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The Expanding Role of Scientists in Natural Resource Policy

Bioregional Assessment in the United States and Europe

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ABSTRACT

This paper deals with the role of science in large scale ecosystem projects, in particular bioregional assessment, in the United States and Europe. Bioregional assessment is a relatively new approach to ecosystem management that involves a scientific assessment of a so-called "bioregion" - an area that is demarcated by ecological instead of political boundaries. Scientists play an important role in this approach which is closely related to policy. The goal of this paper, therefore, is to examine new roles of science in natural resource policy and to study the reflection of these roles in bioregional assessment or similar approaches in the U.S. and Europe.

The author developed her research design in accordance with grounded theory, which is a methodological approach to generate theory from qualitative data. The research was based on case studies that were used to develop general categories describing the role of science in ecosystem projects. The cases were examined by interviewing scientists as experts who had participated in the projects or activities.

The concept of bioregional assessment originates from the United States where several large bioregional assessments were conducted in the 1990s. Three of them were analyzed for this study: the Forest Ecosystem Management Assessment Team (FEMAT), the Interior Columbia Basin Ecosystem Management Project (ICBEMP), and the Sierra Nevada Ecosystem Project (SNEP).

For the European context, the International Commission for Protection of Lake Geneva (CIPEL) was chosen as a single case. CIPEL is a French-Swiss organization that involves scientists as advisors to managers and policy makers. Although CIPEL is not a direct equivalent of the American cases of bioregional assessment, certain patterns and characteristics of science involvement are detectable in both types of projects and organizations.

The results of this thesis show that the participation in large ecosystem projects forces scientists to play a "new" role that significantly differs from traditional modes of academic and scholarly research. Several features characterize this new role. The complexity of environmental issues promotes interdisciplinary and transdisciplinary collaboration. Scientists must overcome traditional boundaries and improve their communication skills in order to interact with scientists from other disciplines, managers, and the public. Furthermore, scientists address policy problems that place their research in a broad, implementation oriented and often controversial context. Scientists working on political problems, however, risk becoming advocates for particular policy solutions, threatening their scientific credibility. When addressing policy questions, scientists are always caught in the area of conflict between fact and value based decision making.

The general development towards scientists playing a new role in natural resource policy occurs in the U.S. as well as in Central Europe. The legal framework, cultural and political environments, however, are responsible for a different perception of science in different societies. They are also reflected in the way in which ecosystem management is approached and organized on the two continents, causing an understanding of bioregions in Europe that significantly differs from the northern American approach.

ZUSAMMENFASSUNG

Thema dieser Arbeit ist die Rolle der Wissenschaft in Ökosystemmanagementprojekten, vor allem "Bioregional Assessment", in Europa und in den USA. "Bioregional Assessment" ist ein relativ neuer Ansatz des Ökosystemmanagements, bei dem Wissenschaftler eine sogenannte "Bioregion" untersuchen, ein Gebiet, das nicht aufgrund politischer sondern aufgrund ökologischer Grenzen definiert wird. Wissenschaftler spielen eine wichtige Rolle bei diesem Ansatz, der sie oft in die unmittelbare Nähe politischer Entscheidungsfindung stellt. Ziel dieser Studie ist es, neue Rollenmodelle der Wissenschaft in der Ressourcenpolitik zu untersuchen und diese mit den Aufgaben der wissenschaftlichen Beratung im Ökosystemmanagement in Europa und den USA in Beziehung zu setzen.

Bei ihrem wissenschaftlichen Vorgehen orientierte sich die Autorin an der "Grounded Theory", einem methodischen Ansatz, der es erlaubt, Theorie auf der Basis qualitativer Daten zu entwickeln. Die Daten wurden anhand von Fallstudien erhoben, die als Grundlage zur Entwicklung allgemeinerer Kategorien dienten. Dazu wurden Wissenschaftler, die an den entsprechenden Projekten oder Organisationen beteiligt waren, in offenen, leitfadenorientierten Experteninterviews befragt.

Die ersten großen Bioregional Assessments wurden in den neunziger Jahren in den USA durchgeführt. Drei dieser Assessments wurden für diese Arbeit untersucht: das "Forest Ecosystem Management Assessment Team" (FEMAT), das "Interior Columbia Basin Ecosystem Management Project" (ICBEMP) und das "Sierra Nevada Ecosystem Project" (SNEP).

Als europäisches Beispiel wurde die Internationale Kommission zum Schutz des Genfer Sees (CIPEL) ausgewählt. CIPEL ist eine binationale Organisation, in der Wissenschaftler als Berater für Politik und Management fungieren. Obwohl CIPEL nicht als Bioregional Assessment im amerikanischen Sinne bezeichnet werden kann, spiegelt es doch etliche Muster und Merkmale wissenschaftlicher Politikberatung wider, die sich in sehr unterschiedlichen Projekten und Organisationen im Bereich des Ökosystemmanagements finden lassen.

Die Ergebnisse der Arbeit zeigen, dass die Teilnahme an großen ökosystemorientierten Projekten Wissenschaftler in eine „neue" Rolle zwingt, die sich signifikant von traditionellen Formen akademischer Wissenschaft unterscheidet. Im Rahmen dieser Rolle übernehmen Wissenschaftler Funktionen, die den ursprünglichen Aufgabenbereich eines Wissenschaftlers überschreiten. So fördert die Komplexität der Probleme interdisziplinäre und transdisziplinäre Zusammenarbeit. Wissenschaftler müssen traditionelle Grenzen überwinden und ihre kommunikativen Fähigkeiten verbessern, um mit Vertretern anderer Disziplinen, ausführenden Organen und der Öffentlichkeit kooperieren zu können. Zudem treffen sie im Bereich des Ökosystemmanagements auf politische Probleme, die ihre Forschung in einen größeren, anwendungsorientierten Zusammenhang stellen. Dieses politische Feld ist oft von Konflikten geprägt, in denen engagierte Wissenschaftler ihre Meinung auch offensiv vertreten. Dabei laufen sie jedoch auf Dauer Gefahr, an wissenschaftlicher Glaubwürdigkeit zu verlieren, da die Öffentlichkeit die Probleme, Kontroversen und Meinungshaltungen in der Wissenschaft stärker wahrnimmt, wenn diese öffentlich debattiert werden. Letztendlich steht Wissenschaft in der Politikberatung immer im Spannungsfeld zwischen "rationaler" wissenschaftlicher Meinung und wertorientierter Entscheidung.

Sowohl in Europa als auch in den USA läßt sich die Entwicklung neuer Rollenmodelle in der Wissenschaft beobachten. Die rechtlichen, politischen und kulturellen Rahmenbedingungen führen jedoch zu einem sehr unterschiedlichen Wissenschaftsbild in den verschiedenen Gesellschaften. Dies zeigt sich unter anderem in der Art und Weise, wie Wissenschaftler mit ihrer Rolle in der Politikberatung umgehen, und wie die Bevölkerung diese Rolle wahrnimmt. Auch die Ansätze „bioregionalen" Ökosystemmanagements in Europa unterscheiden sich deutlich von der nordamerikanischen Herangehensweise.

CHAPTER I

INTRODUCTION

The important thing in science is not so much to obtain new facts as to discover new ways of thinking about them.

(Sir William Bragg) [1]

A thing is right if it tends to preserve the stability, integrity, and beauty of the biotic community. It is wrong if it tends otherwise.

(Aldo Leopold) [2]

The idea for this paper evolved from a course called "Governing at the Bioregional Scale: Implications of Bioregional Science - Policy Assessments in the United States," which the author attended in 1999. The course dealt with "bioregional assessment" as a new approach to ecosystem management focussing on "bioregions" which are large geographic areas defined by ecological boundaries. In a bioregional assessment, a group of scientists assemble to study a particular bioregion, in order to provide integrative information as a base for political decision making.

The story of bioregional assessment began in the late 1980s in the U.S. Pacific Northwest. The Forest Service and the Bureau of Land Management, as well as other public land management agencies, were involved in a series of law suits. These law suits were a result of a conflict familiar to forest managers around the world: commodity production versus biodiversity protection, that is, the timber industry versus environmental associations. In Central Europe, these conflicts are generally addressed by a mélange of political activities that involve confidential negotiation between public agencies and the different stakeholders, pluralistic advisory committees, and public campaign by more activist interest groups.[3] Environmental conflicts in the U.S. are often negotiated in court where various stakeholders attempt to convince judges of their technical arguments.[4] In order to escape never-ending litigation in the Pacific Northwest, the federal government eventually initiated a number of bioregional assessments in which scientists were given the opportunity to find scientific solutions for political problems. The assessment areas were defined by ecological boundaries widely exceeding the political borders of counties, states, or federal planning units. An example of this is the habitat of wide-ranging species such as the northern spotted owl.

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1 Sir William Bragg 1862-1942, American physicist, Nobel Prize in 1915 http://www.quotationspage.com/quotes/Sir_William_Bragg/

2 Aldo Leopold, 1887-1948, American ecologist, forester, "father of wildlife ecology", first to develop a concept of "land ethics", http://www.geocities.com/~spanoudi/alpha-l2.html

3 Brickmann et al., 1985, p. 310

4 Yearly in „Handbook of Science and Technology Studies", 1995, p. 465

Scientists play a particularly important role in bioregional assessment (also called scientific assessment). The context of broad geographical scales and the political aspects of the problem challenge traditional modes of scientific research. Therefore, the focus of this study is guided by the two words making up the term "bioregional assessment." Bioregional aspects encourage the researcher to ask: What is a bioregion? How is a bioregion defined? Where does the bioregional idea originate? The scientific assessment part evokes the questions: What role do scientists play in the effort? How far do they approach policy and management issues?

Grounded theory was chosen as a methodological approach to address these broad issues (see research design, p. 20.) Grounded theory, "discovered" by Glaser and Strauss in 1967, is a methodological framework for generating theory from qualitative data.[5] As opposed to the classic mode of quantitative research, grounded theory omits test hypotheses drawn from deductively developed theory.[6] The approach relies on concrete data that serves as a base for the "discovery" of general categories and concepts that eventually form theory and hypotheses. Crucial to grounded theory is the understanding that *"Generating a theory involves a process of research,"*[7] and therefore the emerging theory is continuously verified, modified and enhanced during the course of research.

Grounded theory relies on comparative analysis as a strategic method for generating theory.[8] Incidents or cases that appear to be in the same general category are constantly compared with each other and their similarities and differences help to define categories and concepts.[9] The cases, however, are compared because of their relevance for emerging theory, not for their own sake.[10]

This paper initially intended to compare bioregional assessment in Europe with bioregional assessment in the United States. However, the particular context for bioregional assessment in the U.S. differentiates the effort from similar approaches to ecosystem management in Europe. It soon became clear that an exact comparison would be impossible to realize. Thus, by using grounded theory as methodological framework, it became possible to "compare the non-comparable."[11]

In light of grounded theory, all cases that contribute to the illumination of new roles for science in ecosystem management and display bioregional features are relevant for this study. Thus, from the European perspective, an organization dealing with the protection of a large

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[5] Glaser, Strauss, 1998, p. 12
[6] Flick, 1996, p. 56
[7] Glaser, Strauss 1967, p. 6
[8] Glaser, Strauss 1967, p. 21
[9] Ragin, 1994, p. 93
[10] Glaser, Strauss 1967, p. 49
[11] Glaser, Strauss, 1998, p. 50

aquatic ecosystem was analyzed: the International Commission for the Protection of Lake Geneva (CIPEL). The American perspective is represented by three bioregional assessments: the Forest Ecosystem Management Assessment Team (FEMAT), the Interior Columbia Basin Ecosystem Management Project (ICBEMP), and the Sierra Nevada Ecosystem Project (SNEP).

This paper is mainly organized along the chronological order of the research process. The first chapter closes with the introduction of the research question. In the second chapter the author then provides a brief literature review on the three theoretical branches guiding this paper: the role of science in natural resource policy, the dynamics and management of large ecosystems, and the characteristics of bioregions and the bioregional movement. In the third chapter, the research design is presented in more detail, including the concept of grounded theory and the methodological tools used for data collection. The fourth chapter contains the case study on CIPEL and the categories drawn from interviews with CIPEL scientists. The fifth chapter moves across the Atlantic Ocean to the case studies of bioregional assessment in the United States. In order to comply with the logic of grounded theory, this chapter is not organized by case study, but follows the research process step by step from background and data presentation to results and conclusion. The sixth chapter then contrasts findings from the U.S. with findings from Europe and provides an outlook on possible questions for further research. In the seventh chapter the findings from all cases are eventually integrated into a final conclusion.

Due to the initial research interest driven by the course on bioregional assessment, this paper focuses on science and bioregional assessment in a U.S. context and is predominately based on U.S. scientific literature. The reader, however, should note that a variety of cases and theories exist in Europe that deal with the topic of this paper. The author consciously ignored most of the European literature in order to place the experiences of the American scientists in their appropriate context. She attempted to return to Europe with new insights in American approaches to ecosystem management from an American perspective.

THE RESEARCH QUESTION

Due to the fact that this study is based on the methodological framework of grounded theory (see research design, p. 20), the definition of the problem was part of the research process. The initial research question, therefore, was only broadly defined:

- *What is the role of science in large ecosystem projects such as bioregional assessment?*

The question underwent continuous modification and specification as the research process developed. After a brief literature review, the first case study on the "Commission Internationale pour la Protection des Eaux du Léman" (CIPEL) was guided by a slightly amended set of questions that focused on the triangle science-policy-management:

- *What is the role of science in CIPEL?*
- *What is the role of management in CIPEL?*
- *How does science in CIPEL influence policy?*

The categories developed from the CIPEL study constituted the basis of the questions that guided the further research in the United States. The author, however, soon realized that the role of science in large ecosystem projects such as bioregional assessment could not be appreciated without the more general context of the role of science in natural resource policy. Hence, the focus broadened towards the interaction between the role of science in bioregional assessment on the one side, and in natural resource policy on the other. Since bioregional assessment is a relatively recent development, current changes in the role of science were of particular relevance in this context.

The "problem definition process" resulted in three major assumptions that should guide the interviews in the United States.[12]

1. *In the U.S., the role of science in natural resource policy has changed in the last years and decades. Scientists become more involved in policy making.*
2. *This is due to a more systemic and less institutionalized approach.*
3. *Bioregional assessment is part of this approach and has helped to shape it.*

For each assumption, a set of key questions was developed in order to specify the field of interest:

[12] Note: The author uses the term assumption in order to distinguish it from the classic scientific hypothesis. In the context of grounded theory, a hypothesis or assumption constitutes suggested, not tested, relations among categories that are increasingly verified during the course of research. (Glaser, Strauss, 1967, p. 39)

1. *In the U.S., the role of science in natural resource policy has changed in the last years and decades. Scientists become more involved in policy making.*
- What is the current role of science in natural resource policy in the U.S.?
- What was the past role of science in natural resource policy in the U.S.?
- Has there been a change in the last years and decades?

2. *This is due to a more systemic and less institutionalized approach.*
- If a change has occurred, what are the reasons for it?
- Is this change connected to a general tendency to work on broader scales?

3. *Bioregional assessment is part of this approach and has helped to shape it.*
- What is the role of science in bioregional assessment?
- Does this role differ from the role of science in natural resource policy in general?
- Does Bioregional assessment force science integration?
- Does the role of science in bioregional assessment impact the role of science in natural resource policy in general?

CHAPTER II
THEORETICAL BACKGROUND

1 SCIENCE, ECOSYSTEMS AND BIOREGIONS IN LIGHT OF THEORY

This chapter introduces theoretical aspects that are helpful for the understanding of this thesis. Section one deals with the "first branch" of theory relevant for this paper which is the role of science in natural resource policy, its history, characteristics, and conflicts. Section two refers to the "second branch" of theory which concerns ecosystem evolution and management. The concept of "ecosystem dynamics" describes the development of ecosystems as four-phase cycles. Adaptive management and the broader approach of "social learning" constitute two approaches to managing such dynamic systems that were discussed in certain bioregional assessments and affected the role of scientists in the effort. Section three contains some important definitions and introduces the idea of "bioregionalism" as a background for bioregional assessment.

1.1 The Role of Science in Natural Resource Policy

1.1.1 Science Policy Interaction in the United States: A Changing History

The role of scientists in American society has undergone a long evolution throughout the last centuries.[13] The recognition of science as a basis for societal decisions began in the 19th Century with the industrial revolution. Science was necessary to foster progress and facilitate technological development.[14] Another impetus for the rise of science came from the European "enlightenment" in the 17th and 18th Centuries where the theological postulate that only religion could provide universal truth was broken by writers who committed themselves to the power of rationality.[15] By means of observation and reasoning, science reconceived explanations of reality beyond religion and political rhetoric.[16] The new confidence in science was supported by the concept of positivism, particularly identified with the writings of the philosopher Auguste Comte.[17] Positivism is based on the assumption that humankind can reach a complete understanding of reality. Thus, science is the key to discovering the truth of both physical and social affairs, in the same way that Newton discovered the law of universal gravitation. According to Comte, science is thoroughly objective; scientists use quantitative methods to generate empirical evidence about the world.

At the end of the 19th century, science began to conquer public institutions. Scientifically interested administrators regarded skills and expertise as the cornerstone of regulatory

[13] Note: Whenever the author mentions the role of science in policy, this refers also to natural resource policy.
[14] Walters, 1997
[15] Steel et al., 2001, p. 5
[16] Walters, 1997
[17] Steel et al., 2001, pp. 6-7

activities. Therefore, agencies expected their employees to acquire technical knowledge in addition to experience.[18] Administrations increasingly specialized and established inner-agency research branches, as was the case with the U.S. Forest Service in 1928.[19] By the middle of the 20th Century, the public agencies had become veritable "expert agencies" that combined expertise, regulation and management within the same bureau.

As opposed to the comprehensive expert agencies, independent research underwent a development more impartial to policy. Since the middle of the 20th Century, science and research became increasingly incorporated into separate institutions such as the National Science Foundation, which was formed in 1950.[20] Along with institutionalization came an ongoing specialization and fragmentation of scientific disciplines. Although science and its technical results were an important part of American life, scientists were hardly encouraged to take part in political debates: *"It (American society) makes science a convenient abstraction rather than a unified entity in whose name one can speak."* [21] Moreover, academic and organizational scientists themselves were rather reluctant to become directly involved in policy. Scientists, who were often publicly funded, fostered the "ethos of disinterestedness" and remained detached from policy and practical matters.

In the 1960s and 1970s science policy interaction in the U.S. was strongly effected by a number of major events and developments. In 1962, Kuhn's "The Structure of Scientific Revolutions" provided a thoroughly new perspective on science. According to Kuhn, science is dominated by a certain paradigm or theoretical framework that summarizes the scientific knowledge accepted as true by a particular discipline.[22] New research or theories can challenge the existing paradigm, lead to a crisis and eventually cause a "paradigm shift". Kuhn's view of science contradicts the positivist supposition that science reveals the existing structure of the world. It suggests that science is continuously changing and evolving in response to scientific criticism. Kuhn also identifies a division of science into disciplinary communities.[23] Each community uses its own methods, models, language, and paradigms. According to Kuhn, communication and even collaboration between these disciplines is difficult, if not impossible.

Although critics seriously questioned the positivist model of true and objective science, scientists were increasingly called to give advice and provide decision makers with credible information. This development was rooted in the environmental and social movement of the 1960s, which demanded significant changes in organization and behavior of society. In 1965, Rachel Carson published her classic book "Silent Spring", which pointed to the danger of

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[18] Jasanoff, 1990, pp. 9-11
[19] Shannon, 1996
[20] Walters, 1997
[21] Walters, 1997
[22] Steel, 2001, p. 5
[23] Goldstein in "Bioregionalism", 1999, pp. 157-168

polluting substances. In the U.S. it manifested the growing public concern about the future of the planet, and the dark side of human development and technology.[24] In subsequent years environmental interest groups such as Greenpeace and Friends of the Earth were founded. In 1970, the environmental movement culminated in the celebration of Earth Day. These events effected science-policy interaction in two ways. Firstly, the environmental and social movement prepared the ground for participatory and democratic models of policy development. It called for direct public influence on political decisions and the disclosure of policy processes in an "open government." Secondly, environmentalists discovered that science was a useful means to support environmental arguments and to claim the revision of political decisions.[25] The public doubted that the traditional expert agency had the ability to deal with complex problems and assess high risks. It called for external scientific advice and open consultation processes.

The legislator responded to these public demands by introducing new charters, such as the Freedom of Information Act (FOIA) in 1970 and the Federal Advisory Committee Act (FACA) in 1972, which set standards for agency research and scientific advice. It obliged the agencies to use more publicly generated scientific information and consult external scientists.[26] These statutes established a "new type of expert agency" that was required to take on a variety of scientific duties, such as conducting and funding research and risk assessments. The agencies, however, remained powerful. Due to their technical and political skills, they continued to make decisions on the appropriate use of science in regulatory activity.

In the late 1970s, the power of science-policy determination began to shift from the agencies to the courts.[27] During this period, environmentalists closely observed agency activity with regard to natural resource management and began accusing the agencies of reacting too slowly to new scientific knowledge and risk evidence. They demanded legally defined planning and consultation processes that would provide specific mandatory direction for agency activity, and stressed that regulatory decision should be objective and peer reviewed.[28] The courts increasingly began to rule in favor of citizen interveners, forcing the agencies to "take a hard look" at the latest technical evidence and scientific information available to decision making processes.

By the mid-1980s resource managers had realized that their decisions needed to be based on the best available science. However, effective methods for incorporating current scientific information into management practices had yet to be discovered.[29] As court decisions

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[24] Yearley in "Handbook of Science and Technology Studies", 1995, pp. 457-479
[25] Yearley in "Handbook of Science and Technology Studies", 1995, pp. 45-479
[26] Jasanoff, 1990, pp. 45-50
[27] Franklin in "Bioregional Assessments", 1999, pp. xi-xiii
[28] Jasanoff, 1990, pp. 49-57
[29] Franklin in "Bioregional Assessments", 1999, pp. xi-xiii

continued to challenge the agency's land management practices, the agencies increasingly lost scientific credibility with the federal government and the public. Alternative methods for managing resources and framing management options had to be explored. In the early 1990s, the first bioregional assessments conducted in the Pacific Northwest attempted such an alternative approach, providing a key role for independent scientists.

1.1.2 What is Science?

Today the science policy debate continues to revolve around the same question: "what is science?" Two extreme perspectives can be differentiated: the positivist perspective, based on 19th Century positivism; and the constructivist perspective, based on science criticism such as Kuhn's theory of paradigm change. Traditional academic science mainly relies on a positivist model of science: *"Science is a process by which scientists explain and predict some type of phenomenon, event, or behavior using a certain form of rigorous, quantifiable inquiry."*[30] Hence, scientists develop theory and hypotheses based upon empirical observation. The constructivist model understands science as a social construction: the scientific community is embedded in the social world existing beyond it. According to Fleck, who was an early representative of the constructivist doctrine, science is a combination of culture-based values and objectivity.[31]

The underlying definitions of science are reflected in the debate surrounding science advocacy.

1.1.3 Science Advocacy

The debate regarding science advocacy deals with the question of whether scientists should be allowed to advocate particular solutions. Critics of the positivist perspective assert that advocacy is a natural characteristic of science, not limited to science policy involvement.[32] More positivist writers argue that science advocacy can be defined as crossing the boundary between science and policy.[33] Central to this discussion is the question, if and how scientists should participate in policy, and which norms should guide their involvement. Literature suggests a variety of concepts and models for integrating science into policy. This paper, however, will center on the role of scientists in bioregional assessment and scientist's own ideas and attitudes towards science advocacy with its implications for science policy involvement. The following paragraph presents two major approaches, that provide a general framework for evaluating science policy interaction in natural resource projects.

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[30] Steel et al., 2001, p. 4
[31] Goldstein in "Bioregionalism", 1999, pp. 157-168
[32] Shannon, 1996
[33] Jasanoff, 1990, p. 208

1.1.4 The Technocratic and the Democratic Approach

In "The Fifth Branch", Jasanoff summarizes two antithetic models of science policy integration: the technocratic and the democratic approach.[34] The technocratic approach is rooted in a positivist perception of science. Science is the objective exercise of finding facts, and hence it is possible to distinguish good science from bad science.[35] Good science is methodologically sound, reliable, reproducible and peer reviewed. Bad science has either refused to follow the established scientific process, or failed to satisfy all its requirements. Good scientific knowledge is the key to successful decision-making. Advocates of the technocratic view believe that regulatory failure is caused by insufficient consultation of science advisors. Thus, science advisory committees should take a greater responsibility in framing solutions and evaluating alternatives. At the same time, the technocratic model rests upon the notion that facts and values can be separated in a policy making process. Scientists deliver propositions based on scientific facts, which policy makers enrich with values to finally arrive at a decision. A clear boundary persists between science and policymaking. Scientists, therefore, can present the "scientifically best" solution, but they may not advocate for a particular choice if personal values or interests are concerned.

The democratic approach originates from a participatory view of policy making. It emphasizes the need to involve a full range of values in decision making, as well as in developing alternatives. Proponents of the democratic approach argue that facts and values are inseparable; science, therefore, must be socially constructed and biased by nature. The question is not if scientists are advocates, but which norms are suited to guide scientist-advocates as they become more and more involved in policy making.[36] According to Collingridge and Reeve, science is only one of various interests and values that should be integrated into an open decision making process.[37]

1.2 <u>Concepts of Ecosystem Evolution and Management</u>

1.2.1 Dynamics of Large Ecosystems

Bioregional assessments deal with large ecosystems and their development. According to Holling, ecosystems pass through a cycle of four phases: exploitation, conservation, release, and reorganization *(see figure 1).*[38] During the exploitation phase, recently disturbed areas are rapidly colonized. Subsequently, the system moves from exploitation to conservation, slowly accumulating a "capital" of biomass and nutrients, and increasing in stability and connectedness. Continuous accumulation of material eventually leads to "over-connectedness", with the system becoming highly susceptible to disturbance. In the next phase biomass and nutrients are suddenly released, triggered by disturbances such as forest

[34] Jasanoff, 1990
[35] Mazur, 1981 according to Meidinger, Antypas, 1997
[36] Shannon et al., 1996
[37] Collingridge, Reeve, 1986
[38] Holling et al., 1995, pp. 20-28

elements of the system, before it reenters the phase of exploitation. Although Holling developed the four-phase model for ecosystems, the principle can also be applied to social and economic systems.[39]

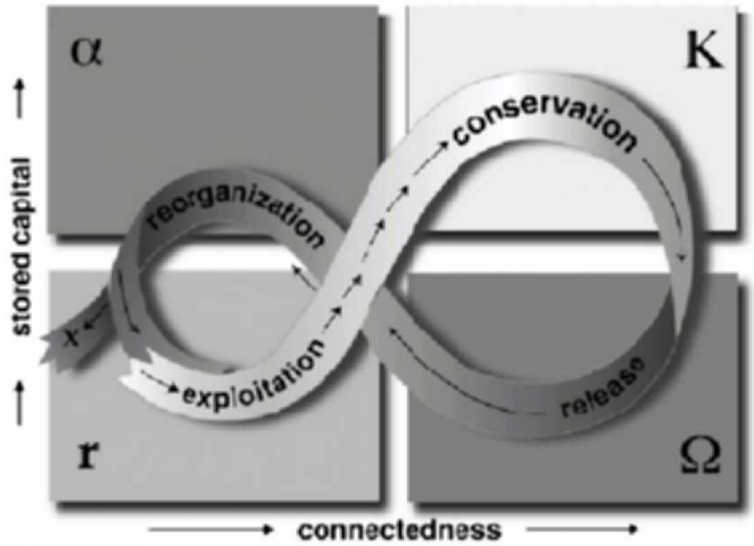

Figure 1: Four Phase Model of Adaptive Systems

Four phases of complex, adaptive systems and the flow of events among them. The arrows represent time; the short arrows represent slow change, while the long arrows represent fast change. The cycle represents changes in connectivity in the system and in stored capital. The system may exit from the cycle at point "x". (Holling, 1986 according to Gunderson in "Bioregional Assessments", 1999, p. 28)

Ecosystem development, as described by the four-phase model, occurs on all levels of an ecosystem hierarchy *(see figure 2).* Each level or structural element experiences its distinct spatial and temporal dynamics within the constraints of the broader level that cycles at a slower pace. In many forest systems, for example, fresh needles cycle yearly, the crown of foliage cycles within a decadal period and trees cycle over centuries.[40] At key points, the cycles are linked and allow for cross-scale interactions or "panarchy". The revolt phase is one such key point that occurs when elements on a lower level trigger a disturbance that causes a release at a broader level. An example is when fuel accumulation on the ground leads to a fire that destroys the entire forest. During the remembrance phase, the process is reversed; the broad level provides resources for reorganization after a crisis at a lower level. According to Holling, panarchy integrates the ecological and human elements of complex systems.

[39] Gunderson in "Bioregional Assessments", 1999, pp. 27-39
[40] Gunderson in "Bioregional Assessments", 1999, pp. 27-39

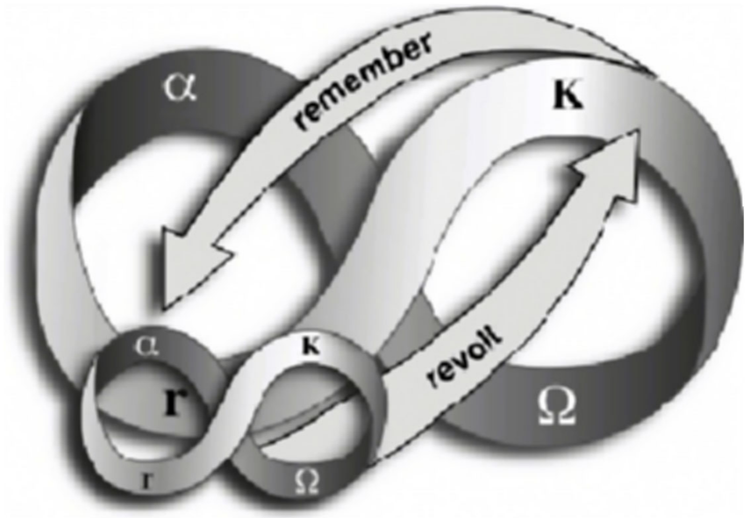

Figure 2: Panarchy

Cross-scale dynamics, or panarchy, showing two coupled adaptive cycles, each representative of distinct structural elements, and each with different domains in space and time. At key points, the cycles are strongly linked, either during revolt phase, describing contagious processes such as fires, or remember phase, where the broader scale provides resources for the smaller-scale reorganization. (Holling, 1986, according to Gunderson in "Bioregional Assessments", 1999, p. 31)

1.2.2 Adaptive Management

The concept of adaptive management, developed by Holling in the late 1960s, has been an important issue in some of the bioregional assessments presented in this paper. Scientists, managers and policy makers have begun to realize that uncertainty and risk are part of every management activity.[41] They call for means that allow managers to "expect the unexpected"; conduct experiments, observe the process, evaluate the outcome and learn from the experience. Adaptive management is a tool to establish flexible management mechanisms. *"It applies the concept of experimentation to the design and implementation of natural-resource and environmental policies."* [42]

Three basic components characterize an adaptive management approach: experimentation, integration of new research and use of local information.[43] Experiments involve the utilization of new and innovative methods, and must be accompanied by careful monitoring and evaluation in order to drive the process of learning.[44] Science is part of planning, monitoring and evaluating management activities. Scientists supply managers with the most recent available research and provide the basis for new experiments. At the same time, adaptive

[41] Stankey, Clark, "Adaptive Management Areas", 1998
[42] Lee, 1993, p. 53
[43] Johson et al. in "Bioregional Assessments", 1999, pp. 108-109
[44] Stankey, Clark "Adaptive Management Areas" , 1998

management relies on local information. While the principle objectives may be defined on a broad ecosystem level, goals and techniques must be adapted to local conditions. These site-specific conditions include biological, social and economic aspects that are assessed by a collaborative group of managers, scientists and local citizens.

Several restraints hamper the implementation of adaptive management. One important problem is the inevitability of risk that is inherent to the application of new research, new technologies or new decision making processes.[45] Another problem is surprise; managers must accept that unexpected consequences of action do not implicate failure, but provide an opportunity to learn more about the reaction of an ecosystem to particular treatments. At the same time, agencies and policy makers must understand that flexible management depends on flexible guidelines and not on an abundance of standards and prescriptions.[46] Improved means of communication between scientists, managers and public participants need to be established in order to assure the regular input of current scientific and local information.[47] Due to the fact that adaptive management involves expensive planning processes, constant monitoring and the development of large databases, funding is critical to its success.[48]

1.2.3 Social Learning

Adaptive management is part of a broader approach that deals with the ways in which society learns from its past mistakes: the concept of social learning. The concept of social learning provides ideas for more effective ways how society can learn and adjust. According to Yankelovitch, society tends to abruptly lurch in the direction opposite to its former behavior. As an example, he states the development of the western world during the social movement of the 1960s, when key values like the traditional family underwent significant changes.[49] Some of these changes were reversed later, because society reconsidered the costs and benefits of these sudden shifts, and learned and adjusted accordingly. Social learning relies on adaptation and flexibility as inherent to adaptive management. Realizing adaptation in a complex world, however, involves institutional changes and political conflict.[50] Logging, for instance, may have a lasting effect on old-growth forest ecosystems, but in order to restrict timber harvest in old-growth forest, a long process of social learning may be necessary, because scientists, managers, politicians, local communities and public interest groups all have their own conflicting perception of "what is the problem?" and "what should be done to solve it?". Hence, social learning emphasizes the role of stakeholders and their problem solving potential in a participatory system.[51] The conflicting parties must understand the interests of the other

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[45] Clark et al., "Overarching Assumptions Underlying the Northwest Forest Plan", 1998
[46] Lee, 1993, p. 63
[47] Shannon et al., "Organizing for Innovation", 1995
[48] Volkman, Lee in "Journal of Forestry", Volume 92, N° 4, 1994
[49] Yankelovitch, 1997
[50] Lee, 1993, p. 8
[51] Janssens, Wildemeersch, 2002

participants and join in a common solution or a compromise.[52] The social learning concept favors a democratic approach to policy making; it relies on public participation as a precondition for solving the complex problems of modern society.[53]

1.3 Important Definitions

1.3.1 Interdisciplinarity

Due to the fact that disciplines and interdisciplinarity are important features for analyzing bioregional assessment, it is helpful to give a definition of the principal forms of interdisciplinary exchange.[54] Intradisciplinarity occurs between different specialties within a discipline. Multidisciplinarity is the mostly additive coordination of various disciplines in a joint research project. Interdisciplinarity means collaboration and integration across disciplinary boundaries. The term transdisciplinarity refers to the interaction of scientific disciplines with their non-scientific environment; it is characterized by implementation orientation, problem orientation and social accountability.

1.3.2 Bioregions and Bioregionalism

The terms "bioregion" and "bioregionalism" are difficult to define. Bioregionalism cannot be ascribed to one major concept or theory, but summarizes a variety of decentralized activities that define themselves as "bioregional."[55]

In "Bioregionalism" McGinnis gives a very broad definition of a bioregion:

"A bioregion represents the intersection of vernacular culture, place-based behavior, and community. Bioregionalists believe that we should return to the place "there is", the landscape itself, the place we inhabit and the communal region we depend on." [56]

McGinnis conceives a bioregion as a complex structure of nature, culture and tradition. Central to his definition is the assumption that nature shapes culture, and that people are part of their surrounding ecosystem. This understanding of bioregionalism was generated by the "bioregional movement", which originated from the environmental and social movement in the 1960s and 1970s. Emerging from the "politics of home place", the bioregional idea was first represented by a generation of young and idealistic activists in northern California.[57] They called for a division of land *"by natural and cultural boundaries rather than arbitrary political boundaries."*[58] Human beings should renew their bonds with their natural environment and abandon their urbanized "machine culture". The early bioregionalists were

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[52] Yankelovich, 1994
[53] Janssens, Wildemeersch, 2002
[54] Flittner, Oesten in "Allgemeine Forst und Jagdzeitung", 173 Jg., 5, 2002
[55] Aberley in "Bioregionalism", 1999, p. 13
[56] McGinnis in "Bioregionalism", 1999, p. 3
[57] Aberley in "Bioregionalism", 1999, p. 20
[58] Snyder, 1970, according to Aberley in "Bioregionalism", 1999, p. 17

inspired by traditional tribal structures in which human activities interact with the natural world. They believed in the power of indigenous knowledge, which unites culture, sensation and intuition with experience[59]. Humans should go and "reinhabit" their "new home place"- a region defined by their instinctive sense of the natural environment, and not by modern science. This distinction between modern science and place-based knowledge discerns the bioregionalist movement from the more sterile scientific construction "biogeography."[60] Today, however, many bioregionalists promote a combination of both types of knowledge to create a "place-based science." [61]

In the late 1970s, bioregionalism had mostly been incubated by various North American grass-roots organizations. In 1981 Dodge summarized the three central values that have characterized bioregionalism until today: *"The importance placed on natural systems as a reference for human agency, reliance on an anarchic structure of governance based on interdependence of self-reliant and federated communities, and rediscovery of connections between the natural world and the human mind."* [62]

In the 1980s, the idea of bioregionalism continued to spread and bioregionalists around the world attempted to put their vision into practice. They proposed alternative methods of natural resource management, such as watershed planning or energy supply, along the bioregional model; focusing on local knowledge, bottom-up approaches and the interaction between nature and culture.

In the early 1990s, bioregionalism was discovered by politicians, resource managers and environmental policy-makers.[63] They adopted the ecological aspects of bioregionalism, but neglected the politically devolutionary and community-based character of the bioregionalist movement.

The bioregional assessments presented in this study can be considered part of this government-initiated model of bioregionalism, which is based on a much narrower definition of a bioregion than that given by McGinnis. In "Bioregional Assessments - Science at the Crossroads of Management and Policy," Herring describes a bioregion as follows:
"Bioregional assessments ... are bioregional, which is to say they are ecosystem-based, delineated by natural processes and elements rather than by planning units and political jurisdiction." [64]

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[59] Goldstein in "Bioreginalism", 1999, pp. 157-168
[60] Aberley in "Bioregionalism", 1999, p. 23
[61] Goldstein in "Bioreginalism", 1999, pp. 157-168
[62] Dodge, 1981, according to Aberley in "Bioregionalism", 1999, p. 25
[63] Aberley in "Bioregionalism", 1999, p. 34
[64] Herring in "Bioregional Assessments", 1999, p. 1

According to this definition, a bioregion is a land unit that is not demarcated by political but by ecological boundaries. Watersheds, wide-ranging species, vegetation or climatological aspects naturally structure landscapes into bioregions - whereas human activity in these areas is not necessarily addressed.

2 THEORY AND PRACTICE: THE CONCEPTUAL FRAMEWORK

The following paragraph summarizes a number of key aspects and questions that were derived from the theoretical concepts and backgrounds described above. It is important to notice, however, that in accordance with the grounded theory approach most of the literature study for this paper was realized after the practical research was already completed. The theoretical background, therefore, constitutes a source of information which was consulted on the basis of the interviews conducted for this study. Due to the fact that they were developed after the practical phase of research, the following questions should not be conceived as additional research questions, but as a guideline for the reader of this paper.

1. The role scientists play in natural resource projects depends on the participant's perception of "what science should be." How do scientists themselves, when involved in bioregional assessment, define their metier? Does the bioregional assessment studied follow a technocratic or a democratic approach? Is there a clear boundary between facts and values and if so, where is that boundary set? Do scientists involved in bioregional assessment support the idea of scientists advocating for particular solutions?

2. The history of science involvement in natural resource policy points to changes occurring in today's science-policy interaction. How can those changes be defined, and how does bioregional assessment fit into the new patterns? In this context, it may be interesting to explore the development of disciplines and cultures within the scientific community.

3. Holling talks about crisis as a bone of contention for system development. Are bioregional assessments driven by crisis? What other reasons cause the initiation of bioregional assessments? What is the role of litigation?

4. Learning and adaptation are important elements of using science in order to prevent crisis. How are they incorporated into bioregional assessment? Can bioregional assessment lead to institutional change?

CHAPTER III

RESEARCH DESIGN

1 METHODOLOGY

1.1 Quantitative or Qualitative Research?

The literature on social research design distinguishes two basic strategies of social research: the quantitative and the qualitative approach. Quantitative research attempts to explain social reality by means of controlled, mathematical methods.[65] The basic goals include the quantification of social phenomena, the formulating and testing of theory and the making of predictions.[66] In order to identify general patterns and their relationships, quantitative research focuses on the objective analysis of variables and co-variables across a large number of cases.[67] Similar to natural scientific methods, data obtained by quantitative social research must comply with the criteria of reliability, validity and representativeness.[68]

As opposed to quantitative research, qualitative research attempts to understand a situation in its comprehensiveness, and is characterized by a number of specific principles: subject orientation, subject adequacy of theories and methods, reflexivity of researcher and research, and problem orientation.[69] Subject orientation refers to the complexity of social situations and to the individuality of participants and their perspectives. The qualitative researcher is interested in the values and emotions that guide human action in a particular context. In order to understand these complex connections, the theories and methods that are utilized in a study must fit the characteristics of the social situation (subject adequacy). Thereby, qualitative research emphasizes the description and interpretation of social phenomena in an open course of research that allows the researcher to flexibly adapt his or her methodology to the particular features of the situation under study. Qualitative research, thus, is characterized by a large spectrum of methods that can be combined in a single research process. As opposed to quantitative research, qualitative methods stress the researcher's communication with the participants of his or her study. The researcher continuously reflects his or her own subjective interpretations, observations, emotions, and irritations (reflexivity). Problem orientation signifies that the research question results from the recognition of a social problem or development; and qualitative research, therefore, seeks to reach critical and practical conclusions that exceed the goal of mere hypothesis testing.

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[65] Atteslander, 1995, p. 91
[66] Flick, 1996, p.10, Ragin, 1994, p. 132
[67] Ragin, 1994, p. 190
[68] Atteslander, 1995, p. 91
[69] Mayring, 1993, p. 9, Flick, 1996, pp. 13 – 16, Atteslander, 1995, pp. 92 - 93

In contrast to quantitative research, qualitative research focuses on in-depth examination of a relatively small number of cases in order to observe commonalties that exist across these cases.[70] The object of a case study can be a particular event, an individual or a group of individuals in a common context, such as a group of scientists in CIPEL for example.

The initial goal of this study was to examine the role of science in large ecosystem projects. The research was therefore guided by the principal cognitive interest of understanding the whole spectrum of characteristics that define the role of science in this particular context. The author intended to illuminate these complex aspects in an open manner without pre-defined theories or hypotheses to restrict the field of interest. In order to meet these requirements, a qualitative strategy was chosen for the research design.

1.2 Grounded Theory

Grounded theory is a methodological framework that allows the researcher to generate theory from qualitative data (see introduction, p. 2). The concept relies on comparative analysis of various cases that appear to be in the same general category. The following paragraph will describe the major steps and elements of generating theory by comparative analysis.[71]

1.2.1 Elements of Theory

During the initial step of generating theory from data, which is called coding, the researcher identifies categories and properties. A category is defined as a self-explanatory conceptual element of theory. This can be further broken down into sub-categories or properties that constitute a conceptual aspect of a category. It is important to note that categories and properties are concepts indicated by the data and not the data itself. An example of a category in the subject area of “the role of science in policy” would be “changes in the role of science”, which can be further characterized by the properties “interdisciplinarity” and “context orientation.” During the course of the research, these concepts tend to develop towards higher levels of generalization.

The analysis and comparison of categories across different cases soon reveals generalized relations among them, which constitute hypotheses. These hypotheses are continuously tested and verified as the theory develops. Eventually, the relations between concepts and hypotheses accumulate and form an integrated central theoretical framework, which is the core of the emerging theory that will guide further collection and analysis of data. Integration of the theory occurs continuously at all levels of generality.

1.2.2 Theoretical Sampling

Theoretical sampling is the process of data collection for generating a particular theory. Central to theoretical sampling is the question of how the researcher selects multiple

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[70] Ragin, 1994, p. 190

[71] see Glaser, Strauss, 1998

comparison groups. As opposed to other approaches of comparative analysis, theoretical purpose and relevance are the sole criteria for selecting cases by theoretical sampling. The researcher, therefore, is not required to choose groups that have a multitude of specific features in common (quantitative representativeness), but to choose groups that indicate the same conceptual categories and properties. Any group, irrespective of differences or similarities, can be compared as long as it contributes to the emerging theory. Two basic strategies are possible to select the samples: minimizing and maximizing differences. If differences between groups are minimized, the researcher will collect more similar data on a given category, while he or she observes important differences to earlier data collection. If differences between groups are maximized, the researcher will collect different data on a given category, while he or she notices strategic similarities that increase the generality of the evolving theory.

As soon as the researcher realizes that no additional data will be found on a particular category, the category is theoretically saturated. He or she may then search for new cases that allow the study of other categories. Theoretical sampling does not rely on a certain kind of data but may combine various methods of data collection such as observation, interview, survey or content analysis.

1.2.3 The Constant Comparative Method

Generating theory is a continuous, repetitive process of sampling, coding and analysis. With the constant comparative method, Glaser and Strauss suggest a tool that combines systematic data analysis with the constant redesign and reintegration of emerging theory. Two basic rules define this method. *"While coding an incident for a category, compare it with the previous incidents in the same and different groups coded in the same category."* [72] If a scientist in an interview, for example, expresses his or her difficulties to communicate with a colleague from a different discipline, this remark can be compared to previous remarks about interdisciplinary communication without further coding. This constant comparison allows the researcher to continuously integrate new knowledge into the process of coding, as well as in the preparation of further data collection. The second basic rule *"stop coding and record a memo on your ideas"* [73] encourages the researcher to write memos of the thoughts and theoretical notions of the developing concepts whenever they cross his or her mind. The coded data and memos eventually enable the integration and formulation of theory.

1.2.4 Literature on Theory

In order to maintain complete openness with regard to the emerging categories, the researcher does not need to consult existing theory before he or she begins the practical research. *"An effective strategy is, at first, literally to ignore the literature of theory and fact on the area under study, in order to assure that the emergence of categories will not be contaminated by*

[72] Glaser, Strauss, 1967, p. 106
[73] Glaser, Strauss, 1967, p. 107

concepts more suited to different areas." [74] After the analytic core of categories has emerged, the researcher can eventually compare his categories to literature and enrich them by information from existing theory.

Two reasons led to the choice of grounded theory as the appropriate research method for this study: the lack of existing hypotheses on the area under study, and the comparative approach.

In "Bioregional Assessment, Science at the Crossroads of Management and Policy", the authors provide a synoptic survey of bioregional assessment and the role that scientists play in the effort.[75] A multitude of authors, mostly scientists who have participated in bioregional projects, deal with various aspects of bioregional assessment and share their experiences. The authors, however, do not develop a theoretical framework that links the role of science in bioregional assessment with the role of science in similar broad scale efforts and the role of science in natural resource policy. By means of a grounded theory approach, categories across these different contexts can be compared in order to establish a theoretical framework. Moreover, grounded theory enables the outside observer to take a fresh, unbiased look at the situation.

This study intended to look at bioregional efforts in Europe and the United States. While the American understanding of bioregional assessment has not been observed in the European context, grounded theory enables the "comparison of the non-comparable." This is achieved through the development of categories that integrate the similarities and differences between the groups in order to obtain generalized information.

1.3 Grounded Theory in Practice

The following section documents the research process of this study, and describes the methods used to apply grounded theory in practice.

1.3.1 The Choice of Cases

The "Commission Internationale de la Protection des Eaux du Léman" (CIPEL)[76] was the first case chosen to study the role of science in large ecosystem projects. CIPEL is a French-Swiss organization, which aims at improving the conditions of Lake Geneva and its watershed. Two principal considerations led to its selection as a research object: firstly, CIPEL shows certain bioregional features because it functions at the watershed level; and secondly, it involves scientists as advisors. CIPEL, therefore, fits into the same general category as bioregional assessment in the U.S., but shows maximum differences as a comparison group.

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[74] Glaser, Strauss, 1967, p. 37
[75] Johnson et al. 1999
[76] "International Commission for the Protection of Lake Geneva"

In the U.S., the situation was somewhat different, as most large-scale bioregional assessments had already been examined. Three of these case studies were selected for the purposes of this paper: the Forest Ecosystem Management Assessment Team (FEMAT), the Interior Columbia Basin Ecosystem Management Project (ICBEMP), and the Sierra Nevada Ecosystem Project (SNEP). The three cases were considered to be sub-groups of the U.S. comparison group, and their differences in outer characteristics were minimized. All three assessments were government initiatives, involved scientists as key participants, focused on public land and were located in the Pacific West.

1.3.2 Data Collection

The data for this study was collected by survey, which is one of the most frequently used methods of qualitative data collection.[77] Two types of survey were utilized: the problem-centered interview, and the mail survey.

1.3.2.1 The Problem-Centered Interview [78]

In a problem-centered interview, the interviewer explores the personal attitudes and environment of the respondent in respect to a particular societal problem. The problem-centered interview is an open, half-structured form of the qualitative interview. It is open, because the respondent recounts his or her experiences without a pre-defined set of answers; it is half-structured, because the interviewer uses a guideline which structures the conversation, but leaves room for spontaneous reactions and ad-hoc questions. For this study, a special form of the problem-centered interview was realized: the expert interview. In an expert interview, the respondent does not serve as an individual case, but provides expertise on his institutional or organizational context.[79]

1.3.2.2 The Mail Survey

The mail or written survey is generally used as a method of quantitative data collection. Based on an open questionnaire, however, the mail survey may also serve as the preparation of a qualitative interview.[80] The questionnaire, sent by post or e-mail, is composed of a simple set of questions that the respondent can answer without further explication. It may be accompanied by a letter that explains the topic and the purpose of the study.[81]

1.3.2.3 Data Collection in CIPEL

In order to get an introduction to the structure, members and functions of CIPEL, a face-to-face interview with the permanent office of the organization was realized.[82] In turn, the

[77] Mayring, 1993, p. 45
[78] see Mayring, 1993, p. 46
[79] Meuser, Nagel in „Qualitativ-Empirische Sozialforschung“, 1991, pp. 441-469
[80] Lamnek, 1995, Volume 2
[81] Schnell, Hill, Esser, 1995, p. 337
[82] see interview guideline permanent office, annex III

permanent office recommended possible partners for the actual in-depth interviews.[83] Five scientists/managers, who represented both countries, were contacted and received a small, introductory questionnaire by e-mail.[84] Their answers served as a base for the preparation of an individual guideline for each interview. Finally, four persons were interviewed by telephone and the conversations were recorded.

1.3.2.4 Data Collection in the United States

The categories drawn from CIPEL and the assumptions presented in the introduction provided the framework for developing a standard interview guideline in the United States.[85] The standard guideline consisted of three parts: personal questions, questions relating to the cases, and general questions regarding the role of science in the United States. For each interview the guideline was modified and adapted to the individual background, experience, and discipline of the interview partner. In accordance with the constant comparative method, the questions for one interview often related to the categories drawn from previous interviews, in order to maximize their relevance for the emerging concepts.

The experts, exclusively scientists, were selected by "snowball system." For each case, the researcher identified one or two key contacts that were interviewed first and who then proposed other possible interviewees.[86] In accordance with the concept of grounded theory, the scientists represented a variety of attitudes and disciplines. Altogether eleven interviews were realized and recorded, three of which by telephone. During and after the interview sessions, the researcher took notes to memo her ideas and observations.

1.3.3 Data Analysis

After their full transcription, the interviews were analyzed step-by-step following the method described by Meuser and Nagel in "Das ExpertInneninterview." [87,88] The analysis method was chosen because of its iterative character, which matches the constant comparative method of the grounded theory approach. The following paragraph describes the reduction, structuring, synthesis, and interpretation of the material, as proposed by Meuser and Nagel, and illustrates the single steps by examples from the CIPEL case study.

Titles:

Titles are assigned to the paragraphs of each interview. Similar titles are subsumed under main captions. *Example: title 1: problems of carbon cycling in Lake Geneva, title 2: the food chain in Lake Geneva ⇒ caption: the Lake Geneva Ecosystem*

[83] see list of CIPEL interviewees, annex II
[84] see questionnaire CIPEL, annex IV
[85] see standard interview U.S., annex VI
[86] see list of U.S. interviewees, annex V
[87] Meuser, Nagel, "Qualitativ-Empirische Sozialforschung", 1991

Thematic Comparison:
The interviews are compared to find similar text passages. For all interviews, the titles are harmonized to build a first set of categories and properties that reflect the metaphors and termination of the text. *Example: "looking through the microscope"*
Sociological Conceptualization:
The categories are "empirically" generalized to build more abstract concepts. *Example: global vision of the ecosystem*
Theoretical Generalization:
The concepts are connected, structured, and integrated into theory. *Example: Scientists can be distinguished into specialists and generalists. The generalist tends to have a broader, more systemic understanding of ecosystems.*

Subsequent to the analysis and interpretation of data in the U.S., a literature review was realized in order to complete the empirically developed grounded theory with existing theory, and to place the results into a broader context.

2 INFORMATION SOURCES

Aside from interviews, literature provided a large amount of information on the cases studied. For CIPEL, newsletters, internet pages, brochures, scientific reports, action plans and minutes from meetings were reviewed. The information on the U.S. cases included the existing case studies and their summaries, newsletters, internet pages, decision documents, scientific papers, press releases and secondary papers that evaluate particular aspects of the assessments.

CHAPTER IV

CASE STUDIES: EUROPE

LA COMMISSION INTERNATIONALE POUR LA PROTECTION DES EAUX DU LÉMAN

1 BACKGROUND[88]

1.1 History

The scientific observation of Lake Geneva dates back to the 1950s, when the first commission was mandated to observe the development of the lake. On November 9, 1960 the French and the Swiss government founded the "International Commission for Protection of Lake Geneva" (CIPEL), headquartered in Lausanne. CIPEL inspired the two riparian states to create the "Convention for the Protection of Lake Geneva" which became effective in 1963 and consolidated the mission of CIPEL on a legal basis.

During the first years and decades, the commission's activities centered around the surveillance of water quality and waste water purification and emphasized the construction and extension of sewage treatment plants. In the 1980s, however, the problem of phosphor pollution and its effects on the lake ecosystem came increasingly into focus. CIPEL, therefore, initiated its first action plan 1991 – 2000 "Lake Geneva Tomorrow," the principal objective of which was to reduce the phosphor content of the lake water by 50% within ten years. With this first action plan, CIPEL extended its activities from the pursuit of domestic to the study of industrial and agricultural pollution.

Despite an improvement in the general water quality, the reduction of phosphor content, in particular, has not yet been achieved. Thus, in 1999 the commission agreed upon a prolongation of the project by means of a new action plan 2001-2010 " Keeping Lake Geneva and its Tributaries Alive". The new action plan added several novel duties to CIPEL's field of functions, for example, the renaturation of watercourses within the Lake Geneva watershed basin.

1.2 Water Policy in France and Switzerland

Since 1992 the French water policy is no longer organized along political boundaries, but according to six hydrographic basins each of which is attended to by a water agency.[89] The water agencies, public institutions subordinate to the ministry of environment, coordinate the water management activities of the different state services, finance water protection projects

[88] Interview with Permanent Office ; CIPEL: material for public information ; "Le Lettre du Léman", Nr. 20, Jan. 2000, Nr. 22, Jan. 2001, Nr. 23, June 2001, Nr. 24, Jan. 2002 ; CIPEL, homepage, www.cipel.org

[89] Ministère de l'Aménagement du Territoire et de l'Environnement, « Une Gestion de l'Eau Concerté », 2001

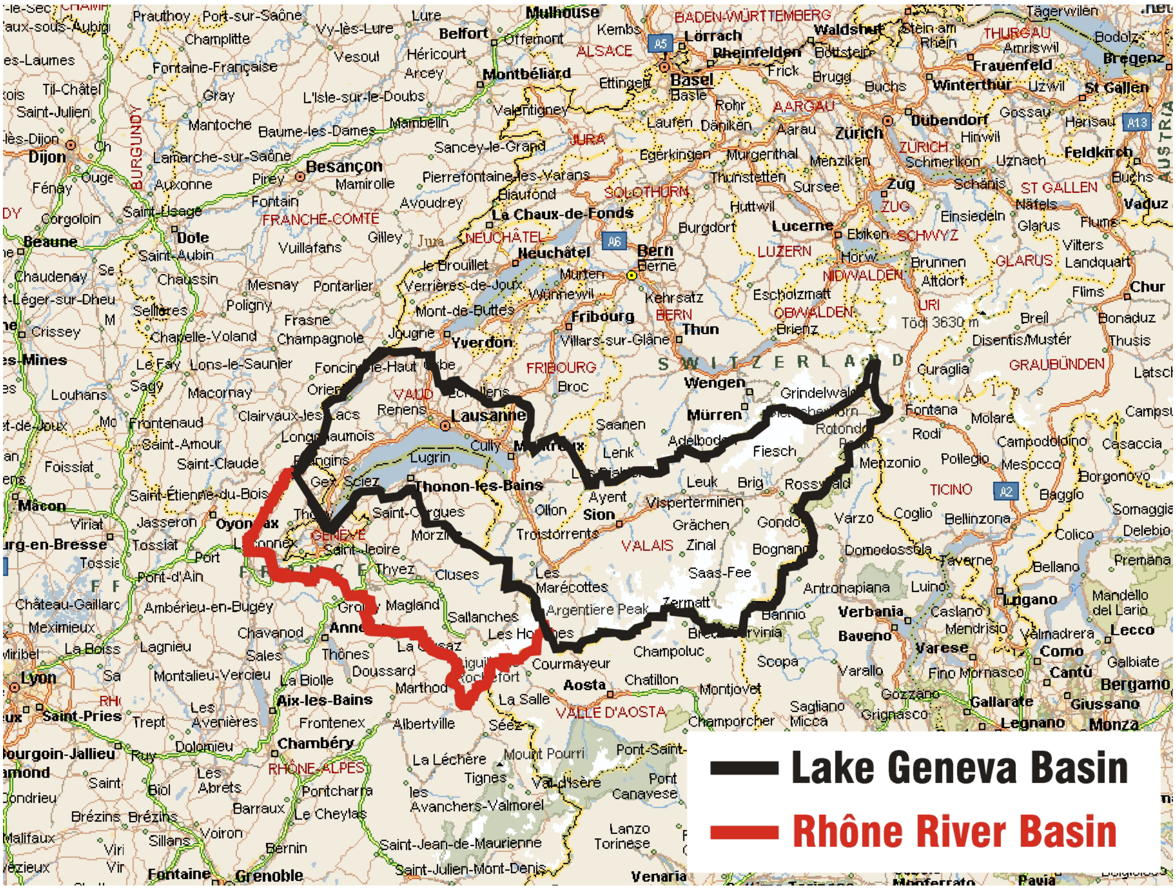
and supervise their implementation. Their goal is to establish sustainable modes of water resource management that respect ecological and economical interests of water utilization and facilitate user collaboration.

In 1992, therefore, the French legislature introduced a new planing modus, the "Schéma directeur d'aménagement et de gestion de l'eau" (SDAGE) which constitutes a guiding-principle for water management in compliance with national and European legal directions.[90] The SDAGE, one for each hydrographic basin, requires the formation of a basin committee that assembles different political actors such as local politicians, industrials, agriculturists or associations around a common project. In order to implement the SDAGE, the water agency develops a five year program that must be accepted by the basin committee and affirmed by the Prime Minister. Lake Geneva belongs to the hydrographic region Rhône-Méditerranée-Corse (R.-M.-C.) in whose SDAGE the CIPEL action plans are well integrated.

The Swiss water policy differs significantly from the French model. It is organized according to political entities, mostly cantons or municipalities, that often show major differences in legislation. While in the Canton of Geneva the cantonal administration is responsible for watershed management activities such as, for example, the control of the waste water system, in Wallis and Waadt these competencies are delegated to the municipalities.

Although CIPEL is well integrated into national water policies, it must also function coherently with the legislation of the European Union. In 2000 a new European framework directive "Instituant un Cadre pour l'Action Communautaire dans le Domaine de l'Eau" became effective, which aims for the unification of watershed management practices in the EU.[91] It requires the member states to establish 15 year management programs that guide the observation, protection, and amendment of superficial and subterraneous watersheds. Comparative to the French system, the new directive promotes the reorganization of political planning units into hydrographic basins wherein a special public authority coordinates water planning and implementation activities.

[90] Ministère de l'Aménagement du Territoire et de l'Environnement, « SDAGE », 2000
[91] Ministère de l'Aménagement du Territoire et de l'Environnement, « Une Gestion de l'Eau Concerté », 2001



Lake Geneva is situated in the southern part of the Swiss midlands between the Alps and the Jura mountains on the border between France and Switzerland. Covering an area of 58.200 ha, this crescent-shaped lake is the largest lake in the Alps. Its average altitude is 372 m, and it reaches a maximum profundity of 310 m. The main tributary of Lake Geneva is the Rhône River that enters the “great lake” in the south east and leaves it in Geneva at the south western end of the “small lake”.

Approximately 40 % of its surface is in French territory, but only 30 % of its 200 km riparian length are in French ownership. Five regional political entities share the shores of Lake Geneva: the French “départements”* or departments Ain and Haute-Savoie in the south, and the Swiss cantons Wallis, Waadt and Geneva in the east, north and west. The Swiss side in particular is highly populated; in total approximately 1 million people inhabit the area surrounding Lake Geneva, and 600.000 tourists visit the region each year. Land use in the Lake Geneva basin is distributed as follows: 35 % non cultivated land, 22 % forests, 23 % range land, and 20 % agriculture.

The area of CIPEL activities comprises the Basins of Lake Geneva and the Rhône River that in total cover a surface of approximately 1,8 million ha.

**France is divided into 22 regions that are subdivided into departments*

Brockhaus, 1969
CIPEL homepage 2002 (www.cipel.org)

1.3 <u>The Mission</u>

According to the Action Plan 2001-2010, CIPEL is responsible for the *"Conservation or Restoration of the ecological quality of the aquatic environment of Lake Geneva, including the lake and its basin."* [92] There are five major tasks that CIPEL must accomplish in order to fulfill its mission: Surveillance of the lake, proposals for action, cross national coordination of water policy, development and implementation of action plans, and informing the public.

1.3.1 Surveillance of the Condition of Lake Geneva and its Watershed

The commission is mandated to monitor the condition of the lake and its tributaries. It, therefore, induces the regular analysis of water quality and finances scientific studies of the lake ecosystem and how it functions. CIPEL attempts to localize the main sources of water pollution and supervises the effectiveness of the sewage treatment plants.

1.3.2 Proposals for Action

Even though CIPEL is not a decision making organization, it can at least make recommendations to the governments of the member states for improved water protection. Examples include recommendations for completing the waste water system, dephosphatation in sewage treatment plants, and reduction of plant protective agents in agriculture. Moreover, CIPEL promoted the environmental demand to legally restrict phosphate contents in detergents and cleaning fluids. Although many recommendations failed to effect policy decisions on the national level, they nevertheless supported regional endeavors to reform watershed management practices, for example in certain Swiss cantons.

1.3.3 Coordination of Water Protection Policy between France and Switzerland

CIPEL contributes to the coordination of water protection policy around Lake Geneva, especially between different departments and cantons on the regional level. It supports agency collaboration and provides a platform for the exchange of scientific knowledge and experience.

1.3.4 Development and Implementation of Action Plans

CIPEL is responsible for the development, implementation and evaluation of action plans. Since the commission has no executive power, it relies on various water management agencies in both countries to realize its proposals.

1.3.5 Public Information

CIPEL takes measures to inform the interested public about pollution and remediation of Lake Geneva and to sensitize people towards the ecological instability of their environment. To that end the commission publishes a free newsletter "Le lettre du Léman" twice a year in

[92] Aktionsplan 2001-2010, „Damit der Genfer See und seine Zuflüsse lebendig bleiben", 26. Oktober 2000

French and German. Further information including the action plans and the scientific reports is available on the internet page.

1.4 The Action Plan 2001 - 2010[93]

The Action Plan 2001 – 2010 consists of two sections: objectives and actions. Each of the six principle objectives is presented in a separate document summarizing the background, the current conditions, the desired changes, the proposed actions and the indicators identified for each objective. The ten actions are presented analogously; each action sheet describes a necessary measure and defines its implementing organizations, the role of CIPEL, and the indicators for implementation. In addition to the action plan, a tabular summary visualizes the indicators that were developed to evaluate the realization of objectives and actions.

1.4.1 Objectives

- Reduction of the phosphor concentration in the lake water to 20 µgP/l
- Reduction of micro-contamination in the lake water
- Improvement of the ecological quality of rivers and their banks
- Utilization of lake water as drinking water after only a simple treatment
- Assurance of a high stock of noble fish
- Favorable conditions for bathing and other aquatic sports

1.4.2 Actions

- Measures at regional sources of pollution in order to limit the influx of polluting substances
- Changes in waste water restoration to facilitate:
  - Planing waste water disposal
  - Completing household connections to the waste water system
  - Inventory and amendment of the waste water system
  - Optimization and control of the sewage treatment plants
  - Control and maintenance of individual sewage plants
- Modifications in agricultural methods to allow:
  - Prevention and restriction of pesticide deposition
  - Combating erosion that leads to diffusive phosphor influx
- Renaturation of banks and rivers
- Distribution of information to and improvements in communication with the public

1.4.3 Tabular Summary[94]

The tabular summary consists of numerous simply-structured tables that display the indicators for each objective and action. Using this tabular summary, scientists, managers, and politicians can easily evaluate the effectiveness of their activities. It facilitates the observation

[93] Aktionsplan 2001-2010, „Damit der Genfersee und seine Zuflüsse lebendig bleiben", 26. Oktober 2000
[94] CIPEL, "Résumé du projet de Tableau de Bord", 2002

of the longterm evolution of water quality, and attempts to summarize and categorize the lake parameters that are collected regularly. Modifications to the tabular summary are already anticipated in order to enable the completion or adjustment of indicators to new knowledge.

1.5 Organization

CIPEL is organized on three levels; the international commission, the technical sub-commission with its working groups and the permanent office *(see figure 3).*

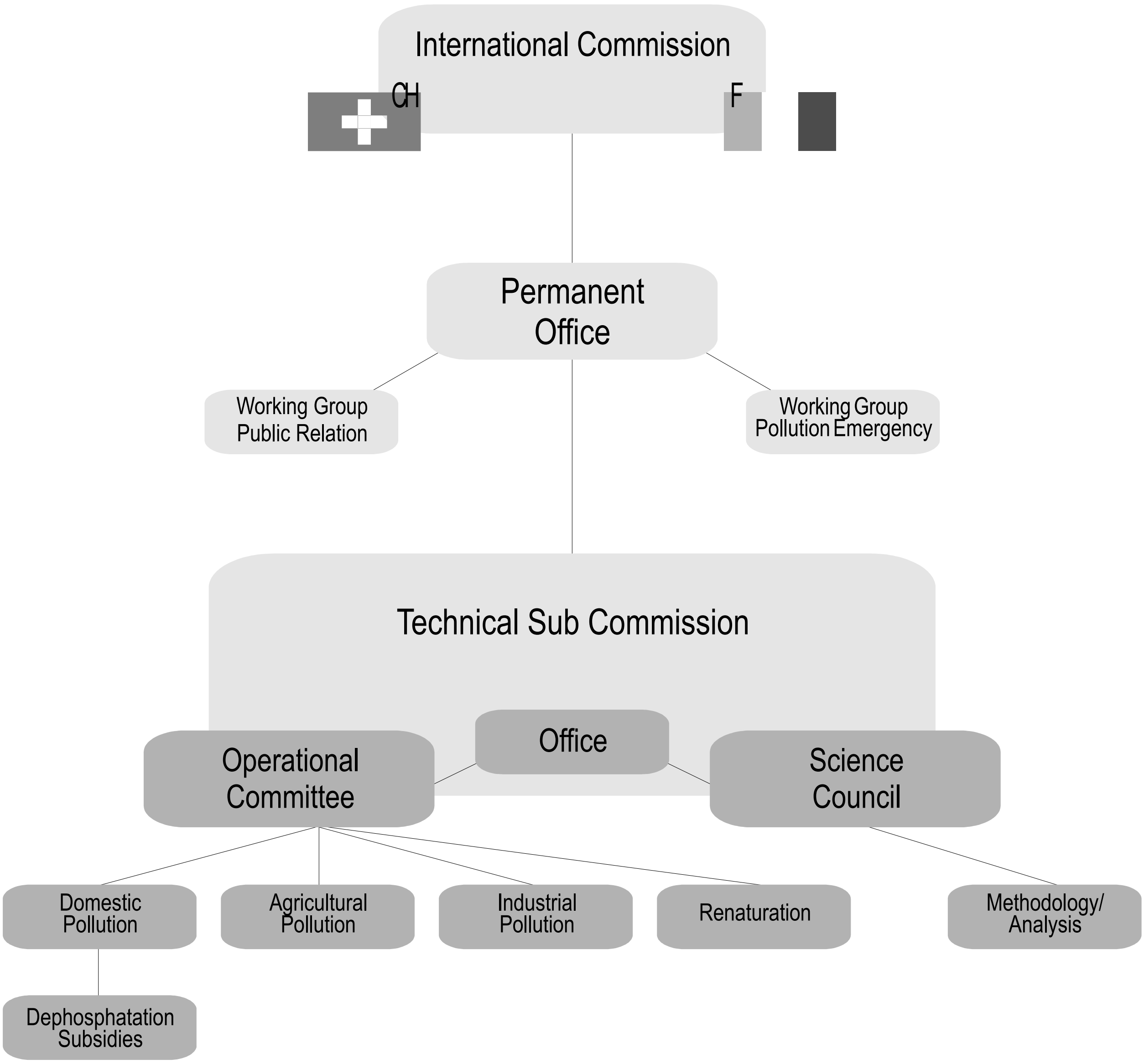


Figure 3: The Organization of CIPEL

(according to „Rund um den Genfer See“, Nr. 24, Jan. 2002)

1.5.1 The International Commission

The International Commission can be characterized as a board of directors in which France and Switzerland are equally represented by 16 high officials. The French delegation is composed of the director of the water agency R.-M.-C., a delegate of the Ministry of Foreign Affairs, the prefect of the Region Rhône-Alpes, the prefects of the Departments Haute-Savoie and Ain as well as representatives of the regional and general (departmental) councils. The Swiss delegation includes representatives of the federal offices of environment and foreign affairs and two administrative advisors of each of the riparian cantons Waadt, Wallis and Geneva. The chair of the commission has a three-year term rotating between the leaders of the two delegations. It is currently occupied by Willy Geiger, the sub-director of the Swiss Federal Office of Environment.

The commissioners meet annually with the other CIPEL entities in a plenary session, in which the Science Council presents the annual scientific report and the participants discuss future activities.

Because the international commission has no power of decision making or execution, it depends on the willingness of its members to push the implementation of its recommendations in their particular sphere of influence. Although the action plan constitutes no legal obligation, it should prompt the different bodies of the administration to consider ecological and water quality aspects of Lake Geneva in their regular activities.

1.5.2 The Technical Sub-Commission

The technical sub-commission comprises approximately 140 experts and scientists, some of whom are members of universities and research institutes but consisting primarily of employees of public agencies. Since in both countries water-related issues are distributed between a multitude of agencies and services, a high number of entities from different administrative levels are represented in CIPEL. Examples from France include the water agency R.-M.-C., the National Agricultural Research Institute, environmental protection agencies of the departments, the Service of Water Control and Sanitary Issues, etc. Switzerland, inter alia, has delegated employees of the cantonal environmental protection agencies, water and soil services, agricultural services, plant protection offices, and nature conservation centers.

The technical sub-commission consists of an operational committee and a science council that are coordinated by a common office and supported by a total of five working groups. In each committee or group both countries are represented, though not necessarily with an even number of delegates. The chair of the technical sub-commission, implying the presidency of the operational committee, rotates every three years between the two countries.

1.5.3 The Science Council

The “Conseil Scientifique” (CS) or science council roughly consists of 15 scientists from agencies, universities, and research institutes. An equal number of scientists are listed as associated members who may occasionally be invited to contribute to a particular subject. The main task of the CS is to coordinate the Lake Geneva research programs and assure their scientific reliability. In order to provide continuous surveillance of water quality and lake conditions, the CS cooperates with different laboratories and endues the working group “methodology.” The scientific findings are published in the annual scientific report that is presented to the international commission in the general assembly.

1.5.4 The Operational Committee and the Working Groups

The “Comité Opérationnel” (COP) or operational committee is charged with the implementation of the action plans. It relies on four working groups, specializing in domestic pollution, agricultural pollution, industrial pollution and renaturation, that meet three to six times per year. The COP comprises 15 to 20 scientists and managers, among others four members of the CS and the presidents of the working groups.

- The group “domestic pollution” takes an inventory of the waste water system and supervises the efficiency of the sewage treatment plants. A sub-group “dephosphatation” is attached to the domestic pollution group that supervises the distribution of subsidies which the Canton of Geneva provides in order to compensate remediation efforts that are undertaken at the upper branches of the lake.

- The group “agricultural pollution” assesses the impact of agriculture on the water quality and promotes the application of environmentally sound agricultural techniques.

- The group “industrial pollution” observes the industrial activities around the lake and takes an inventory of the contaminated sites. However, compared to the groups for domestic and agricultural pollution, the group “industrial pollution” is of minor importance. Videlicet, the small industries in the basin are inseparable from domestic pollution, because they are connected to the public waste water system, whereas the few large industries run proper sewage treatment plants that are easy to control.

- The new group “renaturation” assesses the conditions of riparian and aquatic ecosystems in the Lake Geneva Basin and creates options for renaturation.

The working groups are mostly composed of leading managers and scientists from the various water related agencies. The group “agricultural pollution”, however, constitutes an exception, because it includes a member of the chamber of agriculture that does not belong to the public administration. While chemistry and biology are the two primarily represented disciplines in the working groups, the group “renaturation” displays a broader disciplinary spectrum, including bio-chemistry, physics, hydrology, etc.

The exchange between the working groups is assured in large part by the COP. Furthermore, during the preparation of the action plan, the permanent office organized a day of discussion where the different working groups could present their results and recommendations.

1.5.5 The Permanent Office

The permanent office, with four permanent employees, serves as a coordination center for the CIPEL organization. It administers the financial, scientific, informational and technical activities within CIPEL, and organizes as well as attends the meetings of the technical sub-commission. Two working groups, "public relation" and "collaboration in case of an emergency" are directly attached to the permanent office. The emergency group assures the cross national collaboration between the fire departments, the frontier guard and other services whenever the lake is exposed to hydro-fuel contamination caused by a car accident or a leaking pipeline.

1.6 Funding

The CIPEL budget is provided by both countries. In Switzerland, funding is shared by the three cantons Wallis, Waadt, and Geneva and the federal government. In France the Ministry of Foreign Affaires, the Ministry of Environment and the Water Agency R.-M.-C. bear the costs. The principal matters of expense in the CIPEL budget are the permanent office with its four employees, the scientific surveys, and public relations. Further costs are incurred primarily by agencies that delegate employees to participate in CIPEL committees and accept the implementation of the action plan.

1.7 Public Participation

In its plenary session in October 1999, CIPEL decided to integrate a public consultation process into the development of the action plan 2001-2010. Thereupon, five public meetings were organized in the cities of Morges, Thonons-les-Bains, Genève, Sion, and Thoiry which represent the riparian departments and cantons. In these referendums, CIPEL intended to inform the interested public about the current condition of Lake Geneva, and to hear the public opinion about the project action plan. Although the participation was limited to an invited public, the meetings were relatively open, because the permanent office attempted to invite all organizations, that were somehow related to Lake Geneva. Eventually, 365 individuals attended the meetings, including elected officials, administrative officials, and a variety of groups and associations that represented multiple interests, for example fishing, environmental protection, politics, research, agriculture, and water sports.[95]

After the first meeting, a questionnaire was developed and distributed during the subsequent sessions. The protocols of the meetings and the questionnaires were analyzed and compiled in a final report. According to this report, the public globally agreed with the objectives and

[95] Kazemi, "Consultation Publique pour la Révision du Plan d'Action", 1999

actions presented in the second action plan.[96] Nevertheless, the participants also expressed a number of objections, recommendations, and claims that ranged from propositions for fish migration to concerns about the negative impacts of tourism on the aquatic ecosystem. The most active groups in the meetings were the fishermen, followed by environmental protection associations.

The public meetings led to some minor modifications of the action plan. The fishermen convinced the CIPEL representatives to pay more attention to the problem of dams and fish migration and several aspects were specified or changed in detail.

[96] Kazemi, "Consultation Publique pour la Révision du Plan d'Action", 1999

2 PRESENTATION OF DATA

This section presents the major contents of the interviews with CIPEL, focusing on the conversations with four research associates. The information is summarized by categories and properties.

2.1 Science and Management

In CIPEL the distinction between scientists and managers is not always clear. Agency scientists are represented in the science council as well as in the operational committee and its working groups. In the interviews, however, the term scientists mainly referred to members of the CS, while the term managers referred to members of the COP and working groups that are in charge of the implementation. Depending on their function in the CIPEL organization, the respondents considered themselves either scientists or scientists/managers, who combined scientific background and research activities with management tasks.

2.1.1 Science Council and Operational Committee

2.1.1.1 The Action Plan

One question in the questionnaires and interviews concerned the role of CS and COP in the elaboration of the second action plan. The answers were quite ambiguous. Although the majority believed that the COP with the technical working groups was most involved in the development of the action plan, some interviewees considered the CS to be the chief actor. Generally the respondents agreed that the scientists in the CS set the principal objectives, while the COP and the working groups developed the necessary actions to achieve these objectives. The matter was illustrated in the example of phosphor reduction: *"The science council says that it's important to continue reducing the phosphor but it doesn't know what measures it takes to do that. If you make up a balance sheet of the phosphor pollution, you'll find that for example the sewage net still looses too much phosphor ... and that's the group industrial pollution that underlines that and says 'that's our priority' because those people are technically trained and know the problems of the sewage nets and their operation. That's not the scientist, the operational specialist ... he's not capable of saying, which is the most interesting option in terms of costs and benefits."*

2.1.1.2 Recommendations to the National Governments

As one scientist mentioned, the COP decides about the recommendations CIPEL makes to the national governments, based on the scientific reports and the discussions in the working groups. In 2001, CIPEL advised the governments to suppress the phosphor contents not only in detergents but also in washing-up liquids.

2.1.1.3 Communication

Four common members and occasional joint-meetings ensure a direct cooperation between COP and CS. Per contra, formal exchange between the different working groups as well as between the working groups and CS takes place only through the representation of the working group presidents in the COP. The interviewees, however, mentioned various informal or indirect channels of communication: *"The presidents of the groups receive all the minutes of all the meetings, that's one way to communicate ... and whenever we meet with our group Aline Clerc (the permanent office) gives a summary of what's going on in the other groups and in the COP."* Sometimes different working groups meet to discuss a particular subject that concerns more than one group: *"If there's an issue in one group that's interesting for other groups as well, there's information, sometimes an exchange, joint meetings, ..."* Direct interaction between technical groups and CS occasionally occurs as well. Based on their management experiences and observations, the working groups pose scientific questions to the CS and propose directions for future research.

2.1.2 Science-Management Interaction

2.1.2.1 Maximalist and Minimalist

The respondents agreed that managers and scientists in the separate CIPEL entities worked well together. Nevertheless, in several interviews people pointed at "cultural differences" between scientists and managers that hampered successful communication: *"That's the spirit of the researcher as opposed to the spirit of the engineer."* This discrepancy between the two perspectives often led to a high level of distrust. Scientists suspected managers to be thoroughly unaware of scientific considerations, while managers believed scientists to muse about the impossible: *"The scientists have a tendency to maximize a little sometimes in respect to 'what is possible', and then the managers have a tendency sometimes to minimize, to see only the realistic and to consider scientists to be dreamers anyway."*

Most interviewees emphasized the importance of building bridges between the science and management community. One interviewee said that agency managers with a large scientific background were particularly apt to provide a linkage between scientists and operational managers, because they had enough credibility on both sides. Thus, they could sensitize managers for new scientific knowledge and at the same time remind scientists of the multiple restraints on management decisions. He stressed that scientists needed to deliver clearer messages in order to improve the science management relationship: *"Scientists report that there is filament alga in the lake that causes a disturbance. Well, the day the scientists say what it needs to prevent the growth of filament alga in Lake Geneva, which conditions are necessary, at that moment managers can take measures to work on that problem. If it's not expressed in a comprehensible manner, managers can't do anything about it."*

2.1.3 Management Decisions

One interviewee stated that most management decisions within CIPEL were made by following set conventions. Although managers made their choices in respect to the problems of Lake Geneva, they did not necessarily consider the most recent scientific and technical information.

2.2 The Role of Scientists

The respondents agreed that scientists played an important role in CIPEL. However, their opinions varied remarkably as to "how is this role defined?" and "what should the appropriate role of scientists be?"

The interviewees suggested the following roles for scientists in CIPEL and similar organizations:

- Survey the development of the lake and its tributaries (regular data collection and presentation of results)
- Identify major problems and risks for Lake Geneva and provide managers with this information: *"The scientist is there to illuminate aspects the managers can't know. But a researcher is not an engineer. Everybody needs to do his own job."*
- Set objectives for managerial improvement
- Advise managers
- Develop possible scenarios and point out their advantages and disadvantages, the choice resting with the politician or administrative official: *"The scientist can say what would be the best choice from his perspective, but he doesn't make the choice ... he is supposed to give the necessary objective elements to politicians or managers so that they can make a decision."*
- Only in extreme high risk scenarios may the scientist take an activist role, advocating a particular solution. Sometimes, however, it is difficult to separate the personal opinion from the scientific opinion: *"I'm a scientist but I'm also a citizen."*
- Propose solutions and actions for restoration of and amendments to the lake

2.2.1 Cultures and Disciplines

2.2.1.1 Disciplines in CIPEL

The predominant disciplines in CIPEL are chemistry and biology. In the questionnaire, the respondents were asked, which additional discipline they would like to see included. One scientist proposed the involvement of an expert on bio-geo-chemical interactions, who would be able to study cycling elements of the lake such as carbon. Although the various compartments of the carbon cycle had been assessed, nobody had yet provided a comprehensive view of the whole cycle at the lake ecosystem level.

One person complained that CIPEL emphasized the ecological dimension of sustainable management, but failed to sufficiently consider social and economic issues. Most interviewees supported the idea of introducing economic knowledge into the CS as well as the working groups. They criticized the fact that agency members, represented in the working groups, were well informed about the financial aspects, subsidies, budgets, etc. concerning their own agencies, but nobody was able to evaluate the overall costs and benefits of CIPEL and its activities. It was therefore impossible to translate the effort toward lake water quality improvement into monetary terms: *"We need economists who don't only know how much it* *costs to build a sewage operation plant but who are able to compare these costs to the costs of other management options and at the same time consider the costs and benefits for the environment."*

The interviewees also favored the incorporation of social knowledge into CIPEL by including a sociologist into the CS. If the social impacts of management alternatives were assessed, their acceptance by citizens would be predictable. One respondent mentioned his experiences with the French water agencies that had introduced a formal public consultation process in order to be able to consider social aspects.

2.2.1.2 Interdisciplinarity

The interviewees agreed that in CIPEL the different disciplines mostly worked well together. This referred to the CS as well as the working groups and the COP. They explained that the nature of the problems which CIPEL had to address and the way in which the organization was structured promoted interdisciplinarity. Especially the new group "renaturation" performed a very open scientific exchange. Some people, however, expressed the need for scientists to leave the corner of their specialty and open up towards other disciplines. One scientist mentioned his surprise that *"during meetings the discussion always stays among a few people that have that global vision and the specialists only intervene if their discipline is directly concerned."* In his opinion, interdisciplinarity and ecosystem oriented thinking belonged together. He wished that CIPEL would take a more holistic approach which he underlined by the following example: "*Take the human body: You can't heal one organ if you have only an idea about this organ. You need to have an idea of the whole body, the disease, the symptoms, the whole ensemble. And finally you realize why the organ does not function and see what you can do about it."*

2.2.1.3 Different Scientific Cultures

In CIPEL and other scientific organizations the interviewees had identified two types of scientists; the specialist and the generalist: *"In a scientific community there's always the researcher who counts little bugs and their legs under a microscope for his whole life. And there's the researcher who is also ecologist and closer to management."* The specialist tended to focus on details and preferred basic to applied research. While he might be a well-known expert in his particular discipline, he showed little interest in the context of his findings, and lacked systemic or global understanding of problems and their interactions: *"It's true that there are scientists who prefer sitting in their ivory tower and produce reports without focussing on any important goals."* The generalist, per contra, was described as a scientist with a large vision who was capable of integrating different considerations and developing close bonds to managers.

As opposed to the generalist, the specialist had difficulties explaining scientific results in a comprehensible manner to other scientists, managers, or the public. According to one interviewee, this problem was apparent in the development of the tabular summary for

CIPEL: *"The tabular summary, the final goal, that's to show how the lake evolves in respect to a certain number of indicators, and these indicators must be comprehensible. And if you ask these people to explain these indicators, nobody will understand anything, that's for sure. It's necessary, therefore, to have some people who are able to simplify the matters. That can, that should be scientists if possible, but scientists who are capable of translating these complicated elements in a simple language."*

Several respondents emphasized the importance of personality in the development of the two extreme types of scientists: *"One type of scientist after finishing his academic studies will be open and start to work on more general things, often as part of an organization. The other type will stay in research and maybe become professor and it's really hard to teach him any global approach, because he keeps being an ultra-specialist."*

The interviewees agreed that both types of scientists were necessary elements of an organization. They unanimously sorted themselves to the second, more generalist group of scientists and felt responsible for providing a linkage between science and management.

2.2.2 Changes in the Role of Science

Two respondents had observed a certain evolution of the science community. Scientists were increasingly forced to consider the context of their research and produce results of general relevance. In the previous ten to fifteen years more scientists had started to think in broad ecosystem categories. They proved to be more open to other disciplines and management questions. The enrichment of science councils by social scientists was mentioned as one force that promoting this development.

2.2.3 Scientists and Politicians

As one interviewee asserted, scientists had a certain difficulty having their information considered on the political level: *"The politicians arrive there, listen to our proposals, then they say yes, well they actually say yes pretty often, and then they invite the media to spread the information on a larger scale and then ... in my opinion the politicians don't say too much about facts and results in detail."* He stated that it was very important for scientists or managers to make precise, well formulated propositions that would convince political decision makers of the scientific arguments. Generally, only mediagenic issues of general interest had the chance to be integrated into political decisions.

2.2.4 Scientific Uncertainty

CIPEL does not follow a comprehensive strategy to deal with scientific uncertainty. However, as one scientist stated, yearlong observations of biological and chemical parameters were one approach to evaluate the certainty of data. He proposed presenting these parameters as tendencies over many years and decades that would document the development of lake conditions, rather than to compare one year with the next. Until then changes in methodology, affecting the values of biological and chemical parameters had hampered the periodical comparison of data. Today there are attempts within CIPEL to introduce alternative parameters which would allow cheap and effective measurements and rest stable to methodological improvements.

Some interviewees found the differences between scientists and managers were demonstrated by their way to deal with uncertainty. *"The scientist always needs to have some certainty to give an answer ... that's the difference between the scientist who studies and puts the most credible data on his piece of paper, and then the manager who, even under a certain uncertainty, is forced to make decisions."*

2.3 Public Involvement

"The environment is nothing reserved to scientists but belongs to everybody who uses it everyday."

In general the interviewees had a positive attitude towards public participation. They embraced the open discussion meetings as an attempt to involve interest groups and the attentive public, although one person judged the success of the meetings as relatively moderate: *"At that time we hoped to hear people that live around the lake say: 'these are our concerns, these are the things we would like CIPEL to take a closer look at.' But that didn't really happen."*

Two respondents opined that public involvement did not have to be limited to discussions and meetings; a qualified public could be admitted to working group meetings as well. However, they both stressed that only people with sufficient technical knowledge should have access: *"But still the working groups are there to work ... if we talk about a sewage operation plant, that's not only a question of user representation. It's necessary to know how the plant functions, to know the facts, what are the technical constraints, etc."* Besides technical qualification the scientists identified two additional problems that were associated to public participation in the working groups: "staying objective" and "making the choice". One scientist, for example, stated that he would refuse to work with a nature protection association, if it insisted on advocating its particular interests. He would expect the association to be fully committed to the goals of CIPEL and to collaborate with working group members in an objective manner. He also pointed out the difficulty of choosing between various associations; their contributions had to be balanced, but at the same time the number of participants needed to be restricted, in order to prevent the working groups from growing to an unmanageable size.

One scientist stressed the significance of local knowledge and collaboration: *"My idea is to get the citizens more involved."* He stated that many of the regular measurements and data collection could easily be realized by users of the lake, such as professional fishermen.

2.4 France and Switzerland: Differences and Communication

The interviewees mentioned a number of differences that hampered the collaboration between France and Switzerland in CIPEL. Although both parts spoke the same language, certain cultural discrepancies, apparent e.g. in political structure and debate, needed to be bridged. Differences in legal and administrative organization, direct and decentralized in Switzerland and indirect and centralized in France, made the coordination of observation, planning and implementation more difficult. According to several respondents, concrete problems occurred with collecting and systemizing data because the methods and systems of data collection differed widely between the countries. Nevertheless, the interviewees observed a trend towards unification, since France was required to accord with EU systemization norms and Switzerland, though not an EU member state, attempted to adapt as well. For Switzerland, however, such a reform was described as particularly difficult, because Swiss data collection was denser and more heterogeneous than across the border: *"Today, if you take data of different Swiss lakes, the ways to report the results won't be homogeneous among the different cantons."*

People agreed that in France, CIPEL was better integrated into national water policy, which was ascribed to the water agencies that had provided a key contact for CIPEL and its implementation strategies in France. Switzerland lacks such a super-organization and the three cantons, therefore, participate separately in CIPEL activities.

One interviewee asserted that on the local level, Swiss coordination was more successful implementing the CIPEL action plan. In France, local or sub-regional entities had limited power over decisions, whereas in Switzerland low administrative levels could directly respond to agency demands. He also stated that in France water related competencies were largely distributed among agencies, and therefore it was hard to obtain comprehensive information and perform collaborate implementations. Per contra, Swiss agencies interacted more effectively as shown by the informal "Water Platform" in Wallis which meets every three months to share ideas and information on water management.

In general the respondents agreed that the cooperation between the two countries was quite harmonic and effective. Both countries followed the same objectives for the development of Lake Geneva, and were open for each other's propositions and remarks.

2.5 CIPEL and its Development

One interviewee emphasized the evolution which CIPEL had undergone since its foundation in 1960. It began as a mere research organization that surveyed the water quality of Lake Geneva and focussed on biological and chemical aspects. In the early 1990s, when the first action plan was developed, CIPEL became more directly involved. Today CIPEL is described as an active structure, providing scientifically sound recommendations to policy makers, and facilitating cross-boundary agency cooperation: *"I think that CIPEL is a facilitating structure* *that contributes to walking in the right direction.”* However, although CIPEL was well known and acknowledged by its members, the technicians within the agencies who would eventually implement the action plan, showed little interest in the organization: *“For a technician at the French water agency a sewage operation plant on Lake Geneva is the same as a sewage operation plant on any other watershed.”*

In general the interviewees agreed that CIPEL was a well-functioning organization that fulfilled its mission, as long as it did not have to operate in a contentious environment.

2.6 Problems

In the questionnaires and interviews, people were asked, which problems CIPEL was currently facing. They mentioned the following issues:

Availability of People:

The permanent office is having difficulty mobilizing people to participate in CIPEL. The administrations are forced to reduce staff, and people, therefore, are responsible for too many things and unable to devote time to CIPEL in addition to their regular duties. The interviewees themselves, depending on their position and tasks in the organization, invest one to five weeks per year into matters of the International Commission.

Availability of Data:

CIPEL has difficulties obtaining data scattered among different agencies. Primarily this is due to the bad organization of data bases within agencies which prevents the synthetic utilization of agency information. A second reason is secrecy, because agencies are reluctant to hand out data they consider confidential, particularly where industrial or agricultural matters are concerned.

Coordination:

The multitude of agencies and administrative entities that are involved in CIPEL hampers, at times, the organization of meetings and collaborative action.

Funding:

CIPEL depends on public budgets that have a tendency to shrink.

Politicians:

Local, regional, and national political decision makers still must be more sensitized about issues of ecological health in the Lake Geneva Basin. They must understand the importance of CIPEL recommendations and activities that improve the condition of the lake.

Retirement:

The CS is growing older and many of its members are close to retirement. It may be difficult to replace their experience and expertise with young scientists who focus on new fields and specialties and refuse to place CIPEL as a priority on their agenda.

Uncertainty:

There is still a high level of uncertainty about the lake ecosystem. Currently, scientists worry about micro-pollutants, because they lack knowledge about the amount of micro-pollutants in the water and their effects on plant and animal populations.

3 RESULTS

This part summarizes major aspects of the previous sections, focusing on the role that scientists play in CIPEL.

3.1 CIPEL and its Development

In 1960, CIPEL was founded as an international organization for the scientific observation of Lake Geneva. The first action plan in 1990, however, pushed CIPEL in a much more active and operational direction. Today, CIPEL can be characterized as a facilitating structure which initiates and coordinates various public activities for the protection of aquatic ecosystems within the Lake Geneva watershed.

3.2 The Role of Scientists and Managers

Scientists play an important role in the CIPEL organization. They observe the conditions of the lake, deliver scientific information to managers and policy makers and define the general objectives of management activities. Since agency scientists participate in the COP working groups, scientists are also involved in the framing of management actions. Scientists in the CS, however, barely transcend their roles as scientific advisors. Their recommendations are restricted to scientific goals, such as the reduction of phosphor, and they avoid developing options for management implementation. Scientists admit, that they *"don't know much about means to achieve a certain action"* and therefore trust managers to elaborate the necessary activities in order to meet the objectives.

Contrariwise, the COP has a more extensive mandate in CIPEL. Supported by the working groups, it develops actions, defines the means of implementation and supervises the efforts. Furthermore, the COP uses the scientific information to decide about the recommendations that CIPEL enunciates to the national governments.

Despite the "cultural differences", collaboration between managers and scientists functions well within CIPEL. The CS and the COP maintain a regular exchange and the circulation of reports and minutes allows the different entities of CIPEL to communicate with each other. Moreover, the agency managers within the working groups are able to influence the directions of scientific research by means of questions or propositions to the CS. Sometimes, however, managers wish that scientists were more specific in their objectives, because they depend on practical information to arrange for the necessary activities.

The following paragraph illustrates the role that scientists and managers play in CIPEL with the example of phosphor reduction:

Scientists regularly measure the phosphor content in the water of Lake Geneva. They use their measures to evaluate the current condition of the lake and develop scenarios that show, how different phosphor levels effect the development of bacteria, alga, plankton, fish populations, etc. Based on these scenarios, the CS defines the reduction of phosphor to less than 20 μg/l as a concrete objective. Subsequently, this objective is considered in the meetings of the COP and the working groups, where managers develop alternative options to reduce the phosphor content in the lake water. Examples include recommendations to the governments to restrict phosphate contents in washing-up liquids, the construction of new sewage treatment plants, amendments of the waste water system, or improvements in public communication. In accord with the international commission, the COP eventually decides which actions shall be realized, and the working groups supported by the permanent office organize and supervise implementation within the various agencies.

3.2.1 Disciplines

Although the novel group "renaturation" has led to a certain extension, the disciplinary spectrum in CIPEL is limited primarily to biology and chemistry related fields. This spectrum could be enriched, in order to provide a more synoptic view of the Lake Geneva ecosystem and the role of CIPEL as a protection commission. Thus, the interviewees suggested the introduction of social and economic expertise as well as more integrative natural scientific knowledge about the cycling elements of the ecosystem.

In general, the interdisciplinary exchange within CIPEL functions well. In part, this may be due to the structure of the working groups that are not organized along disciplines but rather along particular objects. Despite this successful cooperation, however, some interviewees emphasized that scientists in CIPEL lacked a holistic approach or "global vision" of the lake ecosystem and neglected to study its long term evolution.

3.3 Public

Apart from discussions and meetings during the preparation of the second action plan, CIPEL excludes public participants. The meetings, however, revealed that the public generally agrees with the objectives and actions presented in the plan.[97] Moreover, CIPEL has no power of decision and may therefore be of limited relevance to political stakeholders. As a consequence, the demand for more regular public participation in CIPEL is probably rather moderate.

Some scientists embraced the idea of admitting a qualified public to the working group meetings and utilizing local knowledge as an enhancement to the scientific studies. However, they were concerned that representatives of public associations would take the opportunity to promote their particular interests and thereby undermine the objectivity of the working groups.

[97] Kazemi, "Consultation Publique pour la Révision du Plan d'Action", 1999

3.4 Two Countries

Because both countries agree upon the overall goals of CIPEL, they can successfully collaborate within the international structure. Certain differences in policy and culture, however, hamper the coordination of data collection and implementation. In Switzerland, the administrative system is rather decentralized and consensus oriented,[98] whereas the French administration is characterized by centralism and agency authority.[99] As opposed to Switzerland, France is obliged to adhere to the EU directives and comply with the EU norms for water protection and data systemization. Also, the French water agency achieves a more effective integration of CIPEL into the national water policy.

[98] Linder, 1999

[99] O'Riordan, Wynne in "Riskante Technologien: Reflektion und Regulation", 1993, p. 204

4 RESULTS: CATEGORIES

The following categories, derived from the CIPEL case study, were selected to guide further research in the United States.

<u>Science</u>

- **The Role of Scientists**
  - Changes in the Role of Science
  - Cultures and Disciplines
    - Disciplines
    - Interdisciplinarity and Integration
    - Different Scientific Cultures
- **Scientific Uncertainty**
- **Science and Management**
  - Communication across Boundaries
- **Science and the Public**
- **Scientists and Politicians**
- **Science and Institutions**

<u>Science and Ecosystem Management</u>

- **The Global Vision**

CHAPTER V

CASE STUDIES: UNITED STATES

FEMAT, ICBEMP, SNEP

1 BACKGROUND: NATURAL RESOURCE MANAGEMENT IN THE U.S.

1.1 Land Distribution

In the U.S., five broad land use categories can be distinguished: forests, rangelands, crops, pastures and urban areas.[100] Forestlands cover about 298 million ha, or one third of the total U.S. surface area. Approximately 60% of forested areas are under private ownership; the remaining 40% belong to public landowners, such as federal, state, county and municipal authorities. With 78%, the federal government owns the largest proportion of public forests, especially in the western states.

67% of the forestlands are classified as timberland, mostly belonging to private landowners. The high productivity forest areas (over 8.3 m^3 / ha / year) are mainly located in the Pacific Northwest and the South Central Sub-Regions, dominated by coastal douglas fir and hemlock-sitka spruce types. In the Pacific Northwest, 4.05 million ha of land is still covered by old-growth forest.[101]

1.2 Federal Land Management Agencies

Approximately 77 million ha, almost two thirds of the federal forests, belong to the "National Forest System", which is administered by the U.S.D.A. Forest Service (FS)[102] (see list of abbreviations in annex I). Other agencies involved in the management of forestlands are the U.S. Bureau of Land Management (BLM), the U.S. Fish and Wildlife Service (FWS), the U.S. National Park Service (NPS), and the Department of Defense.

1.2.1 The U.S.D.A Forest Service[103]

The FS is subordinate to the Department of Agriculture and is responsible for the management of the National Forests, the conduction of forest research and the assistance and cooperation with state, local, industrial and private landowners. It is organized on four administrative levels: the ranger districts (20,000 to 400,000 ha), the national forests, nine cross state forest regions and the Washington office.

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[100] Smith et al., "Forest Resources of the United States", 1997, http://www.ncrs.fs.fed.us/pubs/gtr/gtr_nc219.pdf
[101] The Bugwood Network, last update 2002, http://www.bugwood.org/intensive/forests_and_timberland.html
[102] Smith et al., "Forest Resources of the United States", 1997, http://www.ncrs.fs.fed.us/pubs/gtr/gtr_nc219.pdf
[103] U.S.D.A. Forest Service, homepage, last update 2002, http://www.fs.fed.us/

The FS disposes of an internal research branch, the FS Research and Development Organization. The six Forest Service Research Stations, the Forest Products Laboratory and the International Institute of Tropical Forestry employ scientists of various disciplines who conduct basic and applied research.

1.2.2 The Bureau of Land Management[104]

The BLM is the principal land management agency of the United States. It administers about 106 million ha of public land, including extensive grasslands, forests, high mountains, and deserts, which are mostly located in the western states. Twelve state offices represent the BLM on the regional level. The BLM is subordinate to the Department of the Interior, the nation's principal conservation agency.

1.2.3 The Fish and Wildlife Service[105]

The FWS mission is to conserve, protect and enhance fish, wildlife, and plant species along with their habitats. It manages 539 National Wildlife Refuges covering about 38 million ha. As a regulatory agency, the FWS is also responsible for the administration of the Endangered Species Act under which almost 2000 species are listed as threatened or endangered. Along with the BLM and NPS, the FWS belongs to the Department of the Interior.

1.3 Environmental Legislation in the U.S.

1.3.1 The Legal System

American jurisdiction relies on two major sources: precedents adopted from the English common law system, and codified law manifested in several kinds of enactments, especially statutes, ordinances, regulations and the constitution.[106]

Statutes are formal acts of legislations passed by congress or the state legislature.[107] Although some statutes are very specific, for the most part they leave a wide range of implementation options to the executive administrations. Ordinances (or local law) are similar enactments, promulgated by county or city governments. Generally the legislature delegates some of its lawmaking authority to the executive agencies, empowering them to produce their own legal documents called rules or regulations. Once a regulation is announced, it has the same status as an ordinance or statute. The framework for all federal and state legislation activities is the U.S. constitution, which is superior to any other law. It has an indirect impact on all sector legislation and eventually effects environmental issues in a variety of ways, for example when private property rights are concerned.

Although the environmental enactments presented in this chapter are part of the national

[104] Bureau of Landmanagement, homepage, last update 2002, http://www.blm.gov/nhp/

[105] Fish and Wildlife Service, homepage, last update 2002, http://www.fws.gov/; Department of the Interior, "DOI Quick Facts", last update 2002, http://www.doiu.nbc.gov/orientation/facts2.cfm

[106] Buck, 1996

[107] Buck, 1996

legislation, federalism plays a significant role in U.S. legislative procedures. Within certain constitutional restrictions, the fifty states have extensive autonomy to promulgate their own legislation.

1.3.2 Environmental Enactments

1.3.2.1 The National Environmental Policy Act

As a consequence of the environmental movement in the 1960s, several legislative actions attempted to pass bills to protect the environment.[108] In 1969, the National Environmental Policy Act (NEPA) was enacted. Section 2 of NEPA highlights the principal objectives: *"To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality."* [109]

In section 101, NEPA requires all federal agencies to collaborate in order to preserve the environment.[110] NEPA establishes a number of administrative procedures promoting this active cooperation, most notably the Environmental Impact Statement (EIS). Furthermore NEPA sets standards for public participation and social considerations in environmental decision-making.

Environmental Impact Statement

In order to comply with NEPA, every federal project must be assessed for significant impacts on the environment. If the assessment identifies important environmental impacts, a formal Environmental Impact Statement (EIS) is required. The statement must be circulated to local, state and other federal agencies for their comments.

Although the EIS is not an enforcement mechanism, it has had important consequences for agency decision-making.[111] The "study it first" approach has raised the environmental consciousness within agencies and drawn public attention towards environmental concerns.

1.3.2.2 Environmental Protection Agency

Shortly after the enactment of NEPA, the Environmental Protection Agency (EPA) was created by executive order.[112] The EPA's mission is to coordinate and supervise the environmental activities of all other agencies in order to assure a coherent national environmental policy. As a regulatory agency, it is empowered to set national standards for

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[108] Buck, 1996
[109] 42 U.S.C.A. § 4321, NEPA § 2
[110] 42 U.S.C.A. §4331, NEPA § 101
[111] McGregor, 1994
[112] EPA homepage, last update 2002, http://www.epa.gov/

numerous environmental programs and disposes sanctioning instruments to enforce them. It supports state and local governments, native tribes and federal agencies in the development and implementation of environmental regulations. Conducting its own research, EPA also participates in the production of environmental knowledge.

1.3.2.3 The Endangered Species Act

In 1973 the Endangered Species Act (ESA) was created to prevent the extinction of endangered plant and animal species, and protect their habitats and ecosystems.[113] Two agencies are responsible for its implementation: the FWS for terrestrial species and the National Marine Fisheries Service (NMFS) for marine species. In a formal listing process, these agencies make the determination whether to list or not list a species as threatened or endangered.[114] Individuals or organizations can request the agencies to open a listing process for particular species. The final choice, however, must be made *"on the basis of the best scientific and commercial data available."* [115] Furthermore, ESA obliges all federal agencies, in consultation with FWS or NMFS, to insure that no agency activity is likely to jeopardize the existence of a listed species or its habitat.[116]

1.3.2.4 The National Forest Management Act

The National Forest Management Act (NMFA) is the basic statute for forest management activities in the United States. In combination with the Multiple-Use Sustained-Yield Act of 1960, it establishes an approach that integrates recreation, wildlife habitat and forest production as equal interests in forest management.[117]

NMFA is implemented through regulations promulgated by the FS. A much discussed item of these regulations is the "viability clause" that requires forest managers to maintain a *"viable population of all native and desirable non-native species well distributed within the planning area."* [118]

1.3.2.5 The Federal Advisory Committee Act

Although not part of environmental law, the Federal Advisory Committee Act (FACA) is an important statute in respect to bioregional assessment. It sets standards for the nomination of external committees giving advice to federal agencies.[119] According to FACA, all councils or groups established by the federal governments must meet certain procedural requirements.

[113] Buck, 1996
[114] NMFS, homepage, last update 2002, http://www.nmfs.noaa.gov/prot_res/laws/ESA/ESA_Home.html
[115] 16 U.S.C.A. § 1533, ESA § 4, Bb1A
[116] 16 U.S.C.A. § 1536, ESA § 7, a2
[117] Valente, 1995
[118] Thomas in "Bioregional Assessments", 1999, p. 13
[119] Jasanoff, 1990, p. 46

Moreover, they must be well balanced in terms of their interest, attitudes and functions in the particular project.[120]

2 BACKGROUND: THE CASE STUDIES

2.1 The Forest Ecosystem Management Assessment Team (FEMAT)[121]

2.1.1 History: From Owl to FEMAT

In the late 1980s, the forest management agencies FS and BLM were facing a number of lawsuits because their management practices failed to comply with the requirements of ESA, NEPA and NFMA regulations. Environmentalists feared that timber harvest in old-growth forests would cause a serious decline of the Northern Spotted Owl, an endangered species found in old-growth forest habitat. The agencies repeatedly attempted to develop a plan that would meet the legal requirements, but their efforts were unsuccessful. As a result, they continued to be involved in litigation.

In order to end the gridlock, the FS, BLM, NPS, and FWS established the Interagency Scientific Committee (ISC), a cross agency science team, in 1989. The scientists were mandated *"to produce a scientifically credible plan to assure continued viability of the Northern Spotted Owl well distributed across federal lands within its range."* Their report, known as the "Thomas Report", was released in 1990. It proposed the creation of large habitat conservation areas, totaling more than two million ha of old-growth federal forest, in which any further logging would be prohibited. The Thomas Report, however, faced an adverse political environment. It was harshly criticized by industry groups and agency economists, who considered the social and economic impacts of the strategy to be unbearable. Fearing job losses and the destitution of timber dependent communities, elected and appointed officials hesitated to follow the propositions of the Thomas Report. As no changes occurred, federal courts shut down timber-harvest operations in federal old-growth forest areas, requiring the agencies to develop a management plan that would insure the viability of the owl.

In 1991, two committees of the House of Representatives commissioned a group of four scientists to develop alternative management options for late-successional federal forest in the Pacific Northwest. The Scientific Panel on Late-Successional Forest Ecosystems that became known as the "Gang of Four" was comprised of Jack Ward Thomas, the chief of the FS, Norman Johnson of Oregon State University, Jerry Franklin of the University of Washington, and John Gordon of Yale University. They accomplished an assessment that resulted in 36 alternative propositions. As opposed to previous assessments, they did not focus specifically on the spotted owl, but rather considered old-growth forest ecosystems and anadromous fish species. The conclusion of the Gang of Four Report was thought provoking because it indicated the impossibility of providing species viability without a significant reduction of

[120] Johnson et al. in "Bioregional Assessments", 1999, p. 98

[121] see Johnson et al. in "Bioregional Assessments", 1999, pp. 87-132

timber harvest levels. The report, however, produced no visible reaction from congress or the FS.

In 1992, another court decision again restricted timber sales on public land. The agencies, especially the FS and BLM, were forced to analyze the potential effects of their timber sales program on old-growth species if they wanted to continue with logging. The FS established the Scientific Assessment Team (SAT) to perform the analysis. The SAT produced a list of 667 species, including plants and invertebrates that are closely associated with old growth forests. Management alternatives were evaluated to assess the effects on all of these species and their habitat. The SAT report recommended reserve systems and buffer zones to protect various terrestrial, riparian and aquatic habitats. The establishment of the SAT thereby marked a further step from single species protection to broad ecosystem conservation.

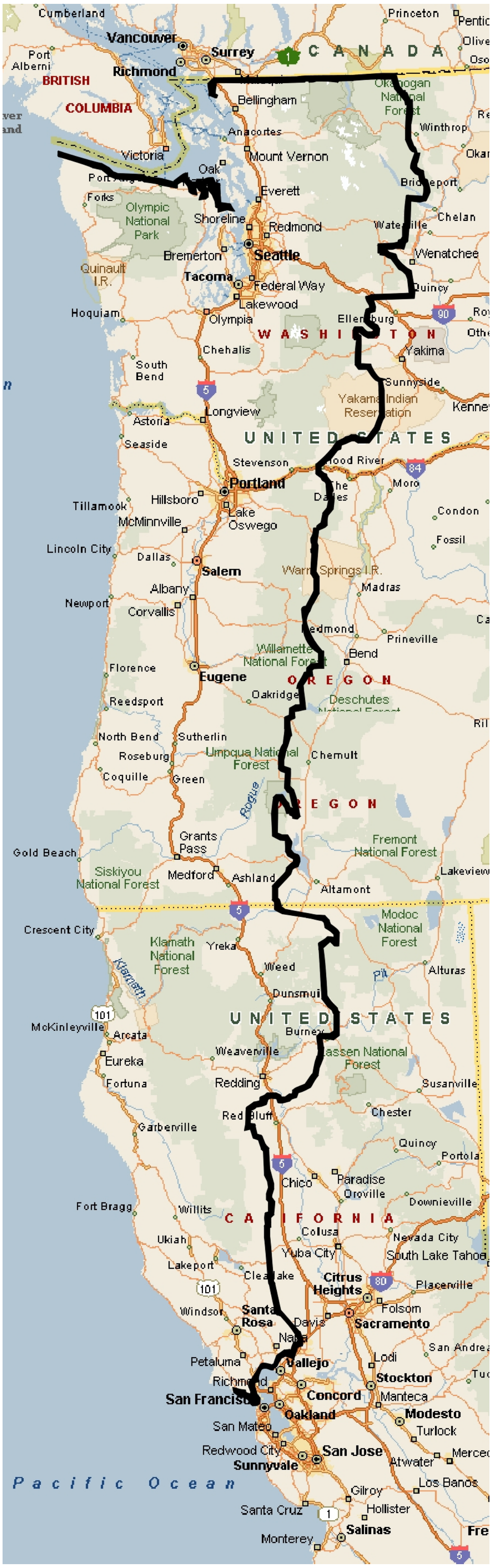
At the same time, the crisis of the federal forests in the Pacific Northwest had come into focus during the presidential election campaign. At a campaign stop in Oregon, candidate Bill Clinton promised to hold a forest summit on the issue if elected. Clinton won the election and in 1993 the Forest Conference took place in Portland, Oregon. Citizens, scientists and experts from the region were invited to give their opinion on forests and present the conflicting interests. At the conclusion of the conference, Clinton announced the formation of the Forest Ecosystem Management Assessment Team (FEMAT). It was commissioned to produce a plan in sixty days that would reconcile environmental issues with social and economic interests. Clinton named five principles which should guide the assessment:

- The human and economic dimension of these problems must never be forgotten.
- The long-term health of forests, wildlife and waterways are to be protected.
- The effort must be scientifically sound, ecologically credible and legally responsible.
- The plan shall produce a predictable and sustainable level of commodity production.
- To achieve these goals, the federal government shall work together and insist on collaboration not confrontation.

2.1.2 FEMAT

Soon after the conference, a science team was set up under the lead of Jack Ward Thomas. The selection of team members did not follow a pre-defined process. Thomas was empowered to choose team leaders that in turn chose team members they thought suitable for the task. The core science team consisted of 70 scientists and experts from different agencies and universities meeting in Portland, Oregon. The scientists were organized into six primary teams according to disciplines that focused on terrestrial ecology, aquatic ecology / watersheds, resource analysis, economic assessment, spatial analysis and social assessment for the 10 million ha region. The primary teams were supported by members of the Clinton administration, who stayed throughout the process in order to clarify the mandate and participate in the discussions. Managers or public representatives were not directly involved in the assessment, except through informal exchange with particular scientists.

FOREST ECOSYSTEM MANAGEMENT ASSESSMENT TEAM



The FEMAT assessment area comprises the range of the northern spotted owl, almost 10 million ha land located west of the Cascade range in western Washington, western Oregon and northwestern California. The assessment focussed on federal land managed by the Forest Service, the Bureau of Land Management and the National Park Service.

Major issues of natural resource management within the area concern the reduction of late-successional forest by forest harvesting and road-building, and the effects of forest production and road-building on watersheds (fish habitat, riparian habitat, water quality).

Pacific Northwest Information Node: pnwin.nbii.gov/geospatial.shtml, last update 2002

Bureau of Land Management Oregon/Washington: www.or.blm.gov/coosbay/fp-back.htm, last update 2002

As FEMAT was designed to become "the new management direction for the Pacific Northwest", a formal EIS was required to satisfy NEPA.[122] A separate team was established to develop an EIS based on the options and analyses developed by the FEMAT team. Other than the assessment, the EIS was open to public comment and review.

The science team soon realized that it would not be able to develop a scientifically sound management plan within the short period of 60 days. The project, therefore, was extended to three months and reduced to accomplishing only the assessment component. Later, a second step would be necessary to integrate the FEMAT results into a plan.

FEMAT started with 48 options drawn from previous documents, especially the reports produced by the ISC, the Gang of Four and the SAT. These options were narrowed down to eight, which would be fully evaluated by the science teams. The chosen options all promoted the creation of late successional and riparian reserve areas; however, they varied in their recommendations for size and distribution of these areas, the activities allowed within an area, and their prescriptions for the matrix in-between the reserves. Moderate management options, such as long-rotation forestry, were not developed. During the project, the eight options were assessed from a biological, economic and social perspective. The biologists focused on two key criteria: providing habitat adequate to support viable species populations, and providing for a late-successional forest ecosystem that was well distributed across the federal forest. The economic assessment team analyzed each option relative to its success in maintaining timber harvest levels, and the employment and county payments associated with them. They found that in all eight options the commodity production was too low to meet the president's mandate. The social team tried to assess the effects of each option on the community-level.

When the weaknesses of the selected options became clear, an interdisciplinary group of scientists initiated the development of a new option. It was to combine the reserve strategy, favored by the regulatory agencies, with the high-risk implementation strategy, favored by the land management agencies.[123] Option 9 proposed the creation of a late-successional reserve system integrated with key watersheds to protect aquatic and riparian habitat. It provided about 25 % of the federal timber harvest levels realized in the 1980s.

During the elaboration of option 9, the idea arose to create areas that would allow for higher risk management under a close monitoring system. Thus, ten Adaptive Management Areas (AMA), ranging from 30,000 to 160,000 ha, were established to apply the concept of adaptive management. They were designed to show a cross-section of biological, administrative and jurisdictional characteristics; offering a variety of ecosystems, land ownership patterns, and social environments. The major goal was to find new ways for managing broad ecosystems that would help to balance conflicting interests and values concerning issues such as species

[122] see Shannon, Meidinger, "Forest Ecosystem Management Assessment Team", 1996
[123] Shannon, Meidinger, "Forest Ecosystem Management Assessment Team", 1996

protection, timber harvest, employment, or recreation. The AMA were assigned to become "natural laboratories" of creativity and social learning.[124] Therefore, a participatory approach was chosen to encourage collaboration between private and public landowners, local communities, NGOs, Native American Tribes and various agencies. In order to reduce the risks for species associated with late-successional forests, most AMA were bound by old-growth forest stands.

When the project was completed, the nine options were presented to the government to make the final decision. On July 2, 1993 the president announced that option 9 would be his forest plan.

The EIS developed during the FEMAT process led to over 100,000 public comments, most of them adverse to the implementation of option 9. It was also unclear as to whether it complied with legal requirements, especially with the ESA. The final EIS identified almost 500 species that were still at risk of extinction under option 9. In order to adopt the option into the Record of Decision (ROD), the secretaries of interior and agriculture decided to modify it. Several reserves were added or enlarged, accepting decreased timber supply from these areas. Special survey and management guidelines would require the land management agencies to conduct surveys on certain endangered species, prior to any timber sale activity. In 1994, the final ROD was adopted, providing management direction for all the National Forests and BLM districts within the range of the northern spotted owl. The summary of the federal management plans, revised in compliance with the ROD, became known as the Northwest Forest Plan (NFP).

The NFP has proved to be resistant to legal challenges. In Oregon it has been endorsed by the state governor, and the "Oregon Plan for Salmon and Watersheds" has largely been based on the watershed protection strategies laid out in the NFP. However, it failed to end the gridlock of court-ordered injunctions in federal forests.[125] The land management agencies have been hesitant to implement the plan and meet all its requirements, which has repeatedly led to court decisions interrupting FS and BLM timber sales. The adaptive management section in particular, which was already belittled between FEMAT and the final ROD, has been realized only fragmentarily.

About a year after the project, a federal court ruled that FEMAT had been violating FACA. The reason for this judgment was mainly due to the involvement of academic scientists who did not qualify as federal advisers. FEMAT was also accused of having neglected certain procedural requirements. Nevertheless, the court allowed the agencies to use the FEMAT results because it doubted that the exclusion of academic scientists would have led to a different outcome.

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[124] Shannon et al., "Organizing for Innovation", 1996

[125] Hearing on the NFP, 1999, House Committee on Resources, homepage, http://resourcescommittee.house.gov

2.1.3 The Coastal Landscape Analysis and Modeling Study[126]

The Coastal Landscape Analysis and Modeling Study (CLAMS) is a follow-up project of FEMAT that develops alternative forest management models on a broad landscape level. The project region comprises the entire Oregon Coast Range which is a sub-region of FEMAT covering approximately 2 million ha. Most CLAMS initiators are scientists who participated in FEMAT but were not perfectly satisfied with the results, particularly the implementation of adaptive management. They hoped to reach a better understanding of landscape patterns by viewing time and space on a regional level. Principal objective of CLAMS is the development of concepts and tools of different forest policies and the evaluation of their ecological and socio-economic consequences across multiple ownerships. It therefore emphasizes the mapping, integration, and visualization of landscape patterns, management strategies and their effects.

The study is conducted by the FS, Pacific Northwest Research Station, College of Forestry of the Oregon State University, and Oregon Department of Forestry. Various disciplines are involved, ranging from ecology, fish and wildlife biology, and geomorphology to computer modeling and economy. The comprehensive approach forces scientists to collaborate across disciplinary boundaries. After 10 years of intensive study the computer model is now almost ready for utilization.

2.2 <u>The Interior Columbia Basin Ecosystem Management Project (ICBEMP)</u>[127]

2.2.1 History

Since the 1970s, the management practices of the BLM and FS in the Columbia River Basin had been continuously debated. The agencies had developed resource plans that focused on individual planning units instead of larger geographic areas, failing to deal with increasing resource problems. Concerns regarding forest health, the decline in the populations of wildlife and anadromous fish species, and the degradation of rangeland led to a number of lawsuits against the land management agencies. In the early 1990s, the courts threatened to shut down several national forests by judicial decision. Large wildfires that occurred in eastern Washington State, eastern Oregon, and southern Idaho intensified the issue. Eventually, members of congress requested a scientific assessment to examine the forest health conditions in eastern Oregon and eastern Washington. The scientists came to the conclusion that forests should be actively managed under an ecosystem approach. A follow-on scientific panel reached similar conclusions, recommending the realization of a more in-depth assessment and proposing that several forest exploitation activities, such as the harvesting of old growth forests and logging in riparian areas, should be interrupted.

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[126] Pacific Northwest Research Station, Science Findings, issue 45, july 2002; CLAMS homepage, last update 2002, http://www.fsl.orst.edu/clams/

[127] see Quigley et al. in "Bioregional Assessments", 1999, pp. 269-302; Meidinger, Shannon, "The Interior Columbia Basin Ecosystem Management Project", 1996

The conflict arising from the call for ecosystem-based management and the need for timber supply was a contributing factor to the presidential conference in 1993, where FEMAT was initiated. FEMAT, however, concentrated only on the western parts of Washington and Oregon, whereas the eastern areas were not addressed. When Clinton announced the adoption of option 9 in July 1993, he directed the FS to develop a "scientifically sound ecosystem-based management strategy" for managing the forests east of the Cascade Crest. In January 1994, the chief of the FS and the director of the BLM signed the charter that established the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

2.2.2 ICBEMP

ICBEMP was to be composed of five different parts: a scientific framework for ecosystem management outlining principles and processes that could be implemented; a scientific assessment of the region's historic, current, and potential future status; two EIS examining a broad array of alternative strategies for forest management; and a scientific evaluation of the EIS alternatives. While the EIS was limited to federal land covering approximately 30 million ha, the scientific assessment included roughly 60 million ha of public and private ownership located in parts of Washington, Oregon, Montana, Idaho, Nevada, Utah and Wyoming - an area as big as France.

The charter did not define a clear policy question, but described the expected product, organization and make-up of the project. It established an Executive Steering Committee that included regional foresters, FS research station directors and BLM state directors. Later in the project, regional directors of the National Marine Fisheries Service (NMFS), FWS and EPA were also included. The Steering Committee was required to oversee and direct the whole exercise and to choose the Project Leaders, who in turn selected the members of their teams. Thomas Quigley was assigned leader of the Science Integration Team (SIT), and was responsible for accomplishing the scientific goals of ICBEMP. The SIT was headquartered in Walla Walla, Washington and consisted of agency scientists mostly from the BLM and FS. All SIT members were federal employees in order to avoid violating FACA. The sub-teams were organized according to disciplines, forming aquatic / riparian, terrestrial, landscape ecology, social, economic and GIS / spatial groups. The overall cost of the project extended to about $40 million, which was mainly borne by FS and BLM. Other agencies contributed by providing additional staff. ICBEMP was originally planned for completion within nine months, but this was later extended to three years. Sections of the project continued for several years after the official time limit.

THE INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT PROJECT

The ICBEMP-Area

The assessment area of ICBEMP comprises approximately 60 million ha located in portions of Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming. The implementation area is limited to approximately 30 million ha of federal land that is administered by the Forest Service and the Bureau of Land Management.

The majority of the people in the basin live in the six metropolitan areas, but the majority of the area is rural. In the rural settings, agriculture is a dominant though declining industry. Principal issues of natural resource management in the Columbia Basin are forest production, declines in wildlife species, degradation of rangeland, and dwindling populations of anadromous fish (fisheries issues, hydropower, etc.).

Quigley et al. in "Bioregional Assessments", 1999
Meidinger, Shannon, 1996

As opposed to FEMAT, public involvement was a basic element of ICBEMP. The meetings and workshops of the SIT were open to public participation. In addition, special sessions and workshops enabled scientists to share information with public stakeholders, present draft reports and to answer questions. Various mediums were used to deliver current information to the public, including radio, television, print and electronic media. A newsletter was published about five times a year. To facilitate collaboration between the SIT and the local level, a coalition of counties was formed that represented the one hundred counties within the assessment area. The project also concerned twenty-two American Indian Tribes in the Columbia Basin. The Executive Steering Committee consulted personally with each tribe and a tribal liaison was established to enable continuous consideration of native issues.

Each of the SIT sub-groups produced a detailed assessment of the basin, which was later integrated into a SIT report. Due to the geographic extent of the area, the scientists primarily relied on remote sensing for landscape information. Besides their own research, they used large amounts of existing data from third party sources. In addition to the assessment, the SIT developed scenarios outlining probable results of different management intensities. Based on these scenarios, the EIS teams worked on more specific management alternatives that could guide future management prescriptions of the FS and BLM. The SIT evaluated these alternatives, analyzing their compliance with the ICBEMP goals. When the EIS processes were concluding, the SIT realized a "science consistency evaluation" to secure the appropriate interpretation of scientific information in the preferred alternative. Internal meetings between the EIS and science team facilitated the integration of their findings and propositions. As was the case with the FEMAT, adaptive management was a major concern.

Although ICBEMP produced a number of reports and published a large amount of information, a final product of the assessment such as a final record of decision (ROD) has not been developed. Attempts to translate the findings from ICBEMP into an implementation process that could be incorporated into law were not successful. The agencies remained free to decide whether they wanted to use the ICBEMP results or not. Several forest and BLM plans, however, have been amended with ICBEMP information and the Oregon Department of Forestry built its statewide forest assessment around the ICBEMP reports. Today, the final EIS of the project is available and open for comment. There are still efforts to draw a conclusion from the ICBEMP and make a final decision, but the science team has been dissolved except for one person in Portland who functions as a coordinator.

2.3 The Sierra Nevada Ecosystem Project (SNEP)[128]

2.3.1 History

As a consequence of the debate on the northern spotted owl in the Pacific Northwest, people in California's Sierra Nevada also became aware of the threats to their ecological environment. Controversial discussions concerning land and natural resource management in the Sierra, along with a number of thought provoking publications on the future of the Sierra, raised the concerns of local citizens and demanded a political reaction. In 1993, congress requested an independent, scientific study of old-growth forest and other ecosystems in the Sierra Nevada region. This act initiated the Sierra Nevada Ecosystem Project (SNEP), for which the FS was charged with implementation. It released a budget of $6.5 million and set up a steering committee that selected the scientists and framed the assignment.

2.3.2 SNEP

The first science team, however, did not function very well.[129] While the participants had previous experience in developing assessments in the Pacific Northwest, they had relatively little knowledge of California. Within the first year, the team leadership changed twice and many of the original scientists were replaced. After a year of struggle, Don Erman became the science team leader, and SNEP became organized around a core team of 19 scientists who were assisted by an equal number of consultants. A small group of scientists from the core team formed a coordinating committee that planned and coordinated the various activities and the budget. In contrast to FEMAT and ICBEMP, the scientists represented a mixture of academic scientists, consultants, and federal and state agency researchers, rather than agency employees. Instead of conducting new research, they mostly worked with existing sources, analyzing and integrating existing databases and information. The utilization of GIS facilitated data synthesis and mapping. New research was limited to a study on old-growth forest. A complex reviewing process included blind and peer reviews, as well as public reviews.

The public played an important role in SNEP, particularly through a key contact group that was created in order to receive input from interested parties within the local community. The group consisted of roughly 90 individuals who regularly met with the science team, so that public interests and concerns could be integrated into the scientist's work. The key contacts also participated in the review of draft documents. Additional public meetings and the publication of a newsletter served to reach an even larger audience. Because SNEP was not directly linked to a policy process, it was not required to meet NEPA and FACA requirements for public participation.

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128 Erman et al., in "Bioregional Assessments", 1999, pp. 303-338; "Status of the Sierra Nevada", Wildland Resources Center Report N° 39, 1996; "A Citizens Guide to the Sierra Nevada Ecosystem Project Report", The Wilderness Society, 1997

129 Interview David Graber

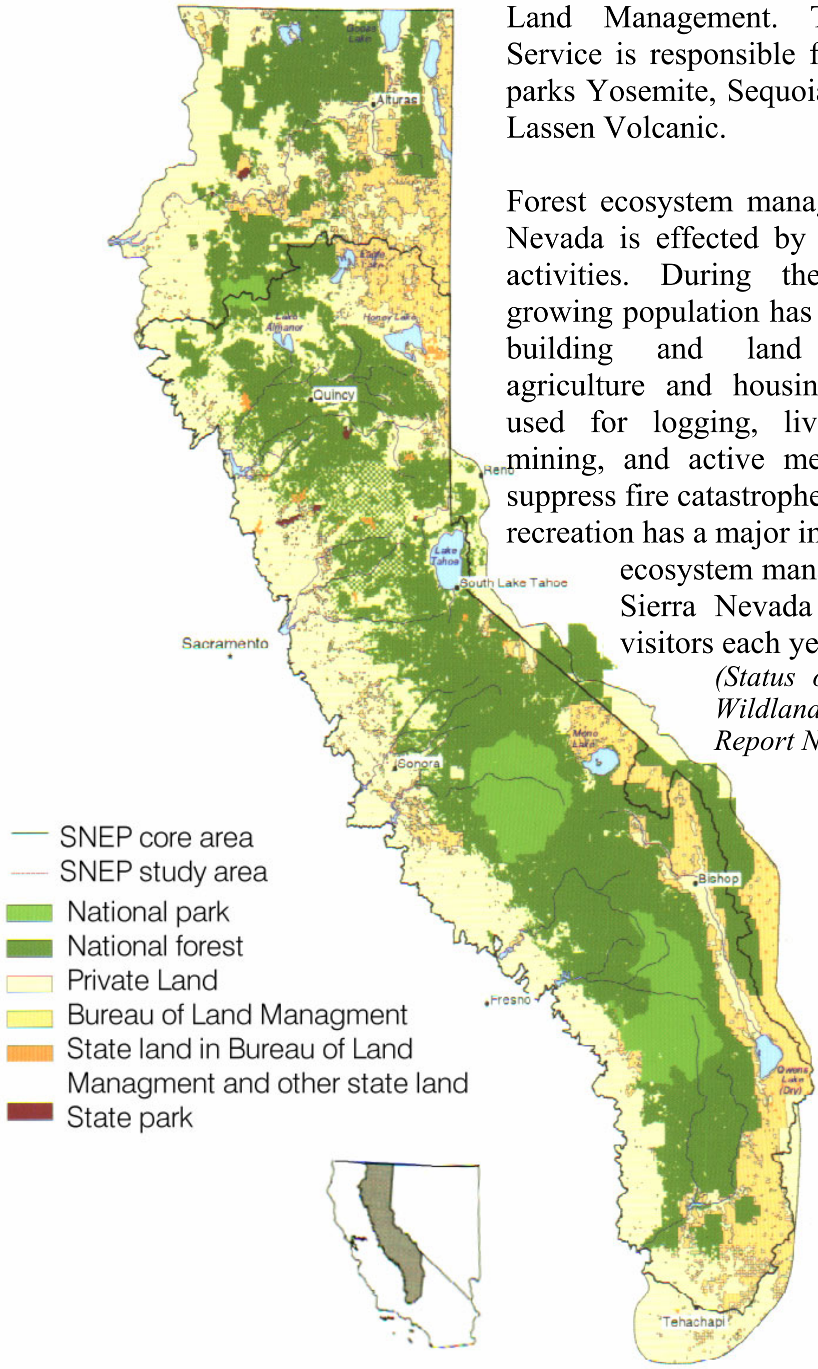
THE SIERRA NEVADA ECOSYSTEM PROJECT

The Sierra Nevada mountain range located in the northern part of California covers an area of 650 km in length and 80 to 160 km in width. Its highest mountains reach an altitude of over 4000 m. The Sierra Nevada is rich in biodiversity and ecosystems including primary old-growth forests and large watersheds.

The SNEP assessment area comprises approximately 8.3 million ha, 40 % of which are in private / local and 60 % in federal ownership. Most of the federal land is administered by the Forest Service and some by the Bureau of Land Management. The National Park Service is responsible for the three national parks Yosemite, Sequoia-Kings Canyon, and Lassen Volcanic.

Forest ecosystem management in the Sierra Nevada is effected by a number of human activities. During the last century the growing population has led to increased dam building and land development for agriculture and housing. Forest lands are used for logging, livestock grazing and mining, and active measures are taken to suppress fire catastrophes. Furthermore, recreation has a major impact on forest ecosystem management, because the Sierra Nevada attracts millions of visitors each year.

(Status of the Sierra Nevada, Wildland Resources Center Report N° 39, 1996)



In 1996, SNEP edited its final report and presented it before congress. The report is composed of four volumes that summarize the scientific findings and conclusions. Because SNEP did not focus on a particular policy problem, but generally worked under the premise to *"protect the health and sustainability of the Sierra Nevada while providing resources to meet human needs",* the report does not contain a comparison of management alternatives. Nevertheless, it proposes four different reserve systems, and assesses their impact on forests, watersheds and wild lands.

The document has been used as a basis for policy decisions in various cases. One particularly important outcome was the EIS revision process. Concurrently with SNEP, the FS was conducting an EIS on the California Spotted Owl. When the SNEP report was published, a FACA committee decided that the EIS had to be revised in order to take into account the findings of SNEP. Furthermore, several interest groups and private foundations have used the SNEP information. The Wilderness Society, for example, has created maps that combine SNEP data with various sources. Other environmental groups have prepared policy proposals based on the SNEP report. Some counties integrate SNEP information into their county planning.

3 PRESENTATION OF DATA

This section presents the basic contents of the interviews done in the United States. It summarizes their most important aspects and underlines them with quotations of some key statements. The information is arranged by categories and properties.

3.1 The Forest Ecosystem Management Assessment Team (FEMAT)

3.1.1 The policy problem

"This FEMAT thing was all built around species protection and there are a lot of other issues out there that are not related to species protection."

This quotation illustrates what most of the scientists thought about the problem definition in FEMAT, videlicet that FEMAT was assigned to preserve the northern spotted owl which was endangered by timber harvest activities in old-growth forest. Particularly for the teams that dealt with the spotted owl and old-growth forest the assessment exclusively addressed the question *"what's it gonna take to protect the owl?"*. However, some interviewees stated that the maintenance of a certain commodity production was a significant part of the problem. As the second part of the quotation displays, they believed that the non-species related questions were not sufficiently considered. The social scientists, in particular, had missed a debate about the nature of the question in the initial weeks of the project. The following citation underlines the opinion which several interviewees expressed, namely that the underlying approach of FEMAT was unbalanced:

"In 1993 when we started it was a different goal ... than you do try to have goals and costs for the human systems and the natural systems, that humans are part of an ecosystem ... FEMAT, it didn't start with that, it started as a habitat conservation strategy, a very sophisticated one that attempted to mitigate the economic impact."

According to one scientist, it was part of the FEMAT approach to exclude those scientists from the team who were known to favor a less ecologically oriented solution.

3.1.2 Scientists

3.1.2.1 Disciplines

Although a multitude of different disciplines was involved in FEMAT, several people disagreed with the heavy compartmentalization of the science teams. One interviewee described the FEMAT exercise as a continuing battle between disciplines focused on ecosystems and disciplines focused on species. He stated that the entire make-up of the project exacerbated interdisciplinary conflict, and prevented real integration except for the final option 9 that was developed under more interdisciplinary conditions.

According to a social scientist, FEMAT constituted one of the first attempts to include social scientists as full partners in ecosystem analysis. The social scientists, therefore, were challenged to define their role in an environment dominated by natural scientists. Due to shortness of time and legal restrictions, most of the usual sociological methods, such as social impact assessment, could not directly be utilized in FEMAT. Thus, the social scientists redefined their task in the assessment. They attempted to provide a conjunction between different disciplines and perspectives, and moved among the various scientific teams in order to raise their awareness of the social impacts on local communities of the elaborated options.
As one interviewee stated, discipline and expertise were only one criteria to select scientists for the science team: *"Some people were called upon because of their expertise. And then beyond that some people were called upon because of their personality and their interest in being there when the big action was happening."*

3.1.2.2 The Role of Scientists

The respondents agreed that scientists played an extraordinarily important role in FEMAT. They developed management alternatives and made the basic decision as to which option should be implemented:

"When the NFP came, it was basically the scientists coming up with the alternatives and then the White House selected them also. But the choice of alternatives was quite narrow. And in both cases (gang of four and FEMAT) the managers didn't lay out the assumptions, the scientists did. And so the accusation is that in the NFP the scientists set policy. And we came damn close to it."

The interviewees, however, disagreed, whether scientists had crossed the line toward science advocacy. Some participants described the process of description, analysis and interpretation of management options as an important scientific mission, that lead to scientifically based policy decisions. Others criticized certain scientists as being biased, because they promoted a strict reserve solution and blocked the idea of flexibility and adaptive management. One interviewee suggested that policy makers had used scientists who advocated a strong owl conservation strategy, because they needed scientific support for the restriction of timber harvest in order to escape the continuous litigation.

3.1.2.3 Personal Experiences

In terms of "costs and benefits" most scientists described FEMAT as a twofold experience.

"The days would start for me, and I would be in the office at 6.00 am, and the earliest I'd get home was at 7.30 at night, seven days a week." The short time frame and the political force to deliver good and reliable results put the participants under enormous pressure that eventually lead to significant burn-out. Several scientists would refuse to participate in another assessment under the same conditions. One respondent wondered that the results of FEMAT had not been more heavily questioned, because they were developed in a less than

adequate period of time. Furthermore, many scientists were disappointed when they realized that their ideas of flexibility would not get integrated into the administrative process, and their frustration turned into the desire to return into a more traditional scientific environment.

However, despite the enormous personal costs and certain disappointments, the interviewees valued the assessment as a great satisfaction and new stimulation to their career: *"I really believe that science and scientists have a great deal that they gain from those experiences."* People were proud of the work they had accomplished within three months, and they felt that their professional perspective had been broadened. The close collaboration between scientists during FEMAT also formed new personal and professional relationships that outlasted the period of the project.

3.1.3 Managers

"The important thing in terms of the make up was the fact that we excluded the managers."

While most scientists criticized the exclusion of managers from bioregional assessment in general, some considered their exclusion inevitable in the particular case. They reasoned that the political environment of FEMAT was extremely contentious and that the environmentalist public distrusted forest land managers in the Pacific Northwest. Managers were suspected to exclusively promote economic interests and to support the FS timber sales program that permitted timber harvest in old-growth forest areas. As some interviewees argued, the assessment could not have maintained its scientific credibility if scientists had not worked independent from manager supervision. Nevertheless, one scientist said that the exclusion of managers probably hampered their motivation to implement the FEMAT results.

3.1.4 Public Involvement

Scientists gave several reasons to explain the absence of public involvement in FEMAT. Firstly, scientists were mandated to produce a scientific document that did not need or even allow for public intervention. A second argument stated that public participation would have complicated the task to accomplish the assessment within 90 days. Some interviewees, however, admitted that public participation might have lead to the discussion of additional alternatives.

3.1.5 Implementation: The Northwest Forest Plan

When academic scientists were charged in court because of FACA violation, they felt that FACA was used as an excuse to exclude them from participation in the elaboration of the NFP. They asserted that the NFP process was dominated by a species approach that undermined the ecosystem context that FEMAT had attempted to bring forward. They criticized that the NFP was developed by species oriented biologists who were very risk adverse. *"We pushed pretty hard that that would be put into FEMAT ... but if you can't fail* *you can't practice adaptive management."* Managers also missed the flexibility they had hoped for: *"Once the NFP came out, the managers knew they had been bamboozled."*

One interviewee pointed out, that scientists were quite ignorant of legal constraints on management that were hard to coordinate with the call for more flexibility: *"They (the scientists) were incredibly naive about how in fact it was implemented on the ground."*

Some scientists mentioned that several problems within the agencies hampered the implementation of the NFP. While modern approaches to ecosystem management confronted the agencies with new challenges, at the same time they were facing the loss of staff and money. The FS, for instance, feared that the NFP would devour a big part of its budget and resources. As one interviewee reckoned, the agencies had *"taken up too much at one time."*

In general most scientists criticized the implementation of FEMAT into the NFP as too prescriptive. Nevertheless, they agreed that the NFP was a success in terms of meeting its goal to establish a legal plan for habitat conservation.

3.1.6 General Outcomes and Impressions

"We've changed the way forests were managed in the Pacific Northwest lately."

Most scientists thought that FEMAT had been a success, because it met its ecological goals, raised the awareness for ecosystem conservation issues, and got implemented into a plan, even though the implementation was not completely satisfactory. FEMAT was considered an important impulse for ecologists to work at a landscape level, an attempt that was well-illustrated by follow-on projects such as CLAMS. One interviewee emphasized the secondary effects brought about by FEMAT such as improved communication between different agencies, particularly the FS and the BLM. Some people, however, remained critical, because FEMAT failed to meet its goals for timber production.

One statement illustrated the notion of change in understanding ecosystems that most participants experienced: *"What grew out of our activity was a notion that first of all that was not only a question of habitat or the owl or how to grow old-growth. It was more a matter of 'how did we as a society make decisions about what we wanted?' 'What is the mix of goods and services that we wanted from these kinds of lands?' 'And what were the appropriate kinds of strategies?'"*

3.2 The Interior Columbia Basin Ecosystem Management Project (ICBEMP)

3.2.1 The Policy Problem

The scientists agreed that the overall mission of ICBEMP had been fairly clearly defined to *"develop a scientifically based strategy for managing the Columbia Basin."* However, some of them admitted that it was difficult to translate the broad assignment into a more specific policy problem. According to one of the participants, the different science groups attempted to develop their own diverse interpretations of the problem, which led to a set of different pieces of policy problems that lacked integrity. At the end the scientists realized that they had addressed the question *"How do you manage this very large ecosystem?"* while the agencies had wanted an answer to the question *"How do we manage national forests or other public lands?"* One of the interviewees made it quite clear that in his opinion ICBEMP had failed to address the right problem: *"ICBEMP hadn't grown up to address some of the important major issues. It was that they tried to avoid them."*

As opposed to FEMAT the participants of ICBEMP considered the underlying approach of the project quite balanced. *"We attempted to integrate across economic as well as ecological and social systems."* One interviewee observed that over the years of the project, there was a certain development towards working more in the context of contemporary forest management that defined humans as part of the ecosystem.

3.2.2 Scientists

3.2.2.1 Disciplines

In ICBEMP the science teams were organized by discipline. According to the participants, the integration part that followed after several years of segregation between the science groups was truly interdisciplinary: *"So we developed concepts that were integrative. And they were concepts of social and economic resiliency and concepts of ecological integrity."*

Two interviewees emphasized that the product of this interdisciplinary work was an integrated science report which was published before the individual science reports. An outside observer of the project asserted to the contrary that there had never been a final document.

3.2.2.2 Science Role

The role of science in ICBEMP was less outstanding than in FEMAT. As one scientist said *"they stayed more in the background."* Scientists attempted to develop broad concepts for ecosystem management in the Columbia River Basin which excluded the elaboration and choice of implementation strategies. According to one of the leaders, the role of scientists in ICBEMP was quite objective; the organization of the science team prevented the influence of personal biases on the scientific results.

Many people criticized ICBEMP as an assessment that took forever, failed to achieve its goals and finally died before it had produced any useful results. According to the following comment, the failure was partially due to the scientists who were selected for participation: *"In the gang of four and the NFP in my opinion they took the first team, the national team ... when they got to the ICBEMP they took what I'd call the B-team and C-team and they tried to grow. And it took forever to get people up to speed and say: 'Hey, this isn't an interesting science exercise. This is something that's far more important than that.'"*

As one scientist explained, uncertainty was a major issue in ICBEMP. Scientists discussed the issue with managers and the public, and attempted to inform people about the uncertainty associated to many of the scientific results.

3.2.2.3 Personal Experiences

The scientists involved in ICBEMP described their experiences as generally satisfactory, particularly because they gained new scientific knowledge and learned more about adaptive management mechanisms. At the same time, however, people were disappointed that their results were not implemented. In comparison to FEMAT, some people considered ICBEMP to be "the opposite evil." While FEMAT struggled with the extreme time pressure, ICBEMP was prolonged for years. People, therefore, were likely to develop a feeling of *"This is never gonna end, it just goes on and on and on."*

3.2.3 Managers

As opposed to FEMAT, ICBEMP involved managers in the assessment. According to the interviewees, they were mandated to translate the scientific concepts into management strategies. Scientists also communicated with managers in order to learn their opinion on future management options which scientists might assess. As one person stressed, *"there was a very strong exchange (between scientists and managers)."* Some scientists, however, doubted the quality of this exchange: *"The quality of the communication between the managers and the scientists was not very specific. And particularly on what were the particular decisions that had to be made, and on what scale were those decisions, what information would then be needed to address those decisions."* Another scientist argued that the strong involvement of managers was in fact the reason for the project's limited success: *"ICBEMP didn't work. I think the reason for it was ... we got back into this notion that the managers didn't want more restrictions and they didn't want to change."*

3.2.4 Public Involvement

Some scientists praised the inclusion of public involvement in the ICBEMP process as very successful. They stated that it was open and transparent, and that the public not only had access to good information but was also able to give certain input. On the contrary, another comment characterized the public participation as a farce, in which people were asked for their remarks when the basic decisions had already been made and certain big political issues had been taken "off the table."

3.2.5 Scales

Many participants thought that the assessment area was too large and that they were overstrained to move between all the different scales that fit into the broad scale of the assessment area: *"In the end it was clear that we had needed to be much more nimble about going back and forth across the spatial scales."* One scientist argued to the contrary that the assessment area fitted the purpose of the project. The initial problem, the viability of wide ranging species such as salmon or northern spotted owl, demanded the setting of wide boundaries: *"Therefore the boundaries that were selected for this analysis was in fact the boundary of these wide ranging species that were most concerned."* In his opinion, the previous limitation of assessments to small portions of the big region was a significant reason for the controversial law suits. Although a smaller assessment might have been more suitable for implementation, it probably would have failed to solve the actual problem.

3.2.6 Implementation

The scientists agreed that ICBEMP was never truly implemented and that no major decisions were made based on its results. Several reasons were given to explain the absence of a real outcome, which was most often attributed to the adverse political environment: *"The failure of ICBEMP might be as much political as the assessment."* Several interviewees stated that there was not enough political will for implementation. Too many people in the Columbia Basin were suspicious that bioregional assessment was a new way for the federal government to control their lives. The different agencies disagreed on the ICBEMP propositions and especially the land management agencies feared that their implementation would imply more restrictions. One person argued that when ICBEMP presented its results, the political process had already passed the issues and made its decisions without the information from the assessment. On the contrary, another scientist suggested that some policy makers considered the science management concepts proposed by ICBEMP but that the policy process was not yet ready to make a large decision. One interviewee reckoned that the lack of common understanding of the policy problem had contributed to the unwillingness of policy makers to implement anything: *"In the ICBEMP we were encouraged to take the most contemporary scientific view of ecosystem management ... but there also was no encouragement to develop something that was likely to be implemented. That would have been two different approaches."* He added that scientists should have been forced to agree on a clear definition of the question before they began collecting data.

3.2.7 General Outcomes and Impressions

The following quotations show that many scientists considered ICBEMP a failure, although they had to admit that the contentious political environment exacerbated the effort.

"ICBEMP didn't work. They didn't get to what they wanted to."

"Maybe ICBEMP was a failure."

"We started wrong and we persisted in going there."

"I think basically ICBEMP has killed bioregional assessment for the short run."

Not all scientists, however, drew such a negative picture of ICBEMP: *"The information that we delivered on the science side has really made a substantial difference in the way the management agencies and the public understand the resources within the basin, and it has* *effected the way that they are managing, but it didn't result in a large decision similar to like the FEMAT decision."*

3.3 <u>The Sierra Nevada Ecosystem Project (SNEP)</u>

As opposed to FEMAT and ICBEMP, only two scientists, A and B, could be interviewed about SNEP. The information, therefore can neither be perfectly balanced nor thoroughly complete.

3.3.1 Initiation

According to B, SNEP was not directly crisis driven but *"somewhat more based on ripening at the national level of the importance of bioregional assessment".* Certain small problems of the Sierra Nevada raised interest on the national level, but they did not constitute a major crisis that required immediate reaction. A added that SNEP was also inspired by FEMAT and the NFP process.

3.3.2 The Policy Problem

"The overall mission of the SNEP was to explain how the system worked, to identify what the key elements of the system were and to characterize them, to present information based on the scientific research that had already been conducted, not to do new research."

The interviewees agreed that the overall mission of SNEP was quite clearly defined. The science team, however, was struggling with the details and the interpretation of the Senate Bill that described their task: *"We sat there and tried to identify what the nature of the problem was, we had bit off far more than we could chew and it took quite a while, a long time, perhaps a year before we really had a focus where we were headed."* Despite these initial difficulties B evaluated the characteristics of the assignment positively: *"We were unusual in having a very thoughtful assignment and it was clearly interdisciplinary, it was clearly called to be integrated, it was clearly not a watershed analysis, ... it was to be multidisciplinary, ... it was clearly a monitoring aspect that was suggested, it was also clearly not to be a decision document."*

Both scientists stated that SNEP attempted to be balanced in terms of the underlying approach: *"I was satisfied ... I mean there was a great lap forward in integrating the social and the natural elements into one report."* However, certain aspects hampered the equal consideration of the social, economic and environmental aspects. Both interviewees criticized the make-up of the science team. It included only one expert per particular subject, such as old-growth, aquatic biology, or fire. The situation promoted a certain imbalance, because members of the science team were reluctant to question the opinion of a specialist from a different field: *"If there's a bias that comes out from some individual representing a whole topic it took strong members of the rest of the team to question that because there was their expertise."* B emphasized that at the beginning scientists struggled to develop an understanding of the human dimension of the problems and its integration into the project: *"In those days we were coming more at the birds and the bees and the water and the trees."* In the report the scientists eventually acknowledged the importance of the human aspects by placing the social chapters at the beginning.

3.3.3 Scientists

3.3.3.1 Disciplines

Although the science make-up hampered the mutual review, B acknowledged that it decreased the general scientific tendency to hide within the own familiar discipline. He believed that the frequent science team meetings and the establishment of personal relationships fostered the development of a certain group feeling that benefited scientific exchange. However, *"the most effective means of integrating was keeping the sub-teams rather broadly assigned."*
A agreed that there was a lot of interdisciplinary discussion and a serious attempt for integration: *"We tried to manage an ecosystem as an ecosystem as opposed to managing all the different elements."* Nevertheless, both admitted that the final document was not really integrative: *"Over time our initial idea that we could produce some kind of very comprehensive, multidisciplinary, interactive document was abandoned."* The scientists, therefore, followed a more traditional approach to write the report which eventually consisted of a set of papers on different topics relevant for the Sierra Nevada.

B observed that the different scientific cultures had difficulties communicating with each other. The social and natural scientists had to find a common language to talk across their different "specialty dialects."

In summary, both scientists were satisfied with the participating disciplines and the degree of integration achieved in SNEP: *"It was probably as interdisciplinary and integrated as we could do at the time with the people and money present."*

A underlined the particular role and its challenges for scientists in bioregional assessment: *"Although what we were doing wasn't scientific research I think it required experienced scientists to be doing it."*

3.3.3.2 Science Role and Advocacy

"One of the areas of dispute among the principals was the degree to which we should be making management recommendations at all."

Both interviewees were rather reluctant to relate SNEP to increased science policy involvement. They emphasized that the congressional assignment did not include making management recommendations but called on scientists as objective researchers: *"It (the report) should not be a policy document at all; it should be a scientific description of the*

Sierra Nevada and how it functions and not a recommendation for management." A explained that the development of certain management scenarios did not implicate the design of management options.

B stated that most scientists in SNEP were somewhat biased: *"We all had our biases and they were very clear, we wore them on our sleeves."* This was apparent in the initial debate about the approach. Both interviewees refrained from criticizing the fact that scientists were biased, but criticized the fact that scientist's biases caused them to advocate a particular solution. A expressed his regret that *"some of my colleagues I think secretly wanted to be science advisors to the president."* He stated that academic scientists were more likely to take an advocacy position, whereas *"I think the government scientists are much more familiar with working in this kind of a context and understand the limitations."*

3.3.3.3 Scientific Uncertainty

According to B, the team extensively discussed the problem of uncertainty. Experts were invited to advise scientists on the issue. Finally, the team decided to omit a quantitative risk analysis, choosing instead to identify the types of risk that might occur: *"We tried to set up the nature or explain and communicate the nature of uncertainty at this scale of assessment."*

3.3.3.4 Personal Experiences

"I think everybody who goes through these can never go back into the hole again of his own narrow discipline."

Both scientists described SNEP as an important experience that had a lasting impact on their professional career. People had looked across their own disciplinary ken and formed personal relationships that would outlast the project. A touched the issue of science utility: *"It was enormously satisfying, I felt far more useful working on SNEP ..."*

The interviewees, however, also mentioned the hardships of the exercise that included long drives and hard days. Scientists were forced to interrupt their traditional research career and neglected their private life.

3.3.4 Managers

According to A only one retired senior manager was involved in the assessment. Probably, this was due to the nature of the assignment that did not intend to develop management options or produce a major plan.

3.3.5 Public

A described the two basic public interests that were expressed in SNEP; nature conservation and commodity extraction. Both sides were extremely suspicious that SNEP would promote the interests of the other side. The interviewees agreed that the frequent public meetings attempted to build trust between scientists and the public and to underline the independent nature of the SNEP assignment: *"These (meetings) were primarily designed to build trust, that we were at least honest brokers, that we didn't have a secret agenda which many people thought. If we made mistakes it was simply because we were stupid, not because we were up to something."* A said that the public meetings were successful, although the academic scientists in particular had difficulty communicating with "the unwashed public." He also regretted that the public knowledge was unorganized, incomplete or out of date and, therefore, it was impossible to integrate local information into the project: *"I don't think that the public involvement was helpful to me, I think that our involvement was helpful to the public in the sense that by getting up in front of people they could see that we were human and that we didn't grow horns."*

Per contra, B emphasized the high value of public involvement that helped the process *"without a doubt. And we could have done much more."* Especially the key contacts group that comprised the so-called "alpha public" was an important partner for the scientists. The key contacts gave much feedback and their review of scientific documents led to certain modifications.

According to B, the regular science meetings were not open to the public in order to prevent the fruitlessness of endless discussions and explanations. Nevertheless, he stressed that transparency was an important goal of the coordinating committee that attempted to organize the scientific process as open and unsuspicious as possible: *"So transparency and disclosure became very important to us ... and there was always the attempt to get sort of this SNEP philosophy through to those who were involved in the more subordinate projects."* Some scientists, however, criticized the emphasis on transparency and disclosure, most vocally those who had had experience with FEMAT.

3.3.6 Outcomes of SNEP

"I think that SNEP achieved its objectives which is it provided a synoptic view of the condition of the Sierra Nevada in the late 20th century."

Scientists from various assessments agreed that SNEP was a success. Both interviewees used the Bible as a metaphor to describe the importance of the SNEP report as a reference document. They stated that it was frequently consulted by different parties regardless of their ideology and that many small projects across the Sierra were initiated in response to the SNEP report. A observed that managers were very reluctant to make a decision that would contradict SNEP: "*They go to enormous trouble to demonstrate that their scientific information is correct and SNEP is not, and that's great ... I think it has improved the level of science underlining management in the Sierra Nevada."* B stated that the strongest reason for success in SNEP was its independence from any decision making process. Scientists were free to collect information about the Sierra Nevada, without facing continuous public suspicion: *"So as scientists were able to be kind of funky, ignorant scientists going out and talking to people without the banner of having an agenda as agency people often do ... therefore people wouldn't feel like they had to rally us so strongly or argue for certain points of view, because something wasn't being decided."*

B mentioned the impact of SNEP on concrete policy processes, in particular the revision of the EIS by the FS: *"We pushed the importance of the need to filter some of the birds and the bees problems through that fabric that SNEP had tried to bring forward."* According to B, however, the EIS process eventually failed to forge a new path. Furthermore, SNEP led to a restructuring within the Pacific Southwest Research Station. Its scientists were organized to form the Sierra Nevada Research Center which assembled interdisciplinary groups that focus on the entire geographic region.

3.3.7 Problems

The interviewees identified a number of problems that arose in SNEP. A mentioned that certain species, particularly the spotted owl, were still in the spotlight of public attention, although SNEP was mandated to regard the entire Sierra Nevada System: *"And although I didn't like looking at a species, there was enormous pressure for me to put effort into spotted owls which I resisted."* Since SNEP relied on existing information, it also struggled with "black holes" in the available information. Furthermore, B pointed out that initial changes in leadership and team composition early on significantly challenged the project.

3.4 <u>Bioregional Assessment in General</u>

3.4.1 Initiation

One scientist linked the function of bioregional assessment to Holling's concept of ecosystem dynamics: *"I think that bioregional assessments are fairly often used as one of the devices to make the transition from one social and ecological state of ecosystems, to make the transition through what may be these crisis periods into the next period ... And bioregional assessment can give a good broad scale basis of information on which to do that."*

3.4.2 Development

Two scientists referred to the 1990s, especially the years between 1995 and 1997, as the "peak of excitement for bioregional assessment." At that time the meeting "At the Crossroads of Science-Management-Policy" was organized and encouraged cross learning between the participants of different assessments. After this climax, however, the interviewees observed declining interest for broad scale bioregional analysis. *"The recent ones that have been done are much less extensive and rely on existing data and they spend more time looking at resource interactions rather than trying to develop these extensive data sets."* Some scientists considered this development as a result of political changes in congress and government which led to rearrangements of priorities on the political agenda. According to other interviewers, the decline in broad scale assessments was due to decreasing agency budgets, and a general shift of scientific focus to more regional assessments.

3.4.3 Scale

Critics argued that large scale bioregional assessments were too ambitious in terms of size and complexity: *"Why do we take on ten million ha? Let's take on 10.000 ha ... and let's pick it very carefully."* Some scientists emphasized the landscape aspect of bioregional assessment: *"We are doing landscape modeling and landscape management studies attempting to implement and overcome the impossibility to implement a landscape plan that's innovative including the threat of terrorist attacks and tree sitters and bad press and resistance by specialists within the agency."* The ecologists, in particular, stated that at first the assessment areas had to be large in order to meet the necessities of wide ranging species, and that the large scale allowed scientists to learn more about management at an integrated landscape level instead of working on fragmented pieces of landscapes. Subsequently to the large assessments, however, the ecologists wanted to go back to the regional level and apply their new understanding of landscape structure in a more specific context.

3.5 <u>The Role of Science</u>

The role of scientists in natural resource policy was the most controversial part of the interviews. The following paragraphs will show, how scientists described their own role in society, what changes they identified for that role, and what role they considered appropriate.

3.5.1 Role Definitions

Most respondents gave a definition of the role which they considered appropriate for scientists in society. In direct comparison these definitions were surprisingly similar, even though there was a large array of opinions and interpretations behind them. The following quotations represent the two major definitions:

"Science and scientist's primary responsibility is to provide information to society." In this definition, the kind of information that scientists should provide is not specified. Scientists, therefore, collect and publish data and society chooses the information that might be utile for decision making.

"Having scientists who describe what the potential outcomes might be of different policies. I think that's what really is scientist's role." This definition includes the contextual aspect of science. It implicates that scientists not only collect information but react to the policy process by evaluating policy options. Most of the interviewees agreed with the second definition.

3.5.2 Changes in the Role of Science

"We have reached the point of realizing science is gonna play a very different role in policy-management business in the future."

Most interviewees noticed that the role of scientists had changed over the previous years and decades. They identified many different aspects that characterized the nature of this change along with its risks and possibilities. Some scientists argued that the role of science was not new but that science occurred "in a new arena." The following comments underline the differences and communities in scientists' perception of their changing role in society.

"There is this veneer of scientific credibility that has to underline natural resource decisions. And that's new and that's different and that's here to stay." Many interviewees believed that policy makers and the public wanted political decisions to be based on the best scientific knowledge. Scientists were asked to play a more important role in policy making because they had more credibility than other political stakeholders. The call for science based decision making, however, may not be such a recent development: *"Science underlining management has been a trend throughout the U.S. in the last 25 years."*

"I think that if nothing else in the past ten years science has been institutionalized in the discussion, in the debates and the resolution in policy." According to this quotation, the demand for science based decision making has been answered by processes of institutionalization.

"We had scientists involved for decades. But they haven't had the power either internally or to the public side to be scientists." According to the interviews, the situation has changed and scientists have gained power and influence. One scientist expressed the concern that scientists might become increasingly involved in political power struggles. *"The more the scientists have power, someone is losing power. And people that lose it are interest groups and managers or policy makers."*

"Every scientist ought to be able to explain why they do what they do." Many interviewees characterized the changing role of science as a shift towards more contextual modes of research. They stressed that scientists should be responsible for providing society with useful information, especially when they are funded by public dollars. *"I don't think scientists are given the privilege in most disciplines any longer to operate entirely in an ivory tower."*

"The really important questions are very complex ... they require a team of people often of multiple disciplines frequently crossing the boundary between natural and social science." Several scientists described the change as a reaction to the growing complexity of policy questions. Politicians had realized that ecosystem protection was more than a technical issue.

"It isn't just a matter of looking through a microscope" Scientists believed that the growing complexity was compelling a move in the scientific community towards more multidisciplinary modes of research. As one respondent stated, ecologists, in particular, had to leave their academic environment where they *"just published in journals that nobody reads."*

Some interviewees suggested that young scientists should be trained for the new tasks they were going to face.

Some scientists, however, identified severe problems associated with these changes in the role of science. One interviewee was concerned that the scientific community, which was decreasing in number, would eventually lack the capacity to deal with policy issues without neglecting its traditional tasks. The most important criticism referred to the ethical problem: *"To what degree may science get involved into policy without advocating for particular solutions? Where should the border be set?"* One scientist was concerned that if scientists became too involved in the policy making business, people would suspect them of being biased: *"Their objectivity becomes questioned and they loose power."*

3.5.3 Science Advocacy

"The role we want scientists to play is unclear."

Although most scientists agreed upon a general definition of their role in policy making, "evaluate the possible outcomes of different policy options," their opinions about science advocacy varied exceedingly. According to the interviews, it was possible to distinguish four groups of scientists that represented four types of roles for scientists in policy making.

The first group of scientists completely refuses to get involved in policy affairs. Its representatives believe that policy involvement is incommensurate with objective scientific research: *"When scientists are asked their opinions they should only be giving science based opinions not policy recommendations."*

The second group supports the idea that scientists provide information for policy processes and help to enlighten certain societal questions. However, this does not involve the development of detailed management scenarios or the advocacy for particular solutions, although certain biases can never be eliminated to a hundred percent. The following quotations stress the position of the second group:

"By having a stronger scientific based policy, the policy ultimately will achieve its goal better."

"It's inappropriate for me to try to influence decisions based upon my own value system."

"... whether or not this (example: contraceptive measures to control deer population) is good or bad or right or wrong, this is a social decision and that's not my role as a scientist. Because I'm no more qualified in my opinion about that than anybody else."

"Scientists who engage in the advocacy type of science in the policy arena run a very strong risk of losing credibility in that process. And it's my belief that the scientists who are operating to provide projections of outcomes, understanding consequences, looking at tradeoffs and doing that in a very transparent way are making a stronger contribution to society than those who are advocating a particular policy."

"Disciplined scientists who have their credibility and the credibility of science at heart will not allow their personal view taint their description of outcomes, consequences, and tradeoffs."

The third group of scientists, mostly represented by scientists that are themselves deeply involved with policy, is convinced that bias and advocacy are inevitable parts of science that may be carried on to policy processes. The following examples illustrate this position:

"Science is just information, it always gets used. It's not good or bad, it's just an example." Science advocacy, therefore, is inevitable and scientists may very well make judgements in a policy process. They just have to clarify, where the science ends and where the judgement begins.

"I think science is a biased exercise. I think that we have an advocacy role."

One scientist observed, that the underlying approach, shaped by the discipline, economy, ecology, etc., had far more influence on the scientific results than the role of scientists in the policy process: *"The strongest advocacy role isn't pushing the one land management policy or another. It's what they bring forward as a way to think about the problem ... economists tend to ignore or de-emphasize catastrophe. And ecologists seem too obsessed about it."*

The fourth group was not represented by any of my interviewees, but mentioned as an alternative scientific attitude. It consists of scientists who promote a very strong science role that includes actually making policy.

The first three groups agreed that scientists should not participate in policy to the degree of making decisions: *"Decision making in the hands of scientists, what could be worse?"*

Some respondents suggested that policy makers liked to keep the decision as close to the scientists as possible: *"Politicians want scientists there, because it takes the heat off them."* They also mentioned the danger that scientists could be used by policy makers: *"Your scientist versus my scientist."*

3.5.4 Different Scientific Cultures

Several statements revealed that scientists saw a connection between personality, discipline, and value set of a scientist on one side, and his ability and willingness to get involved with policy on the other. Rather generally oriented disciplines such as social sciences or economics were likely to work at the science-policy interface, whereas more specialized disciplines such as taxonomy felt uncomfortable about leaving their academic environment. The specialized type was described as rather strict in his attitudes towards real science and therefore avoided getting involved with policy oriented research that exceeded the application of classic scientific methods and experiments. One interviewee explained: *"Scientist sort of self-select them whether they want to do it (play a larger role in policy) or not."* The scientific culture also affected the capacity for integration. One person used a striking metaphor to point out the difficulty scientists have integrating their research, even when they attempt to: *"Lots of people say they do an integrated project. Well, basically the way they integrate is, they use a stapler. So I do the wildlife project and someone else does the fisheries, etc., and when we are all done then we stack them up in a big pile and staple them all together."*

3.5.5 Science in Bioregional Assessment

The interviewees agreed that bioregional assessment provided a non-traditional role for scientists that involved new modes of scientific knowledge production and most often a closer contact to policy: *"It's a new involvement, it forces scientists to examine how science can make a contribution in natural resource policy, other than doing a little scientific article and saying 'here is the scientific implication of what to study.' It's sort of a management application."* Most scientists emphasized the positive aspects of this new role: *"Bioregional assessment broadens the scientist's perspective to a much bigger picture."* However, several less policy-devoted scientists made rather skeptical comments: *"The role of scientists in bioregional assessment ..., it's perhaps the best place that they can be, in this assessment arena. But as soon as those projects get tied together with management decision documents everything starts getting tainted."* Some of the more advocacy adverse respondents stated that it was possible to organize bioregional assessment in a way that would enable scientists to take a context oriented yet objective role.

According to the interviewees, bioregional assessment illustrates the distinction between two types of scientists. Broad scale ecosystem projects were very demanding in terms of openness and flexibility of their participants and therefore only certain personalities, who were capable and trained to collaborate in an interdisciplinary context, could meet the challenge. Per contra, many specialists tended to collect data without thinking about their utility and integration:
"It's more fun to collect data and have data than to give information."

Most scientists described their experiences with bioregional assessment as a milestone in their career that enhanced their capacities for transdisciplinary communication and placed their research into the context of application. At the same time, however, bioregional assessment interrupted their traditional research career and hindered scientists, for example, in publishing the results of their former research projects in time. As one interviewee strikingly expressed it: *"You know, you're not gonna continue on your way to the Nobel Prize by doing this."*

3.6 Management

3.6.1 Managers and Scientists

All scientists agreed that management should be based on credible science. One respondent stated that many managers had a substantial scientific background to support their decisions but that they failed to regularly obtain the most recent scientific knowledge. Several scientists expressed suspicions about management credibility, because managers were biased in order to abide with the targets of their department.

In many interviews, basic differences between the science and management worlds were identified: *"That's a difference between the scientific world and the management world. The management world would like to have some stability, kind of a constancy and implement something and give it way and scientists are always looking to improve things. So our cycle of change is a lot faster than in the management world."* Communication between science and management was hampered by these cultural differences, and a successful cooperation and rapprochement required a certain rare type of personality: *"I'm not seeing very many people out there with the appropriate instincts and skills to really work at the interface."*

3.6.2 Management Flexibility

The question of management flexibility had been widely discussed during the implementation of FEMAT into the NFP. One person gave me an account of the historic evolution of natural resource management in the United States. *"In the old days managers just ran their piece of land like an old baron or king."* They were free to make their proper decisions and faced few restrictions on their management practices. With growing environmental concerns, however *"we ran overboard on prescriptive standards"* that paralyzed flexible action mechanisms. In recent years there was a call for more flexibility by certain scientists, managers and industries whereas other scientists and public interest groups opposed the idea because they feared the risk of returning to less sustainable and nature protective management practices.

The interviewees unanimously supported the idea of more flexibility in management. They were convinced that flexible implementation models such as adaptive management would provide a continuous role for science in management that would outlast the initial bioregional assessment. In order to establish more flexible systems, managers needed to define their own goals and assess the possible options. Society, on the other hand, must provide new means to evaluate the success of management activities that asked "Did they achieve their goals?" instead of "How did they do it?", a strategy that demanded less prescriptive regulation for management. However, as one interviewee expressed it, *"the system tends to work exactly the opposite way."*

Many scientists were disappointed that adaptive management had not been successfully integrated into the NFP. Several reasons were identified that exacerbated the implementation of adaptive management in practice:

- Institutions avoid uncertainty
- Institutions must act in accordance with formal planning processes and legal requirements that prevent experimentation: *"Census stifles creativity."*
- Adaptive management involves more thoughtful planning mechanisms and long-term studies
- Adaptive management forces institutionalized science management partnerships
- Adaptive management is very expensive

In summary, one scientist stated: *"Adaptive management almost doesn't exist, because the reality is: almost all institutions and stakeholders move to prevent any of that tuition."* Another interviewee, who strongly promoted the concept of adaptive management, was asked, if he really believed in the applicability of flexible institution models. He hesitated and answered: *"I want to say yes ... we are sophisticated enough in the developed world and we have enough countries that have different social, legal, cultural contexts that somebody ought to be able to do it somewhere."*

3.7 Public Involvement

Most interviewees spoke in favor of increased public involvement in natural resource management planning. According to one scientist, the interested public in the Pacific Northwest had grown more sophisticated and proved to be familiar with scientific models and ideas. Per contra, some interviewees emphasized that public involvement could in fact paralyze a scientific process, especially if the public participants lacked scientific background.

In agency decision making processes, in particular, public participation faced several constraints: *"Under federal conditions you really can't do collaborative decision making."* The agencies were caught in the dilemma that they were legally required to hear the public opinion, but also legally restricted in letting public comments influence their decisions. As one scientist described it: *"It (public participation) is just something the agencies check off their list."* He regretted the lack of honesty and transparency in decision making that frustrated the active public and caused it to withdraw from further participation. Furthermore, the complexity and length of certain projects was very demanding in terms of time and skills and often deterred public volunteers from more involvement.

In summary, people agreed upon the necessity to increase openness and transparency of environmental projects. They promoted the establishment of honest processes to engage the public that would not endanger the efficiency and credibility of scientific assessments.

3.8 <u>Litigation and Law</u>

Many scientists emphasized the role of litigation in bioregional assessment and other natural resource policy processes.

"*What happens the way our legal system works is that once a plan is written down, approved, and all the signatures are on it, it becomes essentially a legal document. And what happens if the agency like the FS or the BLM strays ever so slightly from that plan, they can be sued in court."* Although people stressed that the frequency of litigation was part of the U.S. system of checks and balances, they complained about the contentious legal environment that hampered political decision making: *"You're forever involved in process."* People who took the initiative for action in the environmental field were more likely to get sued than people who avoided action; a situation that fostered gridlock instead of innovation: "*They make us evaluate the consequences of our actions. So it's not an equal requirement to evaluate the consequences of inaction ... the playing field isn't leveled."* One interviewee pointed to the integration of public participation into U.S. environmental law and the difficulty that natural resource projects were facing if they neglected to follow the legal requirements for public involvement: *"The legal structure is very relevant to how society makes the decisions. And we have a very participatory situation in this time, in this country."*

3.8.1 The Data Quality Act

In 2000, the government enacted the Data Quality Act, requiring agencies to promulgate guidelines "ensuring and maximizing the quality, objectivity, utility and integrity of information" that is used in agency decisions. One scientist was concerned that very expensive measures would be necessary for agencies to prove the credibility of their scientific information: *"It's a really important issue for future bioregional assessments"* Most of the other interviewees, however, had not yet viewed the new legislation. One respondent stated that the public agencies were already obliged to well document their scientific research and data bases and therefore met the requirements of the Data Quality Act, at least in terms of transparency: *"Public dollars, public data."*

3.9 <u>Natural Resource Policy and Natural Resource Science in the U.S.</u>

The scientists agreed that, similar to other countries, the U.S. had experienced a shift towards the integration of ecological approaches into land use management concepts. Especially on public land, management was forced to consider species and habitat conservation: *"Right now the ecologists have been chairmen in defining the problem. And previously it was the economists. However, who is to take over next?"* Some scientists feared a domination of ecological understanding in land use management, whereas other interviewees had observed a transition towards the multifunctional model of forest resource management: *"A new mix of goods and services from our lands."*

Two scientists mentioned that the ecological approach of the "owl and old-growth discussion" in the Pacific Northwest had led to an awkward side-effect or "law unexpected consequence."

Between 1990 and 1992, when judicial intervention significantly reduced the federal timber harvest, logging activities on private land increased dramatically in order to compensate the lack of timber supply from federal land. Private land owners attempted to quickly take advantage of the rises in timber price, before legal requirements could likewise restrict timber harvest practices on their land.

"How do we retain in a technical complex world? How do we maintain on the one hand our democratic principles and processes and on the other hand a capacity to deal with those technically complex policy issues?" Several scientists stated that these complex problems, especially in environmental policy, could only be solved with the involvement of scientists and public participants. They underlined the importance of societal values in making policy decisions as, for example, the value of species conservation in the debate about old-growth-forest: *"Certain species have become trump cards ... does society really want to put itself in that kind of a position where one value turns out other values?"*

In the context of participation and democracy oriented concepts, some people criticized the new Bush government and the recent political developments as a move in the opposite direction: *"You have an administration that really wants secrecy and lack of transparency in many political questions ... they want to minimize public input and basically give you something not really complete."* Furthermore, the new government had several means to freeze environmental projects, in particular by curtailing appropriation.

3.9.1 Institutions

All scientists agreed that institutional and organizational aspects have had an important impact on the success of natural resource policy. Some interviewees recognized major deficiencies in agency communication, within as well as between agencies. Difficulties in communication were a major limitation in the fast and flexible implementation of new management mechanisms.

3.9.2 Social Sciences

Many scientists stressed that since the early 1990s, the social sciences had become increasingly involved in natural resource management projects. They valued the participation of social scientists in bioregional assessment, because the integration of social knowledge contributed to the completion of scientist's understanding of large ecosystems. The social scientist illustrated that development: *"More and more I'm finding that our natural resource management colleagues are realizing that the issues they face and the things that make them wake up in the middle of the night with a bad feeling in their stomach are social issues ... we need to think about more social value based kinds of systems in the future."*

The economist underlined the role of economic scientists in bioregional assessment. Economists fostered interdisciplinarity and were comfortable with the integration of different parts across large systems: *"Economists have a quickness of moving across scales, of aggregation."*

4 RESULTS: KEY FINDINGS FROM THE CASES

This section summarizes major findings from FEMAT, ICBEMP, and SNEP. The conclusions are based upon the interviews conducted, as well as the existing case studies and their summaries.

4.1 The Forest Ecosystem Management Assessment Team

FEMAT originated from a dilemma that the land management agencies were facing in the Pacific Northwest. On one side they wanted to maintain timber harvest levels in old-growth forests; whilst on the other, they had to protect old-growth forest as species habitat in order to satisfy the law. When several efforts to develop a management plan integrating both targets had failed (such as those initiated by FS and BLM), it became obvious that only a broad assessment of the entire bioregion could provide enough information to evaluate the risk of species extinction under various management options.[130] The president himself eventually took the initiative to solve the problem.

The policy problem that FEMAT wanted to address was fairly clearly defined by the president's mandate. It can be summarized as "How do we maintain habitat conditions for various species, especially the northern spotted owl, marbled murrelet and species of anadromous fish and at the same time maintain a certain commodity production?" The second part of the question, however, played a subordinate role. FEMAT was a habitat conservation strategy that attempted to mitigate the social and economic impacts of habitat conservation. It did not follow an ecosystem approach that considers the human dimension as part of the ecosystem.

In FEMAT, the disciplinary organization of the science team prevented the scientists from working in a truly interdisciplinary and integrative manner. The disciplines were described as widely differing in terms of perspectives, worldviews and scientific culture; and the make-up of FEMAT did not help to overcome these barriers.[131] FEMAT was an ongoing battle between scientists who focused on species and those who focused on the whole ecosystem. Although there were several review processes, not all science groups used peer review in the traditional sense of academic research.[132]

Scientists in FEMAT played a very strong role. They realized the assessment, laid out the assumptions and developed management alternatives. Critics argue that due to the way in which option 9 was set up, scientists had already decided the matter before the president could make his final choice. Scientists in FEMAT, therefore, had clearly become involved in the development of policy.

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[130] Johnson et al. in "Bioregional Assessments", 1999, pp. 85-116
[131] Johnson et al. in "Bioregional Assessments", 1999, pp. 85-116
[132] Norris in "Bioregional Assessments", 1999, pp. 117-120

FEMAT was a technocratic top-down approach, which did not allow for public participation or integration on the local level. In part, this lack of broader involvement was due to the short time frame and the pressure to produce a document that would end the gridlock. The exclusive nature of FEMAT, however, produced distrust and misunderstandings on the side of managers and the public.[133] Today, most people believe that if managers had participated in the development of the NFP, they would have felt much stronger committed to the plan and would have pushed its implementation.

The implementation of FEMAT into the NFP is generally judged as being very prescriptive and risk adverse. The revision of the plan that occurred between FEMAT and the final Record of Decisions allowed for less flexibility, and raised the expenses for agency implementation, which disappointed many FEMAT scientists.[134] They believed that the final document was mostly elaborated by agency scientists who promoted a strong habitat conservation strategy, which contradicted the original FEMAT approach to mitigate social and economic impacts.

There are several issues that FEMAT did not address, and goals it did not achieve. FEMAT focused on species habitat and timber harvest, but omitted to analyze alternative land uses such as recreation.[135] Furthermore, the assessment was not wholly bioregional in the sense that it was limited to public land, even though scientists agree that owls and salmon do not stop at private property signs. Finally, FEMAT did not succeed in reducing the polarization of the forest management debate in the Pacific Northwest. It addressed the legal and scientific problems, but failed to acknowledge the underlying social value debate; what are the goods and services society wants from old-growth forest and other natural resources?

Despite all its shortcomings and mistakes, scientists agreed that overall FEMAT was a success. It changed the focus from single species and management problems to sustainable ecosystem management in the Pacific Northwest. It placed ecological problems in their larger context, and tried to provide new and creative ideas about management in large regions. Furthermore, FEMAT forced federal agencies to work together and improve inter-agency communication. There have also been some successful follow-on projects, such as CLAMS, which developed a flexible model on a more regional level. After FEMAT some scientists have started to work on landscape patterns and network structure because FEMAT availed them to recognize the various connections between ecosystems and landscapes. Finally, there has been a considerable amount of writing and exchange regarding the project, which encouraged similar scientific activities and served as a reference for subsequent bioregional assessments.

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[133] Nelson in "Bioregional Assessments", 1999, pp. 121-126
[134] Nelson in "Bioregional Assessments", 1999, pp. 121-126
[135] Nelson in "Bioregional Assessments", 1999, pp. 121-126

4.2 The Interior Columbia Basin Ecosystem Management Project

In a similar way to FEMAT, ICBEMP was built around the effort to reconcile economic interests in forests and watersheds with species protection, and other environmental concerns. It had to address a very broad policy question: "How do we develop a scientifically based strategy to manage the Columbia Basin Ecosystem? " The concrete questions were drafted by the different science teams, which led to a set of various policy problems that lacked integration. As opposed to FEMAT, the underlying approach was more balanced in the sense that social, economic and ecological problems were equally considered.

In ICBEMP, the scientists were organized by discipline. Although the science team tried to compose an integrative report that was based on the single assessments, normative conflicts between the disciplines and their differing interpretations of the problem partly hampered interdisciplinary work. The large distances between the different project stations and the fact that scientists were not able to commit their time entirely to the project increased fragmentation.[136] As opposed to FEMAT, ICBEMP relied exclusively on agency scientists in order to avoid FACA violation. Input from academic scientists, therefore, was limited to informal consultation. Although the data that was used in ICBEMP often came from existing sources, the scientists also realized a large amount of new research in order to fill informational gaps. This was one of the reasons why ICBEMP required far more time than initially intended. Some people argue that while FEMAT had too little time, ICBEMP had too much. By spending years on data collection and working on specific problems, the participants lost focus on the information that might have been useful for developing alternative management solutions. This loss of focus may also be due to the nature of the scientists involved, who were criticized for being unfamiliar with working in the policy arena and incapable of understanding broad issues.[137]

Scientists did not get as close to policy-making in ICBEMP as those in FEMAT. Although they predicted outcomes of certain management scenarios, they avoided making concrete proposals for implementation and attempted to remain objective. Double-blind peer review was used to assure the quality of the science. The anonymous reviews, however, were often desultory or uninformed, and thus necessitated additional reviews from people who were close to the project.[138]

ICBEMP attempted to be a very open, participatory project that involved everybody who showed the slightest interest.[139] Conversely, some people doubt that the general public involvement had any serious impact on scientific considerations or the scientific report. Furthermore, participation did not eliminate opposition to the project, especially in Idaho and

[136] Quigley et al. in "Bioregional Assessments", 1999, pp. 269-287
[137] Quigley et al. in "Bioregional Assessments", 1999, pp. 269-287
[138] Meidinger, Shannon, "The Interior Columbia Basin Ecosystem Management Project", 1996
[139] Quigley et al. in "Bioregional Assessments", 1999, pp. 269-287

Montana, where people were weary of new prescriptions on their land management practices.[140] The broad public involvement also implied certain problems, in particular the growth of the project, because an increasing number of people began working on more and more issues, which made it even more difficult to stay focused on the important questions.[141]

The involvement of managers was also twofold. Although there was a strong exchange between managers and scientists, this exchange was not necessarily very specific and effective. In summary, ICBEMP followed a rather democratic approach of science-policy involvement. Despite the importance of their mission, scientists were only one player within the multitude of different interest groups and stakeholders.

Because it took account of ecological boundaries that were defined by the habitats of wide ranging species, ICBEMP was a very large-scale assessment. The size, however, led to certain problems. In order to realize the scientific assessment, the region was broken into smaller units of approximately 0.4 million ha that later had to be integrated on a broader level. The large scale also increased uncertainty and hampered the evaluation of risk. Although ICBEMP attempted to address risk by a qualitative identification of different types of risk, it did not realize a quantitative risk analysis. Furthermore, the broad geographical definition of ICBEMP exacerbated the implementation of its outcomes at the management level. As opposed to the assessment units, the planning units corresponded to more narrow political boundaries, and thus managers could not thoroughly take advantage of the contextual information.[142]

Besides the problem of scale, there are several other reasons why ICBEMP did not get properly implemented. First of all, the project did not produce a final product that would be applicable on the ground. In part, this was due to the length of the process that prevented scientists from staying through the whole project without neglecting their further obligations. Another reason was associated with the political environment, which changed during the time of ICBEMP and became more adverse towards large ecosystem projects. Since 1994, the Republican Party had dominated congress and executives were not very committed to the specific policy question.[143] Moreover, implementation was hampered by the high level of controversy between regulatory and land management agencies. The regulatory agencies favored a conservation-based approach towards implementation, whereas the land management agencies feared that a legally approved plan would paralyze management activities with even more prescriptive standards and guidelines.[144] Thus, they promoted an adaptive management strategy, but high risk and lack of funding restrained the attempt.[145]

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140 Meidinger, Shannon, "The Interior Columbia Basin Ecosystem Management Project", 1996
141 Hahn in "Bioregional Assessments", 1999, pp. 293-298
142 Agee in "Bioregional Assessments", 1999, pp. 288-292
143 Quigley et al. in "Bioregional Assessments", 1999, pp. 269-287
144 Meidinger, Shannon, "The Interior Columbia Basin Ecosystem Management Project", 1996
145 Clark et al., "Overarching Assumptions Underlying the Northwest Forest Plan", 1998

There is a general agreement that ICBEMP was not a complete success. It did not meet its goal to produce a "scientifically sound ecosystem-based strategy." However, opinions vary as to whether the effort was worth the time and money to be undertaken. Some people believe that ICBEMP has ruined the reputation of large-scale assessments and has set a negative example for bioregional assessment. Others argue that scientists produced a great amount of information that is useful in various contexts. The scientific findings have had an impact on the public policy debate in the Columbia Basin that moved from site-level considerations to an ecosystem perspective.

4.3 Sierra Nevada Ecosystem Project

In contrast to FEMAT and ICBEMP, SNEP was not directly crisis driven. Environmental and public interest groups expressed major concerns about the future of the Sierra Nevada and pushed congress to take action, but the situation was not as legally and politically contentious as in the Pacific Northwest.

The policy problem was defined by the congress request: "How do the Sierra Nevada ecosystems work? What are their key elements? What is the role of old-growth?" The Senate Bill outlined the structure of the project and emphasized that it was not charged to produce a decision document. Although the scientists agreed upon the broad assignment, they spent some time to specify its contents in detail. As with ICBEMP, SNEP attempted to be balanced in terms of economic, social and ecological issues, which was partially hampered by the science make-up that allowed for only one or two specialists per discipline.

While the science organization prevented intradisciplinary argument and evaluation, it fostered the interaction between the disciplines on the science team. The work in SNEP was interdisciplinary and integrative, despite difficulties of communication between the different scientists. People attempted to follow an ecosystem approach that prevented them from breaking the system into small pieces. Nevertheless, scientists failed to produce the report as a truly integrative document. The controversies and differences in perspective were too fundamental, and the report, therefore, was designed as a set of separate papers instead of an overall summary.[146]

The role of scientists in SNEP was to provide information rather than to make policy recommendations. Scientists analyzed and synthesized data, and commented on it in the report, but were not assigned to engage in concrete political issues and advocate particular solutions. This role was a result of SNEP being an independent scientific assessment that was not linked to any policy process. There was criticism, however, that certain scientists attempted to promote policy propositions based on their own biases, and thereby went beyond the presentation of scientifically based information.[147]

[146] Erman in "Bioregional Assessments", 1999, pp. 303-320
[147] Kennedy in "Bioregional Assessments", 1999, pp. 326-329

Risk and uncertainty were important issues of the scientific discussions in SNEP. Risks were addressed by a qualitative identification of major risks without a quantitative risk analysis. The scientists attempted to address uncertainty by transparently communicating the doubts and limitations associated with the scientific information. Since SNEP relied on existing data, uncertainty was particularly connected to the credibility and availability of information.[148]

SNEP followed a "philosophy" of transparency and disclosure that put a lot of emphasis on public information and participation. It thereby successfully rebutted the suspicions that various interest groups brought up against the project.[149] Exchange with managers occurred during the public meetings, managers were part of the key contacts group and contributed to the final report. However, since SNEP was assigned to be an independent scientific project, managers were not allowed to take part in the actual assessment, and contrary to ICBEMP, the public was not given access to the internal science team meetings. Nevertheless, the SNEP report constitutes a source of information that is accessible to everybody and may promote more democratically elaborated policies in the Sierra Nevada.

The general science-policy approach of SNEP is hard to classify. Since SNEP was not designed as a policy related project, the two models, technocratic and democratic, do not exactly apply. In a larger sense, however, SNEP shows technocratic as well as democratic elements. On the one hand, the project laid much emphasis on transparency and public involvement; but on the other, independent scientists were the major players in the effort.

The SNEP report has become an important reference across political borders. The findings of SNEP influenced various policy processes, such as the revision of the EIS in the Sierra Nevada. It did not result in a major plan, but served as a basis for many smaller projects and local initiatives.[150] The SNEP report, however, is not suitable for direct implementation.[151] The data are inapplicable in the existing form, and the management alternatives examined in the report lack location detail.[152] As opposed to the interviewees, Kennedy states that managers and local decision makers did not feel committed to implement findings from SNEP, because they had not been involved in the development of the report. Moreover, in a similar manner to ICBEMP, SNEP implementation suffered from a decline in political support and funding.

On the whole, SNEP was considered a success because it met the goal of providing a synoptic view of the Sierra Nevada ecosystem that included the human dimension. The fact that it was

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[148] Curry in "Bioregional Assessments", 1999, pp. 321-325
[149] Erman in "Bioregional Assessments", 1999, pp. 303-320
[150] Erman in "Bioregional Assessments", 1999, pp. 303-320
[151] Kennedy in "Bioregional Assessments", 1999, pp. 326-329
[152] Erman in "Bioregional Assessments", 1999, pp. 303-320

not designed as a decision making project promoted its acceptance by diverse political actors. According to Machida, SNEP was *"one of the most comprehensive resource assessments ever undertaken."* [153]

4.4 Conclusion

Each of the three Bioregional Assessments displayed its own special profile when compared. They each had their strengths and weaknesses, and responded to a particular situation. *Table 1* summarizes major similarities and differences between FEMAT, ICBEMP, and SNEP.

FEMAT was one of the first examples for bioregional assessment, and struggled with a short time frame and a very exclusive science set-up. ICBEMP and SNEP had the opportunity to learn from the FEMAT experience, avoid its mistakes and adopt its incitations. ICBEMP appeared to have learned what not to do and went off in the opposite direction, establishing a very open democratic structure that resulted in a never-ending process of controversy and negotiation. SNEP appeared to have learned what not to do and spent an unproductive first year discussing the mission, and replacing science team members before it found its own alternative structure. It was maybe the most successful of the three assessments, although (or even because) it did not address a definite policy problem.

The three assessments were conducted in the 1990s during the "peak of bioregional excitement" culminating in the conference on "Science at the Crossroads of Management and Policy." Today the peak has passed, and in the last years few broad ecosystem assessments have been initiated in the United States. Various reasons may be responsible for this development. It may be due to external reasons, such as changes in the political environment, curtailment of budgets and staff, or loss of societal interest in resource-related issues. However, it may also be due to a natural evolution of scientific focus. Broad scale assessments help scientists to understand the connections and networks formed within large landscapes. At the same time, the broad perspective must be completed by regional and local information in order to implement the new management strategies on the ground. Scientists, therefore, translate their broadened understanding of ecosystems onto a regional level, where they apply their new knowledge in smaller, longer-term and more site-specific projects. In that respect, bioregional assessment is only one step in the process of gaining a holistic view of large ecosystems:

[153] Machida in "Bioregional Assessments", 1999, p. 338

Criteria / Assessment	**FEMAT**	**ICBEMP**	**SNEP**
Origin	crisis / conflict	crisis / conflict	minor crisis / environmental concerns
Policy Problem	well defined by the president's mandate; only marginal debate, but different interpretