenging to address in the flexible formal structures of Watershed Analysis and other TFW programs. I discuss this issue further in Sections 7.4.2.2 and 7.4.6.3.

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[42] 10/13; 1 DNR scientist, 2 industry scientists, 1 Tribal scientist, 2 DNR field staff, 1 industry scientist-consultant, 2 industry operational, 1 DFW scientist.
[43] 12/15; 3 Tribal scientists, 1 industry lawyer, 3 industry scientists, 1 DNR scientist, 1 ENGO other, 2 industry operational, 1 DFW scientist.
[44] 7/11; 1 industry scientist-consultant, 1 DFW scientist, 1 other scientist, 1 ENGO policy worker, 1 ENGO lawyer, 1 industry policy worker, 1 DNR scientist.

Unfortunately for policy analysts, the micro level of policy adjustment, beyond formal rules, is also the most difficult to confirm, often leaving no record except in the minds of a few people. Where those people have relocated to other regions or states, the record may be almost irretrievable. Transparency becomes a problem (Sullivan et al. 1997, Collins and Pess 1997b). Learnings may be lost if they have not been institutionalized (Westley 1995). Thus, while scientific adaptive management may fail to account for these informal micro-level social processes, the omission does serve to question the weaknesses of predominantly informal learning structures. In general, the learning processes of implementation personnel and higher-level policy makers (including advisor scientists) proceeded as separate streams in Washington State:

> [Policy and field levels are] just two different worlds. . . . I think that on-the-ground people know a lot that policy people will never know. . . . I think that was probably one of the biggest problems, is that not enough people who did that [field-level work] wanted to go anywhere else. . . . They don't want to get into that [higher-level policy] arena. (former Tribal scientist)

Thus, an entire level of experimentation and feedback, undocumented and following no formal structure, has been largely overlooked by formal evaluations of Watershed Analysis to date.

At an even lower level than "implementation," learning processes are founded on interpersonal dynamics that may change day-to-day, including varying levels of agreement and trust (Figure 7). This micro level has received very little attention in the field of natural resources management, and it is beyond the scope of this study.

7.4.5. Reference level: revising the Standard Methodology

> One of the problems was, we built the thing in the garage, and we didn't have a chance to run it around the track a couple of times, and work out the bugs. It was already in the rule [WFPB 1992 (WAC 222-22)] and running by the time the very first one hit the street. So we had to fix the car as it was running down the road, which is very hard to do. That's another reason why I think the Collins and Pess paper[s] irritated [see Section 7.2.3]: Where were they? Where did they have the time to sit off esoterically and write a thing and criticize the hell out of everybody, when everybody else was in these committees trying to work this stuff and fix it. And then they sort of get all this public adoration. (former industry scientist)

The writing of the first Standard Methodology manual (WFPB 1992) was rushed by a funding-tied deadline, and the product was a mere sketch of what would become the manual's second version (WFPB 1993). From the start of the program, there was a strong understanding within the Cooperative Monitoring, Evaluation, and Research Committee (CMER) that the Standard Methodology was far from "finished" and required ongoing evaluation and revision (see also Section 7.1.2).

Table 4 lists major (and some relatively minor) revisions of the Standard Methodology that occurred between 1993 and 1997 (WFPB 1993, 1997). Once forwarded by CMER, these revisions were usually approved by TFW Policy and the FPB with little delay. (The "wildlife module" was an important exception to this rule; see Section 6.3.1.) Although at first the critical questions and assumptions of the assessment modules were expected to remain constant over many years (Section 7.3), experience soon dictated otherwise. This is especially true of the large woody debris component (LWD) of the riparian module. A water quality module was also added in 1996, after having a placeholder page in the manual since 1993. Other revisions in Table 4 are less fundamental.

The revisions in Table 4 constitute formal responses to information from a number of sources. These sources include scientific research, both within and outside of CMER. However, the actual experience of CMER scientists in implementing Watershed Analysis collaboratively with forest managers functioned as an equally important source of information for policy adjustment. Yet this latter source of information tends to be much less transparent to evaluation and critique. It is linked to policy adjustments not only through (1) formalization in systematic program evaluations (Section 7.2.3 and 7.2.4), but also through (2) informal face-to-face communication among individuals in the entire range of available arenas:

> [In CMER] we had lots of discussion about [revising the Standard Methodology]. And I think there was a general recognition that we needed a new version . . . . I got to know all the DNR people and some other parties really well, so we talked about it over coffee. (former industry scientist)

It is unclear, for example, exactly where the practice of identifying a "channel migration zone" arose. A channel migration zone is "the area that streams have recently occupied (in the last few years or less often decades), and would reasonably be expected to occupy again in the near future" (WFPB 1997: D-15). The practice appears to have emerged in either ID team or Watershed Analysis processes, possibly in many analysts' minds at once. Over time, the channel migration zone idea spread, was noted with approval in program evaluations (Collins and Pess 1997b), and eventually was incorporated in the Standard Methodology.

It is unlikely that early drafts of Collins and Pess (1997a, 1997b) contributed significantly to the formal adoption of the channel migration zone in the Standard Methodology. The concept had spread more quickly through the informal networks that TFW fostered. Similar doubts exist about the influence of those papers and Sullivan et al. (1997) on many of the revisions listed in Table 4. The published version of Collins and Pess (1997a, 1997b) states in several places that recent revisions to the Standard Methodology had already addressed certain identified flaws to some extent. Examples of such flaws include (1) the assumption that geomorphic processes do not vary by stream channel type and (2) the assignment of mandatory LWD recruitment assessments to streamside areas only 66 feet (22 metres) wide.

Table 4. Revisions of the Watershed Analysis Standard Methodology, 1993-1997.
Based on comparison of WFPB (1993) and WFPB (1997).

- **Addition of a water quality module.**
- **Thorough revision of the mass wasting module:** (1) new critical questions; (2) greater emphasis on roads as landslide triggers; (3) increased guidance for determining confidence levels of findings, including a two-page sample confidence statement; (4) increased discussion of deep-seated landslides; (5) greater emphasis that rule calls must be based on *deliverability* of materials and energy to resources of interest.
- **Important revisions of the surface erosion module:** (1) Hazard rating procedures were revised to be performed at the level of sub-watershed, rather than the original practice of rating road segments individually. This change enabled analysts to model current road sediment budgets and to compare the current conditions to the "background" conditions. The result could be more locally appropriate accounting for the management implications of varying lithologies across the state. (2) The procedure for developing hazard ratings was expanded to include consideration of livestock grazing and off-road vehicle activities. (3) Where sediment

yield increases by more than 100% due to land uses, the required hazard rating was changed from "high" to "moderate or high."

- **Important revisions of the hydrologic change module:** (1) The threshold for triggering a medium or high hazard call was made firmer – if changes in peak flows were less than 10% of background flows, then the analyst should call it low hazard. (2) Expanded discussions emphasize the uncertainties surrounding the standard methods and their focus on rain-on-snow events. While no new methods are made mandatory, the new discussions acknowledge (3) the importance of basing analysis on local data rather than extrapolating from other areas; and (4) several alternative paths of peak flow change — seasonal and annual water yields, spring snowmelt, and road drainage patterns — that are not addressed in standard methods.
- **Thorough revision of the LWD portion of the riparian module.** (1) The stream-bank-adjacent area to be assessed for impacts on LWD recruitment to streams increased from 66 feet to 100 feet (22 metres to 33 metres). (2) Similarly, the boundary of the LWD assessment area was expanded from only "selected" non-fish-bearing streams to *all* streams of less than 20% gradient. (3) It became mandatory to assess the existence of a "channel migration zone," and no logging would be permitted in that area. This practice had already become very common (Collins and Pess 1997b). Other important revisions to this module include: (4) four new and two deleted critical questions; (5) inclusion of a stream channel's sensitivity to LWD inputs as a component of hazard rating procedures; (6) a new procedure to estimate past riparian forest conditions and logging practices for comparison with the present; and (7) more detailed (but still optional) guidelines for estimating impacts on *long-term* LWD recruitment.
- **One important revision of the shading portion of the riparian module,** adding a new critical question. Analysts were now required to estimate historic conditions for comparison with current conditions.
- **Minor revisions of the stream channel module,** including (1) more detailed reporting guidance; (2) minor clarifications of procedures and concepts; (3) greater emphasis on coordinating and communicating with other module analysts; (4) a higher sampling standard (10-20% of stream segments in 1993 but 15-25% in 1997); (5) inclusion of riparian forest conditions as a component of field assessment.
- **One major revision of the fish habitat module,** improving the module's linkage with the LWD assessment by requiring identification of a stream's "key piece" size — that is, the size of LWD piece required to anchor a geomorphically stable habitat feature.
- **One minor revision to the water supply/public works module:** The 1997 manual includes a new matrix for determining infrastructure vulnerabilities to 5 types of material/energy input.
- **Doubled length of the voluntary monitoring module,** including details on project design principles, a process for local cooperative implementation, and a list of alternative parameters for measurement. The new material made direct reference to detailed protocols developed by CMER after 1993 (e.g., Schuett-Hames et al. 1999a, Schuett-Hames and Pleus 1999a, 1999b).
- **General revision of language to acknowledge uncertainties more strongly:** For example, where the 1993 manual (page C-6) states, "The analyst establishes the historic patterns of peak flows . . ." the 1997 manual (page C-8) is more humble: "The analyst attempts to establish . . . ." Where the 1993 manual states (page D5), "Overall, the confidence level for evaluating the riparian status for near-term LWD recruitment is high," the 1997 manual (page D-11) expands to read, "The analyst's confidence in the near-term assessment of LWD recruitment potential

will be influenced by the quantity and quality of information related to both riparian vegetation condition and in-channel LWD levels."

- **General revisions to emphasize the need for communication and coordination among modules and analysts:** For example, to the surface erosion module was added a page-long list of the analyst's "points of contact" with landowners and other module analysts (WFPB 1997: B-16).
- **Non-mandatory reference to the need for improved stream classifications:** The 1997 manual (page 16) includes the recommendation that, "Before actually beginning a watershed analysis, interested parties should consider updating stream types for the WAU." This addition appears to be a response to the work done by several ENGOs and Tribes in field-checking the DNR's office-based stream typing from the 1970s. In some areas, 50-70% of reaches typed as non-fish-bearing had been shown to be incorrect. In some cases, the groups brought their local stream typing results to a WAU process (Section 7.4.2.1).

Given the short time period and small budget available (Section 7.1.2), the list of revisions in Table 4 indicates a rapidly evolving debate. However, the costly prescription-phase breakdowns (Section 7.4.2.2) and systematic program evaluations (Sections 7.2.3 and 7.2.4) make it clear that this list was not "enough." The adjustments were too few, and too many of the new procedures were optional. This is partly due to persistent limitations in the program's analytic and jurisdictional scope as established in higher-level state legislation that could be adjusted only through extensive negotiation (Sullivan et al. 1997).[45]

In addition, many industry representatives began to feel that the WAU-specific learning returns on repeated investments were declining rapidly.[46] They believed that efficiencies could be gained (and implementation variability reduced) by capturing common findings in a new set of standard state-wide forest practices rules. Thus, even as the Standard Methodology was undergoing continual revision, more fundamental changes were envisioned:

> Something had to change. . . . With our first watershed, there was huge learning, . . . and then diminishing returns. And I think the coup de grace was . . . from an operational side . . . it became evident that there were commonalities. At about

[45] As discussed elsewhere in this report, examples of scoping and jurisdictional limitations are: (1) the potentially enormous fish habitat impacts of agriculture are outside of the FPB's regulatory authority; and (2) no formal or transparent analysis was required to determine potential impacts of prescriptions on timber values.

[46] 5/9; 3 industry scientists, 1 DFW scientist, 1 industry operational.

> that time, it was also evident to [ENGOs] and others that they weren't getting what they wanted. The social fabric deteriorated. We were a pretty tight family up until about the mid-1990s, until these riparian problems started to arise. . . . It got to where the policy people were calling each other names . . . and we hadn't seen that for years. . . . We were all really working towards the motto of "go where the truth leads us" in TFW, and everybody was open, and that began to deteriorate about then. (industry scientist)

Thus, by 1997 it had become obvious that the Watershed Analysis program was in need of major revision, probably including the first revisions of the Watershed Analysis legislation (WFPB 1992 [WAC 222-22]) since 1992 (Sullivan et al. 1997). Both Collins and Pess (1997a, 1997b) and Sullivan et al. (1997) emphasized greater specification and formalization of procedures and authority, especially in the synthesis, prescription-writing, and monitoring phases (Appendix E). Relying on the informal "TFW spirit" was no longer effective.

However, the evolution of the formal Watershed Analysis program itself would not progress beyond this crisis point. In November 1996, the TFW Policy Group, the Governor of Washington's office, several federal resource and environmental agencies, and a group of municipal governments commenced negotiations that ultimately would suspend the Watershed Analysis program and instate a comprehensive new package of standard state-wide rules. This was the *Forests and Fish Report* (FFR; USFWS et al. 1999) – a high-level restructuring of Washington State forest policy.

7.4.6. High level: the *Forests and Fish Report*[47]

7.4.6.1. Another major shift

The FFR negotiations were most directly a response to the federal listing of nine ecologically significant units (ESUs) of salmon (*Onchorhyncus* spp.) in Washington State as either endangered or threatened under the Endangered Species Act (ESA; United States 1973,

[47] In this study, I use the name "Forests and Fish Report" generally to refer not only to the negotiations beginning in 1996 and report released in 1999, but also to the rule-writing process and final set of rules revisions in July 2001.

USFWS et al. 1999: 3-4).[48] The ESA is a strongly worded piece of legislation that requires federal agencies to prevent “take” (harm or killing) of listed species by any party, whether public or private (ESA Section 9[a][1]). However, a party may obtain exemption from this take prohibition by complying with federal “conservation rules” (ESA Section 4[d]) or by implementing a federally approved conservation plan (ESA Section 10). In granting take exemptions, federal agencies are held to a “best available science” standard and a requirement to allocate all risk in favor of the listed species:

> The Secretary shall base the determinations and advice given by him . . . upon the best available biological information derived from professionally accepted wildlife management practices . . . . (Section 8A[c][2])
>
> . . . the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild . . . . (Section 10[a][2][B][iv])

FFR was a unique multi-stakeholder negotiation aimed at obtaining take exemptions for all private and state-owned lands in Washington State. If successful, it would be the first federally approved state-scale conservation plan to address ESA obligations. The goals of FFR were:

> (1) to provide compliance with the Endangered Species Act for aquatic and riparian-dependent species on non-federal forest lands;
>
> (2) to restore and maintain riparian habitat on non-federal forest lands to support a harvestable supply of fish;
>
> (3) to meet the requirements of the Clean Water Act for water quality on non-federal forest lands; and
>
> (4) to keep the timber industry economically viable in the State of Washington. (USFWS et al. 1999: 3)

FFR is a revision of Washington State forest policy at a higher level than the Watershed Analysis program (Figures 7 and 8). Quite suddenly the question was no longer how to improve Watershed Analysis, but instead whether Watershed Analysis is a program worth pursuing at all.

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[48] FFR also attempts to address the water quality problems of over 660 streams listed under the Clean Water Act (CWA; United States 1972). However, the CWA is much weaker than ESA in its immediate prohibitions (though potentially much farther reaching over time) and so has received less focus in the development and critiques of FFR.

After negotiations lasting about two and a half years (1996-1999), FFR answered this question by dramatically increasing the minimum levels of protection afforded by the state-wide standard rules and leaving the role of Watershed Analysis for further discussion and development, but with no immediate support (USFWS et al. 1999: Appendix F). Standards for minimum buffer widths on fish-bearing streams in western Washington State were increased from 25 feet (8 metres), with partial cutting allowed, to 50 feet (16 metres), with no logging allowed, plus a no-logging channel migration zone (defined in Section 7.4.5) and an additional partial-cutting zone ranging from 10 to 100 feet (3 metres to 33 metres; WFPB 2001 [WAC 222-30-020(3), 222-30-021, and 222-30-023]). The report also set out detailed assessment and planning procedures for hazardous terrain, road networks, and pesticide use (WFPB 2001 [WAC 222-24, 222-30, 222-38]).

Less deliberately, FFR negotiations produced informal shifts of an equally profound nature. The introduction of federal agencies, holding ultimate regulatory power over all other parties, caused a major reorientation in relationships among the TFW participants. It became a game of "capture the feds":

> In Forests and Fish [the professional mediators] started us out as caucuses. . . . We were placed in opposing camps, and we couldn't talk to one another. And to me that was a complete violation of the whole process. . . . There were statements like "we don't like your scientists." (industry scientist)

> There was a great deal of anger on all sides. This was like any of the other [negotiations], squared. The intensity of the pressure and the intensity of the emotions was tremendous. There was a whole series of meetings in which there was a great deal of pressure put on the Tribes. (ENGO policy worker)

Parties accused each other of violating the TFW ground rules (Appendix C). The ENGOs and many Tribes eventually withdrew from the negotiations, and some – the Washington Environmental Council, the Yakima Tribe, the Muckleshoot Tribe, and the Puyallup Tribe – submitted alternative rule proposals to the Forest Practices Board (FPB). In the case of the ENGOs, scarce resources for participation played a major role in determining strategy[49] – almost all participation in TFW had been voluntary since the early 1990s, and funds for FFR

[49] 12/13; 2 industry scientists, 1 industry operational, 1 industry scientist-consultant, 1 other scientist, 1 ENGO lawyer, 1 ENGO policy worker, 1 industry lawyer, 1 industry policy worker, 1 Tribal scientist, 1 DNR scientist.

participation were raised through grants and other ad-hoc efforts.[50] When the alternative proposals gained little ground at the FPB, ENGOs launched a series of legal challenges to FFR that have made the climate more litigious and mistrustful than at any time since the original TFW agreement. In this climate, it has become more difficult to share information and explore fresh perspectives.

> We [DNR staff] can't have an open discussion with anyone listening [out of fear of how casual comments could be used in court]. And this is awful, this is the opposite of TFW . . . . [In the TFW years, w]hen you didn't know, you'd invite everybody you knew to come out and look at it with you and you'd all kick it around and figure it out. (DNR scientist)

7.4.6.2. Linkages between the *Forests and Fish Report* and Watershed Analysis

Although the strongest immediate trigger for FFR negotiations was the ESA listings of salmon species, the outcomes of the FFR negotiations owe much to the Watershed Analysis program. Many FFR participants had extensive experience of Watershed Analysis at one level or another, and they brought what they had learned to the table. Most generally, the intensive collaboration of the previous decade had resulted in a common language and a set of shared experiences among many policy and scientific actors.[51] While policy makers often are accused of having neglected the ecosystem science, and while scientists often are accused of failing to appreciate necessary socio-economic tradeoffs, in interviews all participants demonstrate a remarkably high level of interdisciplinary understanding.

> I remember being just amazed . . . I would listen to the discussion where even the high-level policy people were talking in all this scientific detail . . . that they had learned from their scientists in Watershed Analysis. . . . I work here, I work in Oregon, and nobody talks at a higher scientific level, through the policy level on down, than the Washington group. And it's because of Watershed Analysis. (former industry scientist)

[50] 1/1; 1 ENGO policy worker.
[51] A valuable study could focus on the role that ENGOs' lack of resources to participate in Watershed Analysis had in developing the sense of alienation that ultimately led to their withdrawal from FFR.

The FFR negotiations offered a "policy window" (*sensu* Kingdon 1995) – an opportunity for Watershed Analysis participants to formalize many of the analytic methods and policy ideas that had emerged as informal standards within TFW networks (Figure 8). Many parties consciously took advantage of this policy window to forward their policy ideas:

> The timber industry made it clear to the rest of the players at the table that they did not want to come back to the negotiating table for other listings in a few years. The state caucus worked hard to develop a proposal to negotiate from that would protect aquatic resources and be operationally feasible. We knew we would not get another opportunity so broad in scope for some time and used our science, operational and policy experiences since TFW began to negotiate. (former DNR policy worker)

FFR, triggered by monitoring and evaluation processes at a level of governance much higher than the Watershed Analysis program (federal agencies' implementation of ESA), provided opportunity for the collective Watershed Analysis experience to shape a transformed Washington State forest policy. All participants interviewed agree that the new standard rules are a major improvement in protection of fish habitat, yet opinions about whether these rules are *adequate* for an endangered species vary widely (Section 7.4.6.3). In addition, many mourn the violation of the "TFW spirit" and the suspension of Watershed Analysis as a loss of opportunities for individuals and watershed communities to engage in watershed- and site-specific collaborative learning and relationship building.[52] The vision for management now extends little further than the formal bottom line, and the "social capital" (*sensu* Ostrom 1992 and many others) that TFW facilitated and used to fuel so many innovative processes now appears to be at risk of collapse.

> TFW process gave the landowner a little bit of room, and gave us, the regulatory agency, a little bit of room to go right or left. . . . And basically what we've got now, Forests and Fish doesn't give the landowner much room. . . . When you go out to each individual site. . . now we don't have the leeway. (DNR field staff)

[52] 12/25; 3 DNR field staff, 1 industry policy worker, 2 Tribal scientists, 2 industry scientists, 1 ENGO field staff, 1 industry scientist-consultant, 1 DNR scientist, 1 Tribal policy worker.

7.4.6.3. Stream buffers and timber viability – again

As in Watershed Analysis, the FFR rules for riparian forest buffers on streams are the most controversial part of the package. FFR negotiators interpreted the Watershed Analysis prescription team breakdowns as evidence that such a technically uncertain issue, involving very large potential timber losses, is unsuited to repeated battles on a watershed-by-watershed basis. All parties wanted a process that would extend more consistent protection to all lands immediately. Industry wanted planning certainty and efficiency. Tribes, ENGOs, and government agencies wanted more transparency of on-the-ground implementation than is implied by a voluntary, watershed-specific rule-making process such as Watershed Analysis.

Accordingly, FFR produced a new set of standard stream buffer rules for the entire state. At the same time, however, the experience of Watershed Analysis and other TFW arenas had demonstrated that any standard rules needed to provide a modicum of flexibility for site-specific adjustment. As a result, the FFR rules are very complex, discriminating among multiple regions, multiple stream types, multiple buffer zones, and multiple management options for implementation. They occupy about six times more space than the previous rules in the Washington Administrative Code (30 pages vs. 5 pages).

Unfortunately, this formal complexity leads many to doubt whether the FFR stream buffer rules provide significant improvements in transparency or assurance of consistent application (e.g., Pollock 1999).[53] In addition, some scientists have compared the FFR rules to those of the blue-ribbon Forest Ecosystem Management Assessment Team (FEMAT 1993) as an example of previous applications of the ESA's "best available science" standard. These comparisons found FFR to be far less protective of salmon habitat than FEMAT (Pollock 1999). (I discuss the FEMAT report's implications for state forest policy in some depth in Section 7.4.2.2.) Many other reviews of FFR have also been strongly critical of the stream buffer rules (e.g., Goldman 2001, SER 2000, Pollock et al. 1999, Pollock and Kennard 1998).

Thus, despite great increases in minimum levels of fish habitat protection, a major contingent of TFW participants deems the FFR stream buffer rules an unacceptable trade-off of

[53] 13/14; 1 DNR policy worker, 1 DNR field staff, 2 industry operational, 1 industry scientist-consultant, 2 other scientists, 1 ENGO lawyer, 1 Tribal policy worker, 3 Tribal scientists, 1 DNR scientist.

fish habitat for timber values.[54] As in Watershed Analysis prescription processes (Section 7.4.2.2), there is confusion over how, or even whether, to make this trade-off. While the ESA as originally passed in 1973 makes no concession to any but the inherent value of species conservation, the adoption of the Habitat Conservation Plan (HCP) instrument (ESA Section 10) in 1982 – and strong federal promotion of it in the early 1990s – is explicitly an attempt to enable land use and development to continue in critical habitat areas without undue risk of high fines for incidentally taking protected species (Moser 2000). The HCP instrument also offers planning certainty as an incentive for industry to be pro-active in protecting species. Like the TFW agreement, FFR states an explicit timber viability goal (USFWS 1999: 3).

FFR negotiations included almost no transparent, systematic assessments of the timber value impacts of alternative stream buffer proposals. The Washington Environmental Council commissioned such a study during the negotiations (Schillinger and Helvoigt 1998), yet no other participants asked about this report are familiar with it. In addition, the report assesses only one aspect of financial impacts to industry, the loss of timber-growing areas. Several operational points raised frequently by industry representatives in interviews, such as incidentally increased costs of planning and building access to remaining timber areas, are overlooked. These costs depend on a large number of site-specific factors, and they are difficult to assess in a generalized fashion.

A second economic assessment of FFR rules occurred as part of the standard state administrative procedures for significant new rules (State of Washington, unknown date [RCW 34.05]). Perez-Garcia (2001) performed a comparative cost/benefit analysis for the FFR package and for an amalgamation of the alternative proposals. The analysis included a much wider range of potential costs and benefits to both the timber industry and the general public than did Schillinger and Helvoigt (1998). However, the Perez-Garcia assessment occurred *after* the major FFR negotiations, and it assumes insignificant differences in levels of fish-related benefits provided by the two alternatives. These flaws are not necessarily due to the author's neglect – there is much scientific debate in the policy domain around quantification of likely benefits to fish populations due to protection or restoration of fish habitat. In addition, given that the state

[54] 17/37; 2 other scientists, 5 Tribal scientists, 2 Tribal policy workers, 1 ENGO field staff, 1 DNR scientist, 3 ENGO policy workers, 1 ENGO lawyer, 1 industry scientist-consultant, 1 DFW scientist.

environmental impact statement (WFPB 2000) found both the FFR package and the alternative proposals adequate to achieve the environmental goals of the negotiations, the provisions of the Administrative Procedure Act required that Perez-Garcia's analysis identify the "least burdensome alternative for those required to comply with it." (RCW 34.05.328[d]) Nonetheless, differences in levels of fish-related benefits are the heart of the FFR controversy.

7.4.6.4. The *Forests and Fish Report* as scientific adaptive management

Given the highly contradictory participant evaluations of the new rules, reducing future conflict may depend heavily on the adaptive management provisions of FFR (USFWS et al. 1999). Tribal and ENGO representatives claim that throughout the 1990s, industry was able to block valuable new rules proposals in TFW Policy (Section 7.2.2). Consequently, during the FFR negotiations these groups demanded a detailed formal system of research, policy feedback, and dispute resolution – assurance of more transparent and reliable implementation. In particular, calls for a more rigorous "firewall" between ecosystem science and policy decisions are heard frequently.[55] FFR aims to deliver such a system, including the first dedicated paid position for implementing adaptive management (the "Adaptive Management Coordinator"), a process for external peer review of research proposals and findings, and a dispute resolution procedure. Appendix F provides a diagram of one participant's view of the new formal adaptive management program.

> [The FFR adaptive management system] has a forcing mechanism that you can't block. There's information that can be presented to the [Forest Practices] Board. . . . There's good science and the approach is that it's supposed to be channeled to the Board . . . it has to go forward. And so I think that's a big difference with the old process that was more like, "We're going to hold hands and sing Kum-bah-yah and make adaptive management happen." (Tribal policy worker)

While these new structures respond to recommendations that have been heard for many years (e.g., Collins and Pess 1997a, Sullivan et al. 1997, Flynn and Gunton 1996, Halbert 1993), today a large contingent of participants, particularly Tribal and ENGO participants, are

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[55] 9/15; 1 Tribal scientist, 2 industry scientists, 1 industry scientist-consultant, 2 other scientists, 2 DFW scientists, 1 DNR policy worker.

pessimistic about the FFR adaptive management system.[56] Through both the Watershed Analysis prescription team breakdowns and the FFR negotiations, trust has declined. Significant rule changes will probably be slow in coming – trends in processes like LWD recruitment may take many decades to detect, yet resources for a rigorous monitoring and evaluation process are limited and will almost certainly vary over time. To date (mid-2003), four years after the *Forests and Fish Report*, CMER still is occupied as much by the details of formal structuring and process for implementing the program as by carrying out research and feedback to TFW Policy.

> People can sit there and talk about how adaptive management ought to happen, but there's just not the resources. (former industry scientist)

> The *Forests and Fish Report* has been out for almost two years now [in spring 2001], and we're just now describing the structure for how we do adaptive management, and we haven't got consensus on that. . . . We're not engaged at the policy level very well. . . . If you don't have both sets of people involved in this process, it's not adaptive management. . . . The policy people are like, "Oh didn't we already make that decision? Haven't you done it yet? We've moved on." (Tribal scientist)

> Funding is a big issue. We have a big stake in the adaptive management process. The *Forests and Fish Report* generates as much process as it does prescriptions. . . . Our work is cut out for us. People would like to write prescriptions, break camp, and go home. (Tribal policy worker)

[56] 13/27; 2 industry scientist, 4 Tribal scientists, 2 ENGO policy workers, 2 other scientists, 2 Tribal policy workers, 1 industry scientist-consultant,

8. WATERSHED ANALYSIS AS A COMPLEX ADAPTIVE SYSTEM

8.1. Policy feedback: formal and informal

The image of policy feedback in Watershed Analysis that I provide in Section 7 differs greatly from the scientific adaptive management image of evaluation and policy adjustment. Few of the formal feedback structures functioned as intended. Five-year reviews were often delayed by years. CMER and TFW Policy stand accused of timber industry domination and resistance to important policy ideas. Revisions of the Standard Methodology incorporated new ideas and elements, yet major problems remained. During implementation, critical assumptions that were originally posited to be stable underpinnings of the Standard Methodology in fact turned out to be a source of contention and to require repeated adjustments over a short timeframe. Perhaps most surprisingly, even the goals of the program as a whole, while formally documented in the Watershed Analysis legislation (WFPB 1992 [WAC 222-22-010(1)]) and the TFW agreement (TFW 1987: 3), have been the subject of widely differing interpretations and emphasis.

At the same time, however, examples of important policy and behavior adjustments are abundant from 1987 through 2001. These adjustments took place at a wide range of system levels, responding to unexpected events and new information that emerged from all manner of sources. Yet most of these adjustments were facilitated by (1) the flexibility explicitly provided by the Watershed Analysis Standard Methodology, (2) lessons drawn from the experience of implementing Watershed Analysis, or (3) the cross-disciplinary and cross-functional education that the program catalyzed through intensive face-to-face communication and interdisciplinary analysis. Some levels of change – especially the micro and the macro levels – are linked to the formal Watershed Analysis program through informal and ad-hoc processes that have as much to do with emotions, shared (or competing) interpretations, cultural symbols, power, and chance as they do with science and rational planning. The complex, messy, often surprising pathways of such successes are frequently invisible to all but the direct participants.

Would a more rigorous cooperatively developed formal program structure and more faithful implementation have yielded greater learning success? This is certainly possible. If policy feedback structures had been more mandatory, formal, and detailed – if the scientific adaptive management vision had been more closely approximated in the case by, for example, setting quantitative WAU-specific objectives in the manner of the WAU A process (Section 7.4.2.1) –

then perhaps policy adjustments would have followed formal pathways much more frequently. On the other hand, the turbulent nature of this policy domain suggests that negotiating and maintaining a stronger formal structure may have been a risky investment, diverting scarce resources away from on-the-ground experimentation that could inform higher-level processes in a more flexible and opportunistic manner.

What actions should be taken to improve policy feedback in the case? The remainder of my analysis applies the concepts of complex adaptive systems theory (CAS) as an alternative framework for understanding and acting on this ambiguous case evidence. While CAS will highlight a different set of dynamics and structures in the case, its utility for generating policy recommendations will prove not to be clearly superior to the theory of scientific adaptive management. In fact, in some points CAS theory will suggest explanations for why scientific adaptive management has a useful place in our thinking about the case. Conclusions and recommendations (Section 9) will draw on both perspectives.

8.2. Single-loop, double-loop, and systemic learning in Watershed Analysis

> So there was major learning. . . . I can remember when *that* committee did *that* report, and then we had all *these* discussions, and then policy made a new rule, and then the Forest Practices Board, and I remember the meetings where we went from *here* to *here*. . . . Wouldn't you call it a big kinda deal when we went to watershed scale? And that we then took the watershed learning and scaled it back up to the state level? (former industry scientist)

The discussion of watershed analysis in previous chapters shows that recommendations for improving policy feedback in the case need to be built from an understanding of the Watershed Analysis program as embedded in a larger, complex human environment whose informal structure is at least as important as the formal structure in shaping policy feedback. For aid in this task I turn to the complex adaptive systems (CAS) heuristic (Sections 3.2 and 3.3). I begin by searching the case evidence for examples of the social learning concepts of systemic, single-loop, and double-loop learning. I then proceed with the full hierarchical structure of Figure 3.

8.2.1. Systemic learning

In Section 7, I have already framed the case data in terms of one key CAS concept: the hierarchy of nested structures. The Watershed Analysis period (1992-1997) falls between two high-level shifts in Washington State forest policy – the TFW agreement and FFR (Figure 8). While the "high level" designation implies that these shifts are relatively infrequent on average, the timeframe of this case (1987-2001) has been an unusually turbulent period by comparison with the longer-term history.

We cannot understand Watershed Analysis policy feedback processes in isolation from this higher-level turbulence. Similarly, we cannot understand high-level turbulence in isolation from even higher-level (slower-changing on average) processes at the macro level. For example, the TFW agreement arose in part from increases in broad public support and assertion of First Nations fishing rights throughout the 1970s and 1980s (Section 5.1). In the case of FFR, the macro-level trigger was a formal one – the ESA listings of salmon stocks. Some participants also speculate that cycles in global timber markets – both overall prices and relative returns on tree species that are common in riparian forest buffers – had much to do with changes in negotiation dynamics between 1987 and 1997.[57]

Both TFW and FFR resulted in dramatically new system states as characterized by high-level structures such as stakeholders' relative funding levels, access to decision-making, trust, and shared symbols. After the TFW agreement, Watershed Analysis served to focus the re-configured resources and relationships for semi-independent intensive collaborative processes at the watershed scale (Figure 8). The informal shared understandings and formal products that emerged from the collective Watershed Analysis experience were then opportunistically incorporated in the event of the FFR negotiations – though not to the satisfaction of many participants. At the level of systemic learning, then, the policy feedback success of the Watershed Analysis program rests largely in its role as a "prototyping" process (*sensu* Brunner and Clark 1997) for new policy ideas and a "search tool" for areas of high uncertainty and contention that require new approaches.

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[57] 4/5; 1 DNR policy worker, 1 Tribal scientist, 1 industry lawyer, 1 industry scientist.

> You do it by trial and error through time, and it's kind of a mini adaptive management without the formal trappings of that. . . . And Watershed Analysis became a search tool for looking at watersheds to find out what were the best management practices, and did we need to enhance our practices. . . . This is the low-hanging fruit, and we all agreed on it. Mass wasting, roads, and stuff like that, it was easy to see and the science supported it. But the outstanding ones were riparian wood recruitment and hydrology. . . . We couldn't settle it with science. The technical stuff had been spent, and it wasn't resolving the issues. So I think they decided two things. One, let's capture the key learnings that we all agree on . . . . and then, two, we'll use the negotiating arena [FFR] to deal with these uncertainties in the science to try to find agreed upon solutions. (industry scientist)

8.2.2. Single-loop and double-loop learning

Largely due to the delay in implementing five-year reviews consistently, single-loop learning in adjustments of formal prescriptions at the WAU level seldom occured. However, this is not to say that prescriptions were not adjusted at all. As discussed in Sections 7.4.2 through 7.4.4, the average level of fish habitat protection provided by Watershed Analysis prescriptions improved over time due to (1) adjustment of tactics as participants progressed sequentially through WAU processes and (2) site-level adjustments during prescription implementation. These are low-level or micro-level adjustments by comparison with the basic reference level of this study, the Watershed Analysis Standard Methodology (Figure 7).

Double-loop learning is demonstrated in the revisions of the Watershed Analysis Standard Methodology itself (Section 7.4.5). Again depending on our reference level, we might also consider the prescription-phase breakdowns of 1996-1997 and the controversy around formal program evaluations (Collins and Pess 1997a, 1997b and Sullivan et al. 1997) to be "seeds" of double-loop learning that was pre-empted by the *systemic* learning event of FFR. Systematic formal analysis facilitated these double-loop learning events to only a limited degree. Just as important were the non-rational "revolt" signals that emerged spontaneously out of the social experience of collaborative problem-solving during Watershed Analysis. Funding, (mis-)trust, symbolic credibility, and personalities all played important roles here.

8.3. Watershed analysis as a complex adaptive system

I now turn to a more complete application of the CAS heuristic (Section 3.2) in the case of Watershed Analysis and Washington State forest policy. As summarized in Section 3.2, the heuristic comprises the following properties and structures.

CAS properties

- stability and change simultaneously
- diversity of agents
- self-organization through emergent structures
- history dependence of system structure
- non-linear dynamics producing emergent structures

CAS structural features

- hierarchy of nested variables
- variables cycle between stable and unstable states
- remember signals: higher levels cycle at a slower speed, and constrain change
- revolt signals: lower levels cycle at a faster speed, and introduce novelty that can trigger change
- connectedness at the "edge of chaos"

The *diversity of the agents* operating in the case is clear from Tables 1 and 2, though the very public attempt to work from shared goals sometimes obscured this fundamental complexity.

> The whole time . . . people kept saying, "We have the same goals as you do." And then finally I asked them, "Well, what are your goals? And what do you think my goals are?" And they could never answer my question. . . . (former Tribal scientist)

These agents interacted intensively over more than a decade to *self-organize* through often unpredictable pathways determined in large part by the *emergence* of innovative policy ideas and practices out of contentious, messy policy debates and implementation experiences. Central direction of these developments has been limited.

Emergence occurred through *non-linear social dynamics*. That is, intensive and frequent interaction among actors in a multiplicity of arenas allowed some new policy ideas – for example, the need to identify channel migration zones and to develop clearly scheduled road maintenance plans – to gain momentum and spread rapidly through social networks. A hallmark of non-linear dynamics in a social system is that the success in spreading a new idea is not at all proportional to the amount of energy expended in its promotion. Successful ideas will tend to "snowball" through social networks (success breeding success), or they will gain sudden widespread attention once some "critical mass" is achieved or window of opportunity appears.

> Now the problems are so serious and far-reaching . . . that command-and-control just doesn't work. It's really difficult, it takes a long time, it's messy. And you never end up with 100% of the people involved, you've got this critical mass that moves through and makes it happen. And even if the whole thing breaks up, someone is going to take the results, when you've been sitting around talking about science, coming to agreement about the science, they've got a pretty solid basis to take that bunch of stuff and go to the Forest Practices Board and go to Congress . . . . So when you go into these negotiations, you have to realize that there's no going back to that spot again. . . . It's the only way to go. And you've got to have the people from the ground involved, and you've got to have the middle managers, and the politicians. They have all kinds of little committees, and it's just messy. . . . To accomplish things . . . you get together with local groups . . . you put together a little plan. And then pretty soon you pick up some more, you get a Tribe or two involved, and pretty soon you've got a semi-regional thing going. . . . You get to the point where you reach a critical mass and you can start moving. (industry lawyer)

While the spread of policy ideas may be tracked even at the relatively low level of formal professional conferences, at the micro level witnesses to the birth of a new policy idea are usually very few. To understand exactly why some policy ideas emerge from the micro level and become more stable while other ideas do not is extremely difficult. For example, Collins and Pess (1997b: 979) note that one third of the WAU reports under review had identified not only a channel migration zone (CMZ), but also a "channel disturbance zone" (CDZ). A CDZ is an area where activities should be limited in order to reduce channeled landslides. In addition, the

Muckleshoot Tribe's alternative proposal in the FFR negotiations made use of the CDZ idea.[58] As described in Section 7.4.5, the CMZ concept was eventually adopted in the Watershed Analysis Standard Methodology. Why did the CDZ not enjoy the same success? Stacey (2002) and Giddens (1984) provide in-depth theoretical treatments of this type of question.

While bottom-up processes of emergent social structure are abundant in the case, these *revolt signals* are constrained to some extent by the self-reinforcing *remember signals* of relatively stable policies and other social structures that the case's *history* has bequeathed. High- and macro-level structures (paradigms) – for example, the TFW agreement, state legislation, the symbol of "objective science," and the fiduciary obligations of public companies to shareholders – tend to change much more slowly than the understandings and practices of individuals and the informal networks they belong to. Therefore, timing (relative to the *stable-unstable cycles* of higher-level structures) or politically/symbolically adept framing of a policy proposal can be pivotal in determining its success (Michael 1995). The opportunism of many actors in standardizing their policy ideas during the FFR negotiations is an example of skill in timing (Section 7.4.6). An example of skill in framing feedback to fit the constraints of high-level structures is the Collins and Pess (1997a, 1997b) evaluation of Watershed Analysis. These papers' claim to an "independent science-based" method was a symbolically acceptable form of knowledge in the general public and a fundamental structuring concept of the TFW agreement. The result was a surprisingly powerful impact on the TFW community.

The enduring influence of the symbol of objective science is also seen in the fact that the FFR approach to adaptive management constitutes a move to more closely comply with the model of scientific adaptive management (Section 7.4.6.4). Particularly strong is the TFW community's desire to build a "firewall" between the science and policy components of the system – quite the opposite of, for example, a Watershed Analysis prescription team, where Tribes often placed natural scientists to negotiate local forest practices rules (e.g., Sections 7.4.2.1 and 7.4.3).

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[58] 1 Tribal scientist.

At the same time, some participants now anticipate the advent of a *new* approach to adaptive management – one that will replace the "scientific policy" symbol with a symbol more congruent with the hard lessons of the 1990s.

> We were showing them that it wasn't as explicitly scientific as they were selling it to be to the public. And it can't be. And I think that you need to just acknowledge that . . . . There's economic values, there's socio-political values. (former Tribal scientist)

> If there could be a core fallacy to Watershed Analysis, it was this myth that science would tell you what to do. . . . And that's where people's disappointment came in. From the industry point of view, they thought, well, we're going to get these scientists to tell us what to do, and we'll be completely defensible . . . we'll have a safe course. . . . And on the other side, the environmentalists were saying the science will tell us that you need more and more protection, and it's clearly true. . . . So it comes down to belief systems. And that's what came into the prescription team [in Watershed Analysis], is opposing belief systems . . . . I feel like a lot of us who grew up in the 50s and 60s and 70s became very disillusioned with politics. And now to say something is political means directly and quite clearly that it's lying, cheating, greedy, and not trustworthy. . . . And it means little more than that. . . . [But to me] "political" means people coming together and negotiating and exploring different points of view and trying to figure out ways of coming to decisions. (industry scientist)

> A question that I have is what is the future of forest practice regulation? Can we continue to regulate in the manner that we have, with these very complex set of rules? They are the 'you shall do this, you shan't do that' kind of rules, and if you start doing that you have to start providing for every situation and they start getting very complex. . . . So one of the big questions that I have is, is anybody being visionary about where this train is going, and what it really means in terms of our ability to regulate? (former industry scientist-consultant)

For many, the experience of Watershed Analysis, and of the TFW era in general, has also served to highlight the need to revisit many other macro-level structures, or paradigms, of American society. Basic assumptions about property rights, corporate responsibility, and how to meet timber demands come into question as participants realize that uncertainty in our scientific knowledge of ecosystems is only a part – perhaps a small part – of the problem.

> I think it really goes back to what needs to happen to account for the past damage. That is the seldom-articulated overriding social question. Who pays for the past harm? Should a landowner, whose predecessor in title three transactions before stripped the trees across the stream, have to leave wider buffers [than other landowners] so that trees can eventually grow and provide properly functioning riparian habitat? (ENGO policy worker)

> There's an emerging acceptance . . . of the role of intensively managed forests in meeting global demands for timber supply. . . . So there's an emerging willingness to consider that maybe it's okay to meet that need through managed forests, instead of doing ecoforestry. (industry policy worker)

> I reject the suggestion that they [timber companies] need an incentive [to take protective measures]. They don't own the fish and the wildlife [even according to the law]. (ENGO lawyer)

Exactly how slow-changing macro-level social structures can be influenced by lessons learned at lower levels like the Watershed Analysis program and its implementation is a topic beyond the scope of this study. In the wake of FFR, many ENGOs and Tribes have chosen litigation over collaborative processes, challenging federal agencies' interpretation of the Endangered Species Act in FFR. The agencies' decisions in balancing risk to fish with risk to timber companies are at the heart of the challenge.

> You may lose in the courts, but at least you're in the right arena. You're either going to prevail on an issue or you're not. In TFW . . . you get to talk with these people and there's no real reason for them to do what you want, other than you might make enough noise and embarrass them once or twice. (former Tribal scientist)

8.4. Complexity is still messy: connectedness in the Washington State forest policy domain

In the case of Washington State forest policy, social networks have been facilitated by Watershed Analysis and a large number other TFW arenas, and these networks have linked actors vertically across system levels and horizontally within the same level. Countless interpersonal relationships provide the potential for micro-interactions within the networks to "snowball" unpredictably and emerge into higher, more stable and formal levels of structure. These relationships are generally undocumented and without formal definition, yet they obviously have great significance for policy and management processes (Stacey 2002, Gunderson et al. 1995a, Heclo 1978, and many others). Tracing the linkages that are adjusted (in number and strength) to some extent with every social interaction among individuals is an impossible task. However, perhaps we can speak generally about "degrees of connectedness" in policy domains and their sub-systems, comparing this structural feature with the "edge of chaos" ideal proposed by some complexity theorists (Section 3.2).

8.4.1. Connectedness after TFW

The entire set of collaborative arenas spawned by the original 1987 TFW agreement served to increase overall system connectedness (number and strength of relationships) dramatically. Watershed Analysis provided an additional incentive to participate in collaborative learning processes (Section 6.2). The relative importance of the TFW agreement and Watershed Analysis in increasing connectedness is difficult to assess, and it varied widely across regions and basins.

Also varying widely is the degree of connectedness among local social networks and state-level networks.[59] For example, many participants in "Basin A," the larger watershed containing WAU A (Section 7.4.2.1), played important roles in forest policy processes outside the basin. Staff of the local Tribe and of the main timber company included key architects of the Watershed Analysis program itself, co-authors of the major evaluations of the Watershed Analysis program, a key participant in the WAU B train wreck (7.4.3), and one of the most vocal scientists during the FFR negotiations. In addition, the Basin A timber company's large size conferred a strong influence in shaping the Washington State industry lobby as a whole. Finally, the DNR field staff of Basin A demonstrate a strong concern for consistent policy implementation at the state-wide scale.

In contrast, the field personnel and scientists of Basin C were considerably less involved in and concerned with higher-level policy processes. Until recently (after FFR provided more funding), their participation in CMER was very low. DNR field staff and timber company operational managers enjoy and cultivate a relatively high level of decision-making autonomy. In addition, Tribal staff emphasize the value of local data and local personal working relationships in adapting the peer-reviewed scientific literature and formal policy structures to local needs:

> I don't see myself as raising the level of understanding in the whole state. I don't have any insights. I know this basin. . . . and local knowledge lets you concentrate on the unknown and add to the knowledge. [A timber company engineer] knew every road like the back of his hand . . . . [A DNR field forester] knew practically every tree in the watershed. (Tribal scientist)

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[59] The following comparison of connectedness in two basins receives a slightly different and more detailed treatment in Pinkerton and Kepkay 2003.

> [In FFR negotiations] I tried to incorporate the needs of all the Tribes, at the same time being clear with the other Tribes where something was acceptable for us based on what we knew about our basin. . . . So what was acceptable to us might be different from what would be acceptable to other Tribes. We have a pretty good relationship with the timber companies, they basically do what we ask, so the kinds of things that we need in an agreement might have been different from other Tribes. (Tribal policy worker)

Differences in the connectedness of basins' social sub-systems may help to explain why some micro-level policy adjustments "snowballed" further (sent stronger revolt signals) than others. For example, Sullivan et al. (1997) recommend that CMER develop further the prescription-phase innovations of WAU A (Section 7.4.2.1), but they make no mention of policy ideas of Basin C. Yet as a whole, Basin C participants express a higher level of satisfaction with their policy process than those in any other basin that we investigated.

In fact, the high level of satisfaction in Basin C may be due to the combination of a high degree of connectedness within the *basin* and a lower degree of connectedness to the *state* level. Only the most major shifts at the state scale, such as TFW and FFR, disrupt the largely informal structures established in Basin C.[60] Thus, lessons learned at low and micro levels are stabilized and retained in order to be built upon further. This is the value of "compartmentalization," and may serve as a warning against "overconnectedness," where we slip from the edge of chaos towards chaos itself (Levin 1999, Waldrop 1992).

On the other hand, we may ask what relative contributions the two basins have made to social learning processes at the state level. Attention paid by Basin A participants to the state policy level may have drawn resources away from maintaining relationships and shared understandings at the local level. However, this strategy produced its own learning benefits: events like the establishment of the Watershed Analysis program and the major evaluation products have made important contributions to learning processes at higher levels.

This is the paradox of social learning's need for both open and closed structure, which CAS theory attempts to resolve (Section 3.2). The historical focus of Basin C's implementation personnel on local needs, local knowledge, and local relationships has facilitated incremental *low-*

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[60] At this time, the lasting impact of FFR on Basin C participants is still unclear.

level and micro-level improvements in a relatively stable working environment. Basin A's openness to (many strong ties to) state policy processes has produced key revolt signals for rapid learning at that *higher level*. Clear prescriptions for better social learning or adaptive management appear difficult to generalize from the evidence of this case. Part of the problem is that we must first specify the level(s) of social structure that our policies target, although of course we ideally would like to see improvement at *all* levels.

8.4.2. Connectedness after FFR

FFR also produced many far-reaching changes in connectedness. Several key Tribal and ENGO parties have withdrawn from negotiation, and litigation has been threatened or proceeded on a number of issues. Implementation-level policy adjustments are now much more constrained by standard rules designed at higher levels, although these rules attempt to provide procedures for accounting for site-specific conditions. The pathways for policy feedback in adaptive management are receiving much more detailed formal specification.

> We don't see them [ENGOs] at all, and we don't know what they're doing other than suing us. . . . Which I think is a shame, and not good, and someday . . . I hope to try to correct that. (industry policy worker)

In general, the current trend appears to be away from the "edge of chaos" that characterized the 1990s and towards a more rigidly structured domain. That is, overconnectedness is not likely to be a problem. Connections are stronger but fewer, and this raises questions about responsiveness of the system to multiple and unexpected sources of information.

At the same time, the strengthening of some connections through formalization may provide greater certainty that at least some information flows (for example, external peer review of CMER research products) will occur over the foreseeable future. This structure may also provide stability to enable rigorous monitoring for investigating key persistent uncertainties such as linkages between the fish *habitat* components that FFR explicitly manages for and the fish *populations* that are the ultimate concern. This stability has been absent so far:

> I think in some ways [formal monitoring] has been a victim of one of the flaws of what we've been doing. And that is that we continually change our management landscape. And so you get all ramped up, and you start this ambient monitoring program. . . . [and now] it has shifted over to Forests and Fish [and you have to start all over]. (Tribal scientist)

While FFR may be characterized as a decline in connectedness, the gains provided by TFW have by no means been completely lost. All arenas remain open to participation by the parties that have withdrawn. In fact, in some arenas the range of participation has *increased* – for example, the state Department of Fish and Wildlife now has a seat on the Forest Practices Board.

In addition, the cross-disciplinary and cross-functional education facilitated by TFW and Watershed Analysis continues to enable high-quality policy debates at all levels of the system. In spite of the withdrawal of ENGOs and some Tribes, many even claim that the "TFW spirit" of mutual respect and collaborative problem-solving still persists in some parts of the system.[61] Furthermore, new funding – approximately $3 million per year for 26 Tribes (NWIFC 2002), a doubling of the DNR budget over mid-1990s levels,[62] and smaller amounts to other agencies – has the potential to increase the quality of debate.

The Tribes, in particular, can use their added capacity to develop new knowledge and exert influence on policy in ways not provided for in the formal adaptive management structures. For example, the Hoh Tribe has used FFR funding to study the sediment storage function of LWD in small, steep, non-fish-bearing streams. The Hoh has been one of the strongest Tribal critics of FFR, and the study findings could have major implications for riparian forest buffers on this stream type. FFR currently provides no buffers on them.

> That was the biggest benefit of TFW is that it created a monster from the industry's perspective. We [Tribal scientists] are the only people as a group that are really pushing what industry is doing right now. . . . (former Tribal scientist)

> While the environmentalists are saying there is no TFW, and you'll hear other people saying that, the Tribes will say over and over . . . "Guys, this [FFR] is just simply a piece of TFW that had to be ramped up to deal with the [ESA] listings." TFW is still there . . . the communication networks that were set up. There's still ID teams, and TFW Breakfasts . . . . That was the real strength of TFW. . . . The fact that the Tribes have the keys to the gates of [major timber companies' lands]. A lot of these biologists have on their key rings gate keys to these private lands. . . . What was TFW if that's not what it was? (Tribal scientist)

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[61] 13/25; 4 DNR field staff, 1 Tribal policy worker, 1 industry lawyer, 2 industry scientists, 1 industry scientist-consultant, 1 industry operational, 1 DFW scientist, 1 Tribal scientist, 1 industry scientist.
[62] 1 DNR policy worker.

> The TFW agreement provided a whole new platform to deal with, and I think people need to recognize that. And they don't when they haven't been there before [the mid-1980s] . . . when we got no protection, no tribal staff, no ability to duke it out with industry. You know it's much easier to come in late and say what's broken. (Tribal policy worker)

Finally, FFR may also alter the degree of domain connectedness through improvements in *transparency*. One major strength of scientific adaptive management is transparency: understandings, goals, hypotheses, practices, findings, and policy responses are documented in order to facilitate critical review. The CMER email list currently provides public access to meeting agendas, requests for proposals, white papers, workshop announcements, and other process records. Thus, through the simple condition of having access and the right to comment on such documentation, a large number of peripheral and under-resourced stakeholders are connected at least weakly to the policy feedback process. Recall that it is the accessible documentation of the Watershed Analysis program in the Standard Methodology and the WAU reports that enabled Collins and Pess (1997a, 1997b) to perform their influential evaluation of Watershed Analysis (Section 7.2.3).

Of course, one key point of my analysis is that formal process documentation is unlikely to accurately reflect the full range of rationales, activities, and outcomes of a social process such as adaptive management. Section 7.2.3 describes the controversy that arose when Collins and Pess (1997a) took the definitions of purpose in state legislation more or less at face value and used them as a basis for evaluating the Watershed Analysis program. In addition, Sullivan et al. (1997) found that the burden of documenting WAU processes in standard formats tended to draw resources away from key substantive questions such as the synthesis phase of Watershed Analysis. Thus, the costs and benefits of seeking transparency through process documentation must be carefully assessed.

9. CONCLUSIONS AND RECOMMENDATIONS

> In Japan, there are four major religions, each with its own beliefs and assumptions: Buddhism, Confucianism, Shintoism, and Taoism. While the religions conflict dramatically in their basic tenets, many Japanese feel no need to choose only one. They use them all – taking advantage of the strengths of each for suitable purposes or occasions . . . . The ability to reframe situations is one of the most powerful capacities of great artists. It can be equally powerful for managers. (Bolman and Deal 1991: 37)

In Section 4.3, I set out the following research questions:

1. How can we deliberately design Washington State's adaptive forest management programs to improve the effectiveness of policy feedback functions?
2. Do the concepts of scientific adaptive management help to identify and understand learning successes and failures in the case so far?
3. Can complex adaptive systems (CAS) theory help to identify and understand important learning successes and failures that the scientific adaptive management model misses?
4. What do the findings regarding each of these two perspectives suggest about answers to Question #1? That is, how does each hold up as a basis for strategic policy-making?

Sections 7 and 8.1 treat Question 2 in detail. A large number of the processes that influenced policy feedback outcomes in Watershed Analysis find no place in the scientific adaptive management model. However, this may be because the Watershed Analysis program is a relatively poor example of scientific adaptive management (Halbert 1993). That is, if CMER's process for revising the Standard Methodology had been more rigorously specified, or if a dispute resolution procedure had been in place to overcome impasse within TFW Policy, then perhaps the case history would now provide us with a demonstration of successful scientific adaptive management. Without a contrasting yet reasonably similar comparison case, we can only note the doubt around our conclusions. Interestingly, the increased formal structure of the policy feedback functions in the *Forests and Fish Report* (FFR) may provide just such a comparison case over time (see Section 9.2, Recommendation 1).

Sections 8.2 through 8.4 treat Question 3. While CAS theory captures much of what the scientific adaptive management perspective misses in the case, the heuristics are perhaps overly simple and still fail to do justice to the messiness and unpredictability of implementation and other micro-level interactions within the highly connected social networks that characterize the case. I presented a tentative sketch of variability in the general structural feature of "connectedness" across space and time in the Washington State forest policy domain.[63] Investigating the effects of this variability on social learning outcomes at different system levels and regions led us into the heart of the paradox that CAS theory wrestles with: where and when should we *increase* connectedness – the number and strength of linkages among agents and system levels – for better *communication* of new lessons, and where and when should we *decrease* connectedness in order to *retain* old lessons in a reasonably stable management structure? In light of this paradox, I revisited scientific adaptive management as a means of manipulating connectedness – for example, by specifying feedback pathways, increasing process transparency, and capturing resources for monitoring programs and multi-party (especially Tribal) participation.

Questions 1 and 4 are addressed by the following conclusions and recommendations. I discuss both formal and informal options. As explained in Section 4.1, I make no attempt to determine whether the policy adjustments over the past 15 years have produced outcomes that ultimately are sufficient to conserve resources of interest. "Degree of learning success" is determined largely by degree of participant satisfaction across stakeholder groups. I view my role as an "outer circle participant" in the case, with my own biases and goals (Section 2), rather than as an "independent external observer" capable of arbitrating conflicts in participant accounts.[64] I seek to develop fresh ways of interpreting the case of adaptive management in Watershed Analysis, in order to enrich the debate proceeding today under the banner of the *Forests and Fish Report* and related policy processes. I also briefly situate these conclusions and recommendations in the theoretical literature about adaptive management, social learning, and policy change.

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[63] As discussed in Section 4.4, in this study I focus on the events and issues of western Washington State. According to a few eastern Washington State informants, inclusion of that region in the analysis would produce a record of even more variability in implementation experience and local conditions.
[64] Obviously, however, in many ways I am *somewhat* more independent and external than the "inner circle" of participants who have a direct stake.

9.1. Conclusions about adaptive management in the case of Washington State forest policy

1. Successful policy feedback events are abundant in the case history. However, whether these events have enabled the domain to meet fully the formal goals of TFW (1987: 3), Watershed Analysis (WFPB 1992 [WAC 222-22-010(1)]), and FFR (USFWS et al. 1999: 3) is a point of heated debate today. In addition, the question of acceptable and appropriate trade-offs among these goals has seldom received systematic, transparent consideration.

2. Policy feedback outcomes varied widely across regions and basins, depending on local ecological and social contexts, stakeholder organizational structures and strategies, personalities, and the intrusion of signals from external sources – what in some contexts might be called "chance." The relative importance of Watershed Analysis and other TFW arenas in facilitating policy feedback is also highly variable across regions and basins.

3. The policy feedback outcomes of the Watershed Analysis program must be understood as embedded in many levels of formal and informal social structure. The formal structure of Watershed Analysis with regard to policy feedback functions was complemented and often eclipsed in importance by informal and ad-hoc interactions of the program with both higher- and lower-level policy feedback processes. The micro level of the case – implementation and day-to-day interpersonal dynamics – is an especially misunderstood and variable source of revolt signals.

4. The processes of double-loop and systemic learning in Watershed Analysis have arisen in large part from social processes that are non-rational and difficult to trace. Informal social networks have played a large role in developing and carrying new information. Like the implementation function, these structures can be invisible to those who do not participate directly.

5. The number of hierarchical system levels among which policy feedback has looped in the case is great. Even the fact that specific individuals proceeded *sequentially* through several WAU processes over time, rather than all WAUs being negotiated more or less at the same time, created a distinct level of policy adjustment (Section 7.4.2). The formal Watershed Analysis program was able to explicitly target only a small number of these levels. It is an epistemological and practical challenge to select and target specific levels for policy feedback in a formal adaptive management program.

6. The Watershed Analysis program is embedded in a policy domain that is self-organizing. The history of TFW and Watershed Analysis demonstrates just how much can be achieved without formal strategic planning by a central coordinating body. The scientific adaptive management vision of system optimization through formal design is of limited use in highly complex policy domains where goals are contentious and system understanding is highly uncertain.

7. Despite the foregoing warnings against inflated expectations of more effective learning through formal program design, we can identify several basic formal provisions of the TFW agreement and Watershed Analysis that took advantage of the domain's capacity for self-organization and thus enabled successful, if messy and sometimes unpredictable, policy feedback. Most of these provisions served to increase the connectedness (number and strength of linkages among actors at various levels and functions) of the policy domain.

    a. TFW provided several key rights and resources for Tribes and, to a lesser degree, ENGOs to participate directly in forest policy processes.

    b. Watershed Analysis provided a strong regulatory incentive for some parties to devote their resources to a collaborative problem-solving process.

    c. The WAU reports and Standard Methodology manual provided valuable watershed data and a detailed statement of the "working consensus" about ecosystem science – an important step in facilitating ongoing debate for policy feedback.

    d. Watershed Analysis provided great flexibility for participants to "prototype" new policy ideas and negotiation tactics. These prototypes produced new understandings that could be shared and propagated through formal (e.g., systematic program evaluations, FFR) and informal (e.g., social networks) pathways.

    e. CMER was explicitly designated as a consensus-based cooperative arena responsible for revising the Standard Methodology, guided by the handful of TFW Ground Rules in Appendix C. None of the other details of CMER formal structure – few as they are – appear to have had a major influence over outcomes.

8. The formal structure and documentation of Watershed Analysis has reflected the shared understandings of the participants only approximately. Formal statements of program goals were incomplete, vague, and debatable. The rule matrix (Table 3) was largely a failed attempt to improve the meaningfulness and specificity of goals at the WAU level (Section

7.4.2.1). Hopes of a "science-based" prescription process proved naïve. Use of local, undocumented knowledge remained important but largely invisible to outside observers.

9. A similar point about formalization and documentation can be made about the original TFW agreement. While the establishment of such formal arenas as CMER and ID teams was a valuable step forward that is easy to identify, the more fundamental shifts – what makes it a case of systemic learning – are slowly being lost to memory: "There's an oral history, and the one thing you don't have . . . is a continuity. . . . So all the oral tradition of the early part sort of got lost. And it's the oral history that is much richer." (former industry scientist)

10. The formal structure of Watershed Analysis also diverted significant resources away from substantive problem-solving and action and towards the careful completion of standard forms and administrative requirements. Thus, Recommendations 8 through 10 suggest that the demands of transparency also could form a *barrier* to learning.

11. As a whole, the Washington State forest policy domain has been exceptionally turbulent for about two decades. Two high-level policy shifts have occurred, basic power balances have changed, and few arenas have persisted as vital policy instruments. This turbulence poses great difficulties for scientific adaptive management and the policy analyst who wishes to draw lessons for program design in less turbulent domains and periods. (Of course, recent levels of turbulence may be heralding a new era of persistently high turbulence in environmental policy. Global climate change, for one example, may lead to collapse of both the fish populations and the forest ecosystems at issue in this case.)

12. On the whole, policy feedback emerging from the Watershed Analysis program has been facilitated by a multiplicity of partially redundant arenas and networks – both formal and informal – at a wide range of system levels. Participants have been able to select and shift among these arenas as needed in order to provide feedback signals for social learning.

13. Because the Washington State forest policy domain has been very turbulent in recent decades, only the slowest-changing macro-level structures continue to resist policy feedback. These slow variables include some of the most basic social structures of American culture – for example, the rights and expectations of public company shareholders, beliefs about private land rights, and the symbol of scientific management. Many of the "failings" of Watershed Analysis can also be seen as instances of lower-level program implementation revealing a need for high- and macro-level shifts (systemic learning).

9.2. Recommendations for action and further research about the case

To recommend specific forest policy measures in Washington State today is a daunting challenge. First, the quality of participant understanding and policy debate at most levels of the domain is already unusually high. Many of the direct quotes in Section 8 show that little of what I recommend here will be new to the participants. Second, the very turbulent recent history of the domain has left little but the most resistant social structures unaltered. Third, any lessons drawn from decades of high turbulence are likely to be inapplicable to the future if it is more stable.

Therefore, most of the following recommendations are not about specific formal policies. Instead, increasing the quantity and quality of available human, social, intellectual, and financial resources available to ongoing learning processes may provide a flexible and adaptable alternative. I focus on ways of manipulating these resources – funding, expertise, policy images, symbols, models, connectedness, trust, and so on. I am little inclined to predict substantive outcomes of following these recommendations. In any case, the main value of this study for case participants is likely in the rich description of the history – presenting alternative stories about the policy domain – rather than in the summarizing points of Section 9. See Section 9.3 for more about the trends in the theoretical literature that support my approach here.

1. First, most generally, and in spite of the many reservations discussed above, I support the current shift to a more formal policy feedback structure – that is, towards the scientific adaptive management model. The state of policy debate in both the 1997 Watershed Analysis evaluations (Section 7.2.3 and 7.2.4) and the participant interviews conducted for this study clearly show that TFW participants have grown frustrated and suspicious of the weak formal structure for policy feedback in the early to mid-1990s. The scientific adaptive management model has come to appear attractive in its promise of greater process certainty and domain stability. However, the shift to greater formalization is not only in line with the opinions of many well-informed participants. It is also an opportunity to "prototype" – at a higher level than I have used the term elsewhere in this report – a social learning strategy that differs quite dramatically from previous strategies. The learning value of this prototyping is potentially very great, provided the following recommendations are also kept in mind. Note that it is the *insights* (new images of the policy domain) gained through "discovery learning" in such prototyping experiences, rather than the specific formal policies, that are likely to be most adaptable to future turbulence (Brunner and Clark 1997, Brunner and Ascher 1992, Walters 1986).

2. At the same time, policy makers and their science advisors should beware of the exclusionist tendencies of scientific adaptive management (Lee 1999, Brunner and Clark 1997, McLain and Lee 1996, Westley 1995). Where procedures for policy feedback are onerous and costly – for example, where a study that meets high standards of scientific research design is beyond the means of a particular party to perform – the range of active information sources will be restricted to well-resourced parties. Many of the recommendations below seek ways to counteract this tendency by establishing a multiplicity of linkages among potential sources of information.

3. The high-level prototyping of scientific adaptive management in FFR should not completely exclude the kind of messy lower-level prototyping that occurred in the 1990s through Watershed Analysis. Cooperating organizations and scientists should resist the temptation to direct all resources through the single integrated structure of FFR. For example, the recently-passed state Watershed Planning Act (State of Washington 1998 [RCW 90.82]) provides a basin-scale alternative cooperative arena for addressing many key activities that affect salmonids and water quality.

4. Policy makers and managers should maintain and seek more funding for Tribes and especially ENGOs to participate more fully in policy arenas at multiple levels. Tribes and ENGOs themselves should seek more effective allocations of existing resources – some Tribes spend forest practices funding in other policy domains, and the well-funded national and international ENGOs have ignored the TFW process so far.

5. Middle managers should take advantage of the potentially high benefit/cost ratio for policy feedback offered by making process documentation and ecosystem data publicly available. The internet provides one excellent opportunity to improve accessibility at low cost. Several relevant TFW/FFR websites do exist at present,[65] but some are in serious disrepair.

6. The move towards scientific adaptive management should include expanding cooperative research and policy evaluations to include systematic and transparent analysis of timber value

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[65] See the URLs: <http://www.nwifc.wa.gov/cmer/>; <http://www.forestsandfish.com/>; <http://www.dnr.wa.gov/forestpractices/watershedanalysis/> (accessed September 22, 2003)

trade-offs against other socio-economic and ecological components of forest management problems. This is a near-impossible step to take without dramatic increases in available resources, yet it is a major gap in collaborative policy analysis practices in the case. There has been little transparent information about timber values and other trade-offs in the Watershed Analysis prescription phase or in other arenas. As a result, formal policy evaluations have been unable to provide any policy feedback with regard to one of the major goals of both TFW and Watershed Analysis. The same is true of the Tribal cultural and economic values associated with salmon harvest. Some streams of the adaptive management literature have now come to embrace fully the integration of natural and social sciences in environmental policy evaluation (Gunderson and Holling 2002, Röling and Wagemakers 1998, Gunderson et al. 1995a, and many others). Yet one of the clearest weaknesses of the TFW era is that it involves almost exclusively natural scientists in its research programs.

As in Recommendation 5, I emphasize the *communicative* value of this step towards formalization. For example, if timber-fish-culture tradeoffs are modeled quantitatively, evaluators should pay as much attention to the shared policy ideas and images represented by the model as to the numerical outputs of the calculations. Maguire and Boiney (1994) and Walters (1986) provide examples of the potential for formal decision analysis outputs to trigger iterative *adjustment of initial values and system models* – double-loop learning – instead of leading directly to "final" policy design and implementation. Alternatively, more qualitative yet still relatively transparent techniques such as multi-attribute tradeoff analysis may provide a more appropriate understanding of values that resist quantification, such as cultural values.

7. Again with an emphasis on clearer communication and understanding rather than definitive formalization, policy makers should also engage in explicit discussion of the relative priority among high-level goals, values, and symbols as expressed in studies of public opinion, lasting cultural components, and the values and demands of TFW participants. It is clear that the documented main goals of TFW and FFR (Sections 5.1 and 7.4.6) are all very important to major contingents of both TFW and the general public. However, explicit and focused discussion of the many potential linkages among these goals – for example, mutual exclusivity, complementarity, and priority – may yield significant improvements in shared understandings of the policy domain.

Discussion of higher-level structures should also be expanded to "surface" (*sensu* Argyris and Schon 1978 – i.e. to make explicit for critical examination) undocumented but implicit value and symbolic structures that constrain policy feedback processes. Furthermore, TFW participants should explore the distinctions between the goals, values, and symbols of TFW participants and those of the *general public*. New understandings emerging from this type of discussion may also contribute to the *adjustment* of public goals, values, and symbols over time – i.e. systemic learning. The literature of decision analysis (e.g., Keeney 1992, Keeney and Raiffa 1976) provides a structured starting point for such discussion while taking account of uncertainty. However, one weakness of that approach is in the common assumption that decisions do not involve competing stakeholders.

8. All participants should resist dreams of policy certainty (in the expression of Gunderson 1999, "spurious certitude"). The quest for policy certainty, even if only certainty that specific procedures will be followed and documented, lies behind some people's support of the current shift towards scientific adaptive management. However, the recent history of the Washington State forest policy domain has been so turbulent that very few policy expectations shared widely among participants just ten years ago are still in currency today. *Implementation* has been the functional locus of much variability and surprise, calling to mind the words of Pressman and Wildavsky (1973: xxii): "Instead of asking why the process of implementation was faulty, we ask why too much was expected of it." Often participants' specific frustrations with "faulty implementation" triggered accusations of betrayal that "snowballed" through social networks and made collaboration more difficult.[66] In addition, failure to obtain policy certainty led timber companies to question their considerable financial investments in Watershed Analysis, regardless of the many *unexpected* benefits the program conferred. The future will probably continue to be turbulent; if so, the hope of policy certainty needs to be largely abandoned. Instead, parties should focus on increasing the stock of resources for adaptive capacity, as discussed elsewhere in this study and in Gunderson and Holling (2002) and Brunner and Ascher (1992). One candidate term for this emerging approach is "resilience management" (Walker et al. 2002). One question this

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[66] A forthcoming paper with Dr. Evelyn Pinkerton will describe this phenomenon in detail.

recommendation raises is: What will encourage participants to invest resources in the policy process if not the promise of some relatively certain beneficial outcomes?

9. Managers should increase the store of the following skills and attitudes in human resources, either through professional development or through hiring activities.

    a. Beware of temptations to attribute disappointments in policy outcomes to the ill intentions of other actors. It is easy to over-inflate our perceptions of how much power other actors possess (Checkland 1999a, Bolman and Deal 1991, Senge 1990, Sabatier et al. 1987). Turbulence at all levels of a system – changes in funding, divergent interpretations of events and policies, emergencies that draw attention elsewhere, and so on – means that agreements cannot always be kept through sheer honorable intention. In addition, the speed of systemic social learning is constrained in part by high-level social structures that certainly emerge from micro-level interpersonal processes, yet are beyond the control of any specific set of actors. Some levels of policy change very slowly and through processes that are non-rational and largely invisible to external observers. Higher system levels will always lag behind the "state of the art" in lower levels.

    b. Attend to micro-level interactions. Act quickly to clarify and address conflict. Allocate time and opportunity for participants to see beyond small conflicts to the shared experience of a turbulent world. Train participants in teamwork skills. Praise and report successes that otherwise might go unrecognized. All big changes have their roots, if unpredictably, in the micro level. Most of this paragraph repeats the general theoretical conclusions of Michael (1995).

    c. Learn the art of timing in policy feedback. Be opportunistic in identifying and taking advantage of policy windows in slow variables (Kingdon 1995, Gunderson et al. 1995a, Sabatier and Jenkins-Smith 1993, Lertzman et al. 1996, and many others). Alternatively, present policy ideas in ways that take advantage of existing symbolic, value, and policy structures (Michael 1995).

9.3. Theoretical conclusions and needs for further research about adaptive management and complex adaptive systems

The conclusions and recommendations in Sections 9.1 and 9.2 provide empirical support for many specific concepts and propositions in the theoretical literature about adaptive management, social learning, and policy change (CAS). I have noted specific points of congruence where they arise in the flow of my arguments above. In this section, I focus on the relationship between my study's findings and broad trends in the relevant theoretical literatures.

1. My conclusions and recommendations for Washington State forest policy rest on a few simple concepts that have received growing attention in an ever-increasing number of disciplines. The first concept is that of *post-positivist science*. The major policy problems of our day, especially questions of environmental policy and natural resources management, involve questions about systems that are vastly more complex and dynamic than we can predict or control for optimal outcomes. This constitutes a challenge to one of our culture's fundamental myths about what science is supposed to do for us.

   Under such conditions, where the future will be full of surprise and turbulence, the priority for policy work and management might well be to develop stores of various resources that increase a system's *adaptive capacity* – the second key concept here. Adaptive capacity is a system's ability to respond to turbulence by re-organizing itself for continued productive functioning. The more tools we have in our toolbox, the more likely we are to successfully remodel our house when required by new circumstances. As noted in Section 9.2, my focus has been on finding ways to increase the Washington State forest policy domain's toolkit by developing resources such as a diversity of policy domain images, social actors' skills in communication and collaborative inquiry, and system connectedness through social networks and more formal policy structures. Even my recommendation to pursue scientific adaptive management does not subscribe to the positivist origins of that vision (Section 3.1). Instead, I am interested in the unexpected insights that we may gain by giving it a thorough trial in practice, regardless of whether the specific policies end in "error." Just as biological diversity is a cornerstone of ecosystem adaptive capacity, so is diversity of experience, theory, and method crucial to the adaptive capacity of human systems. We are best advised to maintain familiarity with the insights provided by *both* scientific adaptive management and complex adaptive systems theory, as well as the many other perspectives that exist. An abundance of alternative policy ideas and arenas may be one of the surest signs of a resilient system capable of learning change (Lertzman et al. 1996, Westley 1995).

Apart from its focus on the CAS heuristic, which I explore further below, my post-positivist approach to adaptive management and social learning also finds parallels in the "multiple lens" approach to organizational behavior by analysts such as Bolman and Deal (1991), Morgan (1986), and Allison (1971); the "soft systems methodology" of Checkland (1999a, 1999b); and especially the "practice-based prototyping" approach to policy analysis in Brunner and Clark (1997) and Brunner and Ascher (1992). Thus, as does the adaptive management literature as a whole, my study converges on some of the major trends in current thinking about policy work and management of complex problems.

2. The distinctions among and comparisons of insights afforded by scientific adaptive management, social learning, and complex adaptive systems theory (Section 3) have proven enlightening in this study, particularly in contrasting the roles of formal and informal structures and processes. For clarity of discussion, these perspectives should always be distinguished one from another. The term "adaptive management" should be reserved for *scientific* adaptive management (*sensu* McLain and Lee 1996). This usage is actually quite common among natural scientists (Halbert 1993, Lee 1993), yet it needs reinforcement, particularly among social scientists.[67]

3. The CAS heuristic provides a helpful way to conceptualize complex, multi-scale collaborative processes such as TFW and Watershed Analysis. In particular, it provides a helpful framework for discussing the interaction of formal and informal structural features of widely varying qualitative characters.

4. My study has benefited from the fact that the TFW era now offers over 15 years of empirical data about attempts to do adaptive management through a cooperative, multi-party process. In particular, the recent events of FFR provide a striking example of high-level policy

[67] At the same time, the history of the adaptive management idea also demonstrates the *pitfall* in distinguishing rigorously between the two visions: it becomes easier to assume, if only subconsciously, that "adaptive management" can operate independently of "social learning" processes.

learning that drew heavily on five years of lower-level implementation experience. However, it required a trigger from macro levels (the federal agencies implementing the Endangered Species Act) to create a window of opportunity for this learning. As emphasized by Sabatier and Jenkins-Smith (1993), these multi-level learning events often require longitudinal, multi-decade studies to detect and describe them.

5. Some, if not most, CAS theorists seek to "uncover general principles that will enable us to synthesize complex *cas* [sic] behaviors from simple laws." (Holland 1995: 38) I have found no simple laws at work in the case of Watershed Analysis that promise a basis for more reliably improving management on an ongoing basis (the fabled "policy lever" of systems thinking). Complexity remains complex, and the paradox of simultaneously open and closed structure remains a paradox when discussed in general theoretical terms. The devil is in the details of implementation and interpersonal dynamics.

6. CAS provides an insufficient means for conceptualizing the relationship between the macro and micro levels of the case. Some aspects of American culture may resist revolt signals from experiences in implementing natural resource management programs, yet at the same time this culture is itself composed of the individual experiences and beliefs of the general population. What exactly is the difference between micro-level shifts in individuals' norms and values and the macro-level cultural shifts that somehow emerge therefrom? To what extent is the stability of culture reflected in the speed of change in individuals? The CAS heuristic, and systems thinking in general, provides little help in describing this link. Stacey (2002) and Bella (1997) label this kind of dynamic "non-systemic." The social networks concept, which I have deployed liberally in this study, remains vague and serves largely as a theoretical gap-stop (Gunderson 1999). One of the most useful directions of further emprirical research might be to map the structure and functioning of social networks, perhaps adapting the advocacy coalition framework of Sabatier and Jenkins-Smith (1993). Lertzman et al. (1996) provide one useful example of this framework's adaptation to cases of forest policy change.

7. While the theory of CAS is suggestive and helpful, it may be that the most useful "theoretical" work in adaptive forest management is done by those who implement it on a daily basis. If forest management is as complex and subject to multiple interpretations as I claim in this study, then we may do better to focus on increasing our store of implementation prototypes, which can be deployed as suits specific ecological and social situations. Bormann

et al. (1999) are exemplary in providing a rich collection of cases and options for implementing adaptive management in complex human environments. My study of Watershed Analysis, too, may be most useful simply in providing rich "war stories" (*sensu* Westley 1995) of a fascinating sustained attempt to implement complex collaboration.

8. We need to know more about the behavior of implementation-level adaptive managers as they interact with their specific social and natural environments at the micro level. This is the realm of the "reflective practitioner" (Schon 1983) and "civic scientist" (Lee 1993) – symbolic personae that have recently emerged in social learning theory to represent a kind of knowledge that gains validity by opening standard procedures and techniques to the demands of specific social groups and individuals in specific problem contexts with uncertain futures. Schon (1983: 135) pinpoints one key habit of these personae in a way that fits well with the case history of Watershed Analysis: "The [reflective] practitioner evaluates his problem-setting experiment by determining whether he likes these *unintended* changes, or likes what he can make of them [emphasis mine]." Such personae are candidates to replace figures like the strategic planner and consulting expert as new symbols of natural resources management. Within the stream of CAS literature, Westley (2002) provides a close consideration of the career of one successful adaptive manager and his habits of action in problematic situations. Such a study verges on the life-history method of anthropologists (e.g., Spradley 1969) – an approach to developing management theory not normally entertained by natural scientists.

9.4. Transferable lessons for other environmental policy domains?

What transferable lessons can scientists, policy makers and managers in other environmental policy domains take from this study? How can they work with these difficult, often frustratingly general insights?

In keeping with much of the theoretical literature's movement towards a post-positivist focus on building adaptive capacity (Section 9.3), I believe the main value of this study for actors external to Washington State is to add to their "toolkits" for future thinking about and acting in their own policy domains. The specific recommendations for Washington State (Section 9.2) may not apply immediately to many other cases. For example, while British Columbia (BC) shares many forest types with Washington State, the adaptive management structures of their forest policies are very different. From the mid-1990s to the present, BC has held much more closely than Washington to the rigorous formal design of scientific adaptive management.[68] Therefore, it is doubtful whether my first recommendation for Washington – to pursue a more rigorous scientific adaptive management approach – is appropriate. Instead, BC actors may do better to heed the shortcomings and unusual interpretations of the scientific adaptive management approach offered by many of the other recommendations. I hope the empirical narratives of my study (Sections 7 and 8) provide sufficiently vivid indication of the promises and pitfalls of alternative approaches. However, in the end, every policy domain is unique in some key ways.

Thus, the challenge is not to seek favored new models of adaptive management for more predictable success in social learning, but rather to develop a new personal discipline – perhaps becoming one of a new breed of "civic scientists" or "reflective practitioners." This new discipline would embrace the eclectic use of multi-disciplinary ideas, images, and tools to respond to the specific demands of changeable social systems. This is a path of patience (Lee 1993) and bravery (Geldof 1995). It is also a path of alertness – alertness to the peculiar contraints and opportunities that every complex adaptive system presents.

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[68] See, for example, Nyberg and Taylor (1995) and the BC Ministry of Forests' adaptive management website at <http://www.for.gov.bc.ca/hfp/amhome/amhome.htm> (accessed September 29, 2003).

10. SOME STUDY LIMITATIONS

In the foregoing analysis I have used concepts from the fields of complex adaptive systems and scientific adaptive management to aid in evaluating and recommending improvements in policy feedback functions of the Washington State forest policy domain. The confidence level of the product is limited by many considerations, including the following.

1. Through both the sampling approach (Section 4.4.1) and the attempt to tell a reasonably coherent story (Section 4.7), my analysis focuses on several specific issues and "sub-cases" to represent the range of experiences across the entire policy domain. I speak mainly of Tribal-industry interactions and conflicts, thus downplaying the role of government agencies, ENGOs, and less organized participants from the "general public." I have also almost completely ignored outcomes in *eastern* Washington State, which is very different from the western portion, both ecologically and socially. Thus, very different stories might be told about this complex case.

2. The grounded approach to data analysis (Sections 2 and 4.4.2) – eschewing the practice of working from hypotheses, to standardized instrumentation, to data collection, and thence to data analysis – is somewhat lacking in transparency. I have often proceeded intuitively and iteratively, discovering both interview themes and congruent theoretical literature in an ongoing parallel exploration of the case and the idea of adaptive management.

3. The purpose of the CAS heuristic is to provide simple, enlightening ways of talking about extremely complex questions (Gunderson and Holling 2002, Holland 1995). However, the process of conceptual simplification in my analysis leaves the study open to questions about important distinctions *within* key concepts. While I have used examples from the case data to illustrate the diversity of phenomena falling under the concepts of "social structure," "revolt signals." "connectedness," and so on, I have made little attempt to distinguish functional differences among these phenomena. Such functional differences may be key. Among the neglected distinctions with the highest potential for illuminating the case, perhaps differences in *strength* of connections among system components, instead of simple number of connections, are most important to ponder.

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APPENDIX A: ETHICAL APPROVAL

APPENDIX B: SAMPLE INTERVIEW PROTOCOL

September 2, 2002

For each interview, questions were selected from among those offered below, depending on the experience, temperament, and knowledge of the subject. The set of available questions itself evolved over time in an iterative fashion as some questions became well understood and new questions emerged. Time available for the interview also determined which and how many questions were put to the participant.

Interviewee and current title____

Phone _____________________ Email _______________________

Other contact ___________________________

Preferred means of contact __________________________

Research products requested ______________________

Willing to review drafts? (Y/N) _____________

Interviewer(s) ____

Date and Time _________________________________

Place ____

Checklist:

____ letter of introduction and explanation of research goals

____ discussion of confidentiality and permission to record

____ offer to provide research products, request their participation as a reviewer

AVAILABLE INTERVIEW QUESTIONS AND PROBES

Work History

general resume

entry to TFW

role in TFW, WSA, FFR

current title

Relationship with TFW clients or employers

Did you act as (a) technical/science consultant, (b) policy negotiator, (c) manager, or (d) other?

Were you constrained by existing policy positions of your client or employer? How?

Did you have opportunity to affect higher-level decision-making processes? In what ways?

What considerations were you required to account for in your own decisions and actions?

What sort of training or guidance was provided to you for TFW work?

What have been the greatest personal challenges for your skills or understandings?

<u>Adaptive management — General</u>

How would you define adaptive management?

How did you first become acquainted with the concept of adaptive management?

Do you feel that this concept is well understood in the TFW arena? Why/Why not? At what levels is it least well understood?

Does the public understand existing uncertainties and the need for adaptive management in Washington State forest management?

How well do natural scientists understand the social and institutional complexities and dynamics involved in forest management? (Is the forest resource system commonly viewed as a coupled system?) Does poor understanding of this sort inhibit success of rule changes?

What are some key uncertainties that you see in current understandings of forest ecosystems, watershed processes, and interactions with fish populations?

What are some key uncertainties that you see in current understandings of economic and social impacts of forest practices rule changes?

What efforts have been made to improve understanding of adaptive management in TFW? (training seminars, conferences, etc.)

Do you perceive resistance to the adaptive management strategy in any parts of the forest management arena of Washington State? Where? Why?

How likely do you think it is that currently listed salmon stocks will go extinct in the next 20 years?

<u>CMER — before FFR</u>

Was CMER a case of successful adaptive management? Why/Why not?

What was your role, funding, and time commitment in CMER?

What CMER projects or sub-committees did you work on?

What was the relative representation and strength of various TFW caucuses in CMER? What determined this representation and strength?

Did the ground rules from the original TFW agreement have a strong influence on the CMER process? Were there any other understood ground rules, formal or informal?

What happened in the case of persistent conflict?

What were the major CMER achievements?

Were there any attempts to carry out large-scale management experiments, including effectiveness monitoring?

What role did policy questions play in CMER?

How did CMER studies get prioritized?

Was there a peer review process for CMER products?

Did the TFW Policy Group provide clear goals for CMER? Did CMER information and recommendations influence the Policy Group? Why or why not?

Did TFW Policy understand existing uncertainties well? How did they respond to uncertainty?

Why have there been so few rule changes for terrestrial wildlife, considering the amount of resources and interest in that topic in CMER? (large landowner wildlifer pilots)

How did CMER studies get documented and circulated?

How was CMER data stored? Were there standard data collection protocols? How willing were individual parties to put their own 'proprietary' data on the table?

How did the structure of CMER change over time? Why did it change? How did CMER's role change?

How did the funding of CMER change over time? How did these changes affect CMER's effectiveness?

What were the key individuals in CMER? What made them so influential?

Watershed Analysis (WSA) – to be raised at either a general level or the level of a specific WSA case

Was WSA a case of successful adaptive management?

What was your role in WSA?

Was the WSA training program effective? Did it cover communication and teamwork skills?

What was the strategy of your client/employer in recruiting people for WSA teams?

What were the incentives, costs, and benefits of WSA for your employer or client?

What was the role of the general local public in WSA? How have the media affected public opinion?

What was the strength of ENGO involvement in WSA? local governments? tribes? the state agencies? industry? What factors determined the strength of involvement?

In your view, what was the purpose of the start-up phase? Was there a significant problem-definition component to this phase?

What were the key barriers to performing your role in WSA?

What were the most common problems with the WSA process?

How successfully was information conveyed from the assessment team to the prescription team? How was this communication achieved? or, why did it fail?

How was uncertainty treated in WSA assessments and prescriptions? Did the prescription teams understand and respond appropriately to scientific uncertainty?

Name some examples of successful WSAs. Why do you consider these successful?

Name some examples of good WSA prescriptions. Why do you consider these successful?

What was the role of policy negotiation in prescription phase? Were objectives clear? Were there hidden agendas?

How autonomous were local managers in negotiating prescriptions? Was there a 'bottom line' that could not be violated? (e.g., maximum of 15% total landbase netdown)

In your experience, are WSA prescriptions implemented faithfully? What is DNR's role in enforcing the prescriptions?

Where prescriptions gave a choice between, for example, a 'no cut' reserve and a geotechnical review to justify partial cutting, how often was the latter chosen? What determined that choice (cost of the review, value of the timber, thinning to develop big trees faster)?

Do you know of any WSAs that included a monitoring component?

What has been the trend in the quality and success of WSAs over time?

How have different companies and DNR varied in their approaches to WSA approaches? How has the quality of WSAs varied among these initiators?

How did the WSA process address non-forestry impacts to resources? (agriculture lands, dams, etc.)

What have been the major achievements of WSA – improved relationships? increased knowledge? improved practices? improved rules?

Were the watershed stampedes useful? Why or why not? How were revisions of the WSA methods manual achieved?

What factors contributed to the decline of WSA in Washington State?

How has WSA-generated information been used outside the WSA process itself?

Were Collins and Pess (1997) accurate in their criticisms of WSA? In your opinion, was it appropriate for them to publish those papers in the way they did? Were there other avenues in TFW for them to influence policy with these criticisms?

What was the process for the CMER Watershed Analysis Review (1997)? How did that study affect WSA methods and the TFW community in general?

What were some key individuals in making WSA happen? What made them so influential?

What is the future of WSA in Washington State?

Forests and Fish Report (FFR)

Who intitiated FFR, and why? What role did the Endangered Species Act and Clean Water Act have in the beginning?

How does FFR compare to Habitat Conservation Plans as a strategy for ESA compliance?

What other options existed for timber companies? tribes? ENGOs? federal agencies? state agencies? Governor's office?

Was it clear from the start what the decision-making authority of FFR would be?

What were the goals and objectives of FFR? Were these clear from the start? Did all parties respect and hold to those goals and objectives?

How did the public gain access to the FFR and related rule-making process?

What was the role and strength of each caucus in FFR?

Did all caucuses have sufficient technical support? Why or why not?

What were the key individuals in initiating, negotiating, and concluding FFR? What made them so influential?

How influential were the revised ground rules in FFR? Was consensus sought sincerely?

Was the mediator effective? Why or why not?

What was the structure of the meetings? Did you or your employer/client feel left out of any discussions? Why?

Were any efforts made to build group skills, trust, and a team approach? What were they?

How was science introduced into the negotiations? How were competing models or conflicting opinions debated?

Was data shared openly in the negotiations?

How were WSA findings accounted for in FFR?

How were CMER research results accounted for in FFR?

What was the process for development of WFPA's

What formal non-ecological analyses were performed as a part of FFR negotiations? cost/benefit analyses? risk assessments? decision analyses? What was the impact of these analyses? (Schillinger and Helvoigt 1998, WFPA cost/benefit analysis, DNR environmental impact statement)

Why did consensus break down? Why did the ENGOs leave the table? Why did some tribes leave the table? Why did some tribes stay at the table?

What was the role of the Governor's office and Forest Practices Board?

Why was FFR submitted directly to legislature instead of the Forest Practices Board?

What role did time constraints play in FFR? Was there significant time pressure on the federal agencies?

What are main strengths and weaknesses of FFR? Are these rules more protective than the average WSA prescription set?

How successful are the following components of FFR?

- -stream typing models
- -stream temperature models
- -riparian rules (too complex for implementation? report of 75% unprotected?)
- -mass wasting rules and models
- -road planning rules
- -pesticide rules
- -watershed analysis (will it be used any more?)
- -wetland rules
- -small landowners
- -federal assurances and legislature economic incentives to industry

How did the eastside-westside distinction evolve in FFR for the riparian rules? Why didn't any of the tribal or ENGO alternative proposals make that distinction? Why didn't this kind of distinction get made more at the level of the eco-province?

What are the funding provisions for FFR implementation? Will DNR have the capacity to enforce FFR?

What are the main strengths and weaknesses of the adaptive management provisions of FFR?

Does the potential for a 50-year HCP based on FFR limit the opportunity for adaptive management? Why or why not?

Does the ecological fragility of the listed salmon stocks limit the opportunity for adaptive management? Why or why not? (For example, how can we learn about the limits of salmon stock resilience unless we surpass those limits in at least some cases?)

What was the process for the Forest Practices Board to revise the FFR for approval as final new rules? Who was involved? What were the major changes that needed to be made? Why? Did the Society for Ecological Restoration critique have an influence? Did the ENGO lawsuits have an influence?

CMER - now

Is CMER likely to succeed as a case of adaptive management? Why or why not?

How has CMER's role and structure changed since FFR?

What is your role in CMER now?

How significant are FFR's "Key Questions, Resource Objectives, and Performance Targets for Adaptive Management" for guiding the activities of CMER?

How are problems defined in CMER? How do research priorities get set? What is the role of the Scientific Advisory Groups as opposed to the general Committee table?

How does CMER address the problem of rare events and their long-term influence over forest functioning and stream habitat?

How clear is CMER's role in affecting forest policy in Washington State? Does CMER have a significant influence over the TFW Policy Group?

How does CMER convey technical information to TFW Policy? Has there ever been any attempt to use computer gaming or similar modeling-type approaches to educating policy people?

How well are policy and technical issues distinguished in CMER? Does the Policy Group provide adequate policy guidance to CMER?

What commitments has the Policy Group made to change rules based on certain monitoring or research results? In other words, how do you know rules will get changed as warranted by CMER results?

What is CMER's relationship to the Forest Practices Board?

What are the ground rules for CMER? How do participants learn about them?

How effective are the CMER co-chairs in facilitating meetings? Do you consider them neutral? Why or why not?

Is CMER a true consensus process? What happens in the case of persistent conflict?

How do teamwork and group skills get developed in CMER?

How do CMER members represent their constituencies? Are they independent or strictly instructed?

How well is data shared in CMER? Is there a plan for data storage and availability?

What is the role of the Science Review Committee? What do they review? What is their composition?

Is CMER dominated by any specific personalities? Why?

What are some key projects underway right now?

What has been the success with the following research initiatives?

-perennial stream initiation point studies

-Last Fish model validation

-mass wasting model development

Monitoring Design Team

What is the greatest challenge in designing a comprehensive statewide monitoring plan?

How was the MDT originally put together?

How will monitoring results be interpreted and conveyed to the Policy Group?

What has been the degree of success in gaining cooperation from landowners at a landscape scale?

What are the legislative and regulatory barriers to monitoring programs?

What is the expected statistical power and strength of inference for each of the monitoring program levels?

Have any partnerships been established with other monitoring programs in the state? For example, the WRIA assessment program, or other sectors of the Governor's Salmon Recovery Plan?

Other Questions

How has the political climate for Washington State forest management changed since FFR? (Bush election, change in state Lands Commissioner)? How has this affected the progress of FFR and adaptive management?

What is the role of responsibilities to stockholders in industry's willingness to surrender timber value for the sake of ecological protection?

Since the original TFW agreement, how much progress have the various TFW caucuses made overall in understanding and accounting for (a) new scientific information; and (b) the interests of other caucuses?

Has the range of accepted practice changed for laying out roads and cutblocks since the original TFW agreement?

What are the major events and programs that enabled this learning?

How effective have the interdisciplinary (ID) teams of the original TFW agreement been in improving relationships and improving forest management?

Have the skills demands of your employer or clients changed over the history of TFW? If yes, how?

Do you think the frequent upheavals in Washington State forest policy have mostly improved learning, or mostly hindered it? (tribal and ENGO court cases, ESA listings, etc.)

What actions are currently underway to link forestry management initiatives with non-forestry initiatives? (WRIA assessments, the Governor's Salmon Recovery Plan, the Puget Sound Water Quality Action Team)

Are there any efforts underway to connect with local community groups for small-scale projects such as stream monitoring, etc.?

Is the Forest Practices Board an effective representative of the public interest?

Who do you talk to when you want to find out what's really happening at the Forest Practices Board, TFW Policy, CMER, the tribes, ENGOs, industry,

How have funding limitations affected your employer/client's ability to participate in TFW processes? How have funding limitations affected the overall effectiveness of TFW, WSA, CMER, and the MDT?

Verification

Is there anything we haven't discussed that is crucial to understanding the issues raised?

Special Questions for this Interviewee

APPENDIX C: TIMBER/FISH/WILDLIFE GROUND RULES

<u>TFW (1987: 162)</u>

1. "We will attempt to develop a system which provides:
    a. Minimum guarantees for everyone,
    b. Incentives which maintain and enhance timber, fisheries, and wildlife resources, and
    c. Future flexibility, accountability, better management, compliance with regulations and resource goals.
2. All participants in the negotiation are to bring with them the legitimate purposes and goals of their organizations. All parties recognize the legitimacy of the goals of others and assume that their own goals will also be respected. These negotiations will try to maximize all the goals of all the parties as far as possible.
3. This effort will receive priority attention, staffing and time commitments.
4. Give the same priority to solving the problems of others as you will your own.
5. Commitment to search for opportunities; without creativity there will be no plan or agreement.
6. Commitment to listen carefully; ask questions to understand and make statement to explain or educate.
7. All issues identified by any party must be addressed by the whole group.
8. State needs, problems and opportunities, not positions - positive candor is a little used but effective tool.
9. Commitment to attempt to reach consensus on a plan.
10. Commitment to be an advocate for an agreed plan.
11. Attempt to protect each other and the process politically with constituencies and the general public.
12. Weapons of war are to be left at home (or at least at the door).
13. Anyone may leave the process and the above ground rules, but only after telling the entire group why and seeing if the problem(s) can be addressed by the group.
14. All communications with news media concerning these discussions will be by agreement of group. Everyone will be mindful of the impacts their public and private statements will have on the climate of this effort.
15. No participant will attribute suggestions, comments or ideas of another participant to the news media or non-participants.
16. All rights, remedies, positions, and current prejudices are available to everyone if the effort is unsuccessful.
17. Participants are free to, and in fact are encouraged to, seek the best advice from their friends and associates informed of the progress of the discussions.

18. All of the individuals who are participants accept the responsibility to keep their friends and associates informed of the progress of the discussions.
19. If you hear a rumor, call facilitator before acting on it."

<u>27 June 1997 Revision (during Forests and Fish Report negotiations)</u>

1. "We will attempt to develop a system which provides:
    a. Minimum guarantees for everyone,
    b. Incentives which maintain and enhance timber, fisheries, and wildlife resources, and
    c. Future flexibility, accountability, better management, compliance with regulations and resource goals.
2. All participants in the negotiation are to bring with them the legitimate purposes and goals of their organizations. All parties recognize the legitimacy of the goals of others and assume that their own goals will also be respected. These negotiations will try to maximize all the goals of all the parties as far as possible.
3. This effort will receive priority attention, staffing and time commitments.
4. Give the same priority to solving the problems of others as you will you own.
5. Commitment to search for opportunities; without creativity there will be no plan or agreement.
6. Commitment to listen carefully; ask questions to understand and make statement to explain or educate.
7. All issues identified by any party must be addressed by the whole group.
8. State needs, problems and opportunities, not positions - positive candor is a little used but effective tool. If a caucus does not agree, don't say no without offering reasons why and alternatives.
9. Commitment to attempt to reach consensus on a plan. TFW uses a consensus process, which means that each caucus must agree to each proposal. Acceptance of a proposal means that the caucus can live with all parts of that proposal, and that the caucus will actively implement all parts of that proposal. Caucuses will be polled on each proposal. If all caucuses do not accept a proposal. It fails.
10. Commitment to be an advocate for an agreed plan.
11. Attempt to protect each other and the process politically with constituencies and the general public.
12. Weapons of war are to be left at home (or at least at the door).
13. Anyone may leave the process and the above ground rules, but only after telling the entire group why. If consensus cannot be reached on an issue or overall proposal after diligent effort, it will either continue to be modified until all can accept it and implement it, or it will be released to go to another forum. Release of an issue is an explicit action on which caucuses will be polled. Release will be accompanied either by (a) a specifically agreed upon

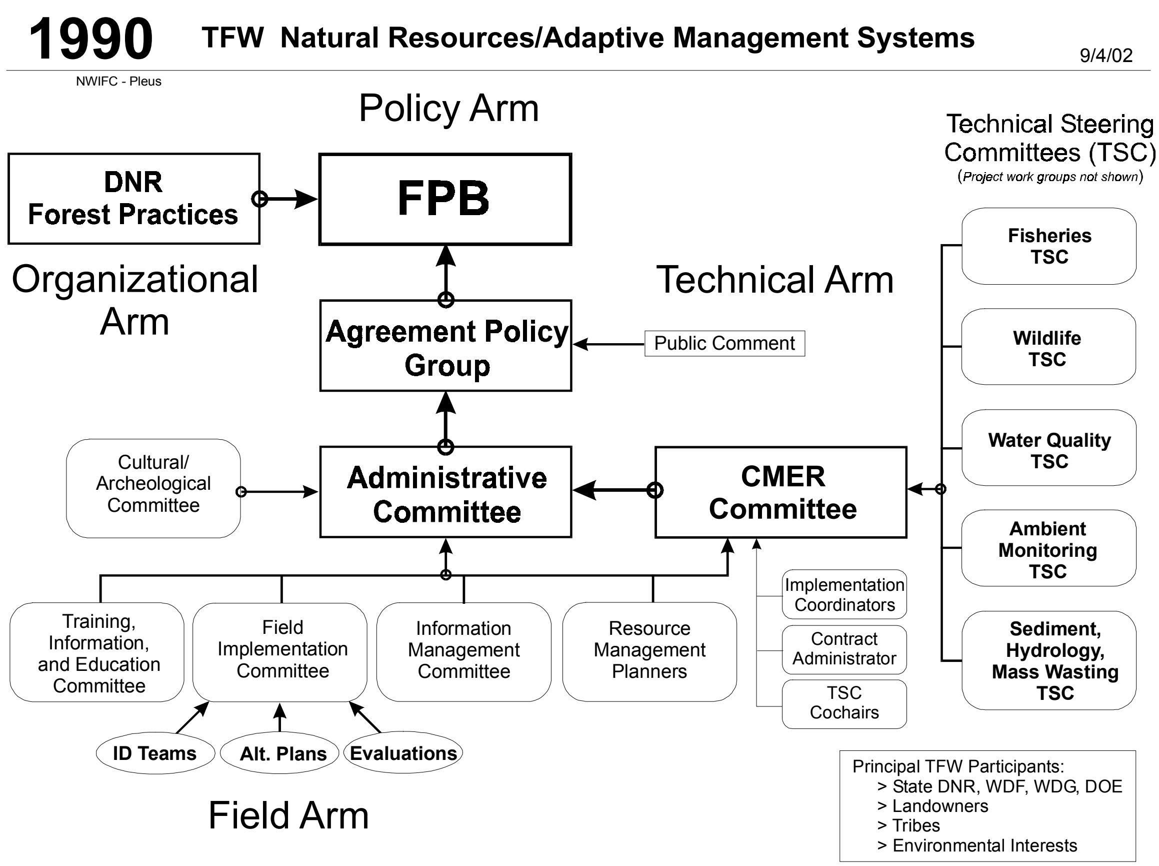
statement explaining the status of the issue, including any partial agreement or (b) by the default statement that no consensus was reached on the issue and no caucus is bound by any part of any partial agreement related to the issue. Final acceptance of any proposed major agreement resides with the governing boards of the members of each caucus. Each caucus decides how it will govern itself in reaching caucus decisions.

14. Each caucus should designate one press contact person, and the media will be directed to these designated contacts. Caucuses are free to talk to the press, but they should not negotiate their positions (or lobby their positions) in the press. At the closure of any TFW issue, the caucuses should agree on what message to give out, and not to give out: each caucus should make a good faith effort to respect the agreement. Affirmative statements should be drafted at the end of each Policy Group meeting as a common position to provide the press when needed. Everyone will be mindful of the impacts their public and private statements will have on the climate of this effort. A proactive approach should be used to get the word out to define the problems and explain what TFW is doing to resolve issues. This approach includes taking the message to the editorial boards.
15. No participant will attribute suggestions, comments or ideas of another participant to the news media or non-participants.
16. All rights, remedies, positions, and current prejudices are available to everyone if the effort is unsuccessful.
17. Participants are free to, and in fact are encouraged to, seek the best advice from their friends and associates informed of the progress of the discussions.
18. All of the individuals who are participants accept the responsibility to keep their friends and associates informed of the progress of the discussions."

APPENDIX D: FORMAL TIMBER/FISH/WILDLIFE ADAPTIVE MANAGEMENT PROGRAM, 1990

Unpublished figure and text by Allen Pleus and references, North West Indian Fisheries Commission, September 2002. This material has not been formally endorsed by any organization.

This document is a quick reference guide to a 1990 snapshot in time of the TFW Agreement's "Natural Resources Management" and "Adaptive Management" systems. The line between these systems is often confusing and/or contradictory in the literature and recollections of past participants. The intent of this reconstruction is to help the current adaptive management program understand its foundation so as not to re-invent, inadvertently change, or eliminate already established process and practices.



The illustration above is a draft reconstruction of the TFW Agreement committees and natural resources/adaptive management systems committees, groups, and organizations reporting relationships as interpreted from the TFW Agreement and the 1990 CMER Work Plan Notebook. Definitions are copied and pasted from documents as noted. The "Arms" of the Adaptive Management Program are derived from the "Defined Decision-Making Process[71]" section in the 1990 CMER Work Plan, Executive Summary section.

Natural Resources Management System[72] **-** The agreement will move people towards solving problems at the planning stage which is the stage at which everyone has the most flexibility. [The agreement will] Develop a management system which promotes participants and consensus while limiting the ability of anyone to abuse the process. The system must function in a timely, cost effective manner and promote informal resolution of problems or conflicts where possible. The agreement incorporates an adaptive management system which through cooperative and collaborative research, monitoring and evaluation will provide a widely accepted data base on which to base future management decisions.

Adaptive Management System[73] – Resources are managed using the best available information, with the understanding that policies and practices can be changed in response to research and monitoring results.

Policy Arm

The State Forest Practices Board[74] **(FPB)–** The Forest Practices Board was created as part of the Forest Practices Act of 1974 to administer Forest Practices Rules and Regulations. The

[71] "Agreement participants built a decision-making process that assigns organizational, policy, technical, and field questions to appropriate standing committees made up of specialists in the areas. Larger policy questions are brought before all participants."
[72] FFR Schedule N-1, "General Attributes of New Natural Resource Management System" bullets 3, 4, and 5.
[73] CMER 1990 Executive Summary, Key Aspects of the Timber, Fish, Wildlife Agreement (p. 3)
[74] CMER 1990, p.17

CMER Committee reports information up through the TFW Agreement structure to the Forest Practices Board.

The TFW Agreement Policy Group[75] – This Policy Group acts as a Board of Directors for the TFW Agreement participants, conducting strategic planning, setting priorities, and establishing funding levels. It also interprets and modifies the TFW Agreement. It provides the link to the state legislature, the Forest Practices Board, and the public. The CMER Committee reports to the Policy Group through the Administrative Committee.

The TFW Administrative Committee[76] **-** The Administrative Committee provides day-to-day management of the TFW Agreement. It frames and recommends modifications to the Agreement, policy measures, and priorities to the Policy Group, and oversees the TFW budgets and staff.

<u>Technical Arm</u>

The CMER Committee[77] **-** As the technical arm of the TFW Agreement, the CMER Committee is responsible for administering the design, implementation, and review of the CMER program. The CMER Committee's role may also include answering technical questions relating to the TFW Agreement, providing technical services to TFW Agreement participants, and reviewing relevant technical and scientific information. The CMER Committee receives its direction from the TFW Administrative Committee.

Technical Steering Committees[78] – Five Technical Steering Committees (Fisheries, Wildlife, Water Quality, Ambient Monitoring, and Sediment/Hydrology/Mass Wasting) each consist of a core of eight members, ensuring representation of the TFW constituencies, along with other interested parties, usually from technical backgrounds. TSCs handle a number of functions,

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[75] CMER 1990, p.17
[76] CMER 1990, p.17
[77] CMER 1990, p.13
[78] CMER 1990, p.14

including: a) Technical implementation of the projects and sub-programs identified as part of the CMER process; b) Technical review of study plans and proposals; and c) Technical assessment of ongoing projects, whether cooperative or contracted research .

TSC Implementation Coordinators[79] – An implementation Coordinator for each TSC is assigned to oversee the implementation and progress of specific research or monitoring projects. There is one coordinator assigned to each project. The Coordinator acts as the liaison between the TSC, the project contractors or managers, and the Contract Administrator.

TSC Cochairs[80] – Cochairs from both the CMER Committee and the TSC serve on ad hoc groups to develop committee procedures, operations recommendations, budgets, and agendas, along with sorting out project overlaps and duplications. The cohairs are asked to serve an overlapping two-year term.

Contract Administrator[81] – The Contract Administrator for the CMER Committee is usually a representative from DNR. The Administrator prepares and administers contracts based on: 1) state contracting/funding guidelines, and 2) information from the appropriate TSC.

Field Arm

The TFW Training, Information, and Education Committee[82] - This committee conducts information and education projects based on the needs of TFW Agreement participants. They coordinate and integrate media projects, review and coordinate training programs, and work with public groups who are not direct TFW Agreement participants. The CMER Committee uses this committee as a source of expertise in assuring that research results are made visible in a readily understandable manner.

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[79] CMER 1990, p.15
[80] CMER 1990, p.15
[81] CMER 1990, p.15
[82] CMER 1990, p.16

The TFW Field Implementation Committee[83] - This committee helps implement provisions of the TFW Agreement and the Forest Practices Act, along with other applicable regulations. They define implementation issues, evaluate implementation practices, and improve cooperative compliance. In addition, they deal with a number of statewide resource issues and work closely with other TFW Agreement committees. The CMER Committee works with them for review and testing feedback as well as to ensure that research data is smoothly transferred to interested parties.

> **ID Teams**: Interdisciplinary [ID] Teams are the most frequently used and the most highly visible of the [TFW] tools[84]. These teams are composed of specialists in areas such as wildlife biology, fisheries, hydrology, soils, geology, and forest engineering. When DNR determines that an issue requires additional field review, the issue is given "priority" status. Interdisciplinary Teams are assigned to the issues and are sent to the site to evaluate specific field conditions. After its examination, the Team makes recommendations to DNR.
>
> In order to provide a basis for understanding resource management interactions and the impacts of forest practices on public resources the participants agreed to develop and implement procedures for cooperative and collaborative monitoring and evaluating forest practices[85]. In addition, cooperative research studies will be undertaken. The results of these efforts will be used to improve future forest practices and identify where rules and regulations need to be modified. The ID Teams will play a major role in the monitoring and evaluation.
>
> **Alternate Plans**: Alternate planning means that a landowner may submit an alternate plan for site-specific practices which may vary from those set forth in the regulations. This gives the landowner more flexibility, providing the landowner can clearly

[83] CMER 1990, p.16
[84] CMER 1990 Executive Summary, "Tools of the Timber, Fish, Wildlife Agreement" page 3.
[85] FFR Schedule N-1, MANAGEMENT SYSTEM, Monitoring, Evaluation and Reseach

demonstrate how the variance will provide equal or better protection of public resources[86].

Evaluations: Annual reviews are used to identify potential issues and conflicts and to evaluate the effectiveness of the Agreement processes[87]. The third and eighth year of the Agreement have been targeted for in-depth reviews of the entire Agreement and the results of its implementation.

We will attempt to develop a system which provides…Future flexibility, accountability, better management, compliance with regulations and resource goals[88].

The TFW Cultural/Archeological Committee[89] – This committee's main charter is to develop systems and processes that will protect cultural resources. They serve as a forum for education, and act as a role model for resolving cultural resource management conflicts. They also serve as advocates for cultural resource protection in the state legislature and state agencies. CMER Committee interactions with this committee have not yet been defined.

The TFW Information Management Committee[90] – This committee is made up of administrators with expertise in data management. They establish data priorities, set data standards, coordinate data collection, and oversee quality control. The CMER Technical Steering Committee that handles information management will work with this committee to share ideas for integrating information concepts throughout the TFW Agreement environment.

Resource Management Planners[91] – A number of local interested parties have become active in putting together Resource Management Plans. Two Resource Management Plans being done

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[86] CMER 1990 notebook Executive Summary, "Tools of the Timber, Fish, Wildlife Agreement" page 4.
[87] CMER 1990 notebook Executive Summary, "Key Aspects of the Timber, Fish, Wildlife Agreement" page 3.
[88] FFR Schedule N-2, Timber/Fish/Wildlife Ground Rules, 1(c).
[89] CMER 1990, p.16
[90] CMER 1990, p.17
[91] CMER 1990, p.17

under TFW Agreement guidelines are underway: 1) on the Nisqually; and 2) in the Upper Yakima River basins. The CMER Committee has assigned members as liaisons to each process to monitoring the progress and see if individual Technical Steering Committee members might be able to help with research or monitoring efforts or projects.

Organizational Arm

DNR Forest Practices Division - Current forest practices rules and regulations provide a management framework for forest practices on state and private lands in the State of Washington[92]. The rules attempt to balance the needs of landowners with the protection of public resources--fish, wildlife and water quality. The T/F/W participants have identified several areas where in this current system is not meeting the needs of one or more of the parties involved.

The DNR manages the forest practices program as one of a number of land management, protective services, and regulatory responsibilities with which the agency is charged[93]. TFW participants have recognized that the recommendations proposed in this agreement will add substantially to the complexity of managing this program.

Confidence in the implementation of this new system is a key to the agreement reached by the TFW participants[94]. Adequate enforcement of rules and regulations is a necessary foundation in building and maintaining confidence in the system. Enforcement personnel need cross-training to have knowledge of the needs and goals of fish, wildlife, water, and archeological and cultural resources. The agreement will require additional enforcement personnel. They will coordinate their work with the ID Teams.

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[92] FFR Schedule N-1, MANAGEMENT SYSTEM, Introduction
[93] FFR Schedule N-1, MANAGEMENT SYSTEM, Program Administration
[94] FFR Schedule N-1, MANAGEMENT SYSTEM, Enforcement

APPENDIX E: RECOMMENDATIONS FROM TWO EVALUATIONS OF THE WATERSHED ANALYSIS PROGRAM

Collins and Pess (1997a: 1008)

"Make geographic boundaries consistent with salmonid ecosystem; increase interagency cooperation in evaluating cumulative effects of multiple land uses."

"Refine objectives for inputs to streams to take into account natural regime and to provide definite standard against which to measure success of prescriptions."

"Develop approach to assessing and addressing cumulative effects of changes to more than one input."

"Include all relevant inputs; develop necessary assessment tools; correct assumptions inconsistent with scientific literature."

"Ensure assessment methods develop all data needed for prescription writing; improve flow of information between assessment and prescription teams; increase effective use of scientific data in prescriptions."

"Develop objective method for evaluating the strength or level of confidence of prescriptions; use confidence level to focus monitoring priorities, to link confidence with level of hazard and risk, to provide quality control in prescription writing."

"Increase level of effort and clarify goals of monitoring, including determining effectiveness of prescriptions; effectiveness of management objectives for geomorphic inputs."

"Increase institutional learning: e.g., develop formal mechanism for making use of innovation by resource analysts; promptly analyze and make available data from prior watershed analyses."

"Strengthen focus on inventorying existing or potential problems that can be remedied, including inaccurate water typing, inventory of road erosion and landslide trigger sites."

"Define restoration goals; develop assessment methods, including assessment of historic productive capacity."

Collins and Pess (1997b: 994) (emphases in original)

"*Testing assumptions of the scientific assessment* will strengthen both the assessment and prescription components of watershed analysis."

"*Improving the rigor with which prescriptions are based on scientific literature and the scientific assessment process* will also strengthen watershed analysis."

"*Formally considering the certainty of prescriptions* could also improve the prescription process."

Sullivan et al. (The "CMER Review"; 1997: 58)

The CMER review of Watershed Analysis never advanced beyond the late draft report stage. The following quotation is from that late draft. Thus, the recommendations are less refined than those of Collins and Pess (1997a, b).

"Watershed Assessement

- Improve Existing Modules
- Structure and improve content of Synthesis Analysis
- Redo Watershed Report formatting, content
- CMR reporting (resource objectives, triggering mechanism, justification)
- Develop Level 1 Analysis
- Watershed and Fish Habitat Modeling
- Fish passage assessment
- Add Wildlife Module

Prescriptions and Watershed Report

- New Rule Call Box
- Manual guidance for the prescription process (including content, detail, adequacy, justification)
- Prescription writing worksheet
- Prescription catalogue
- Decision tools (e.g., [the model that emerged from WAU A — see Section 7.4.2.1])
- Management objectives
- Manager's prescription implementation package

Review Processes and DNR Administration

- Peer Review process improvements
- Pre-SEPA review process improvements
- SEPA review process guidelines
- DNR policy guidelines and training
- DNR guidance documents
- Unclog backlog

Team skills

- Manual guidance on team skills

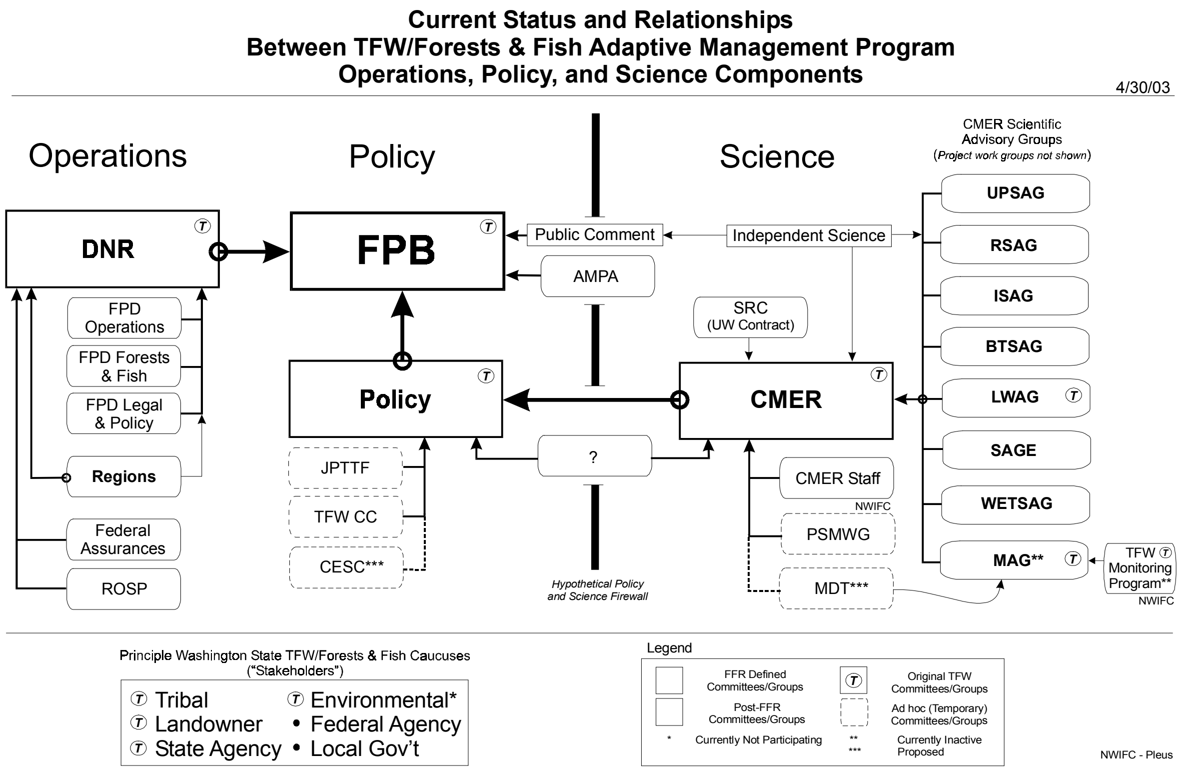
Policy

- Improved policy guidance (risk, values, goals)
- Monitoring
- TFW expectations
- Restoration guideline strategies”

APPENDIX F: TIMBER/FISH/WILDLIFE AND FORESTS AND FISH GROUPS AND RELATIONSHIPS, 2003

Unpublished figure and text by Allen Pleus and references, North West Indian Fisheries Commission, April 2003. This material has not been formally endorsed by any organization.

The Forests and Fish/Adaptive Management Program process continues to evolve. The relationships chart below provides a general overview on how the components of the process currently functions. For more information on participant relationships, refer to Chapter 222-12-045 WAC rules related to the Adaptive Management Program.



Quick Acronym Reference (in alphabetical order)**:**

AMPA	Adaptive Management Program Administrator	**MDT**	Monitoring Design Team (Ad hoc)
BTSAG	Bull Trout Scientific Advisory Group	**Policy**	Forests and Fish Policy Group - Timber/Fish/Wildlife Policy Committee
CESC	Cumulative Effects Steering Committee	**PSMWG**	Protocols & Standards Manual Work Group
CMER	Cooperative Monitoring, Evaluation, and Research	**Regions**	Central, South Puget, Northeast, Southeast, Northwest, Southwest, Olympic
DNR	Department of Natural Resources – Regulatory Programs	**ROSP**	Riparian Open Space Program
FPB	Washington State Forest Practices Board	**RSAG**	Riparian Scientific Advisory Group
FPD…	Forest Practices Division – Olympia Headquarters	**SAGE**	Scientific Advisory Group - Eastside
ISAG	Instream Scientific Advisory Group	**SRC**	Scientific Review Committee
LWAG	Landscape and Wildlife Advisory Group	**TFW CC**	Timber/Fish/Wildlife Cultural Committee
JPTTF	Small Forest Landowner – Joint Policy Technical Task Force (Ad hoc)	**UPSAG**	Upslope Processes Scientific Advisory Group
MAG	Monitoring Advisory Group	**WETSAG**	Wetlands Scientific Advisory Group

Prior to the Forests and Fish Report (FFR), the Timber/Fish/Wildlife (TFW) process was used, since 1987, to resolve forest management disputes between resource stakeholders. Since implementation of FFR on April 29, 1999, some TFW groups were dissolved or mothballed and many new groups, committees, ad hoc groups, and staff have evolved to fill adaptive management program needs. The following is a brief background summary on the committees and groups identified on the chart.

The FFR Appendix L identified five key adaptive management participants (yellow shaded boxes) including the Forest Practices Board (FPB), the TFW Policy Committee (Policy), the Adaptive Management Program Administrator (AMPA), the Cooperative Monitoring, Evaluation, and Research (CMER) committee, and an Scientific Review Committee (SRC).

Implicit in the adaptive management loop is the operational functions of the Washington State Department of Natural Resources (DNR) and their Forest Practices Division (FPD). The DNR FPD is divided into Operations, Forests & Fish, and Legal & Policy sub-divisions. Operations covers forest practices applications and permits, water typing, compliance, and enforcement components. Forest & Fish covers Forest Practices Board (FPB) manuals, the Small Forest Landowner Office (SFLO), rule tools, interdisciplinary teams, training, alternate plan development, and the road maintenance and abandonment plan (RMAP) processes. A DNR Federal Assurances group was formed under the Executive Director of Regulatory Programs to develop and manage the FFR Habitat Conservation Plan (HCP) due to be completed in 2005. The Riparian Open Space Program (ROSP) is an incentive program designed to acquire large channel migration zones to compensate for lost landowner revenues (Chapter 222-23 WAC).

Six new CMER Scientific Advisory Groups are currently working on adaptive management technical issues including the Upslope Processes (UPSAG), Riparian (RSAG), Instream (ISAG), Bull Trout (BTSAG), the Scientific Advisory Group – Eastside (SAGE), and Wetlands (WETSAG). The Landscape and Wildlife Advisory Group (LWAG) and the Monitoring Advisory Group (MAG) pre-date FFR. MAG is also currently being proposed for reinstatement to implement the findings of the Monitoring Design Team (MDT). The MDT was formed at the request of policy to design the foundation and main structure of the CMER monitoring process for adaptive management. A final report has not been published to date. The TFW Monitoring Program staff was reassigned as CMER Staff during the MDT process. The Protocols & Standards Manual Work Group (PSMWG) is tasked with developing and documenting how CMER does business into a comprehensive manual.

CMER is directed by the Forests and Fish Policy Group (FFPG or "Policy"), although the FFR defined pathway is through the Timber/Fish/Wildlife Policy Committee. It has not been resolved whether FFPG replaces them or is a sub-group of them. Policy currently has two sub-committees, one working on Small Forest Landowner - Joint Policy Technical Task Force issues (JPTTF), and the other working on a Cultural Resources Plan (TFW CC). The Cumulative Effects Steering Committee (CESC), a former TFW component, is currently being proposed for reinstatement to work on cumulative effects and watershed analysis processes.

Outside of the Forests and Fish participants, the general public can provide input directly to the FPB at their regular quarterly meetings by public comment. In addition, science developed outside or independent of the CMER adaptive management process may be brought into the process through a Scientific Advisory Group or CMER (FFR Appendix L.2[b][I]).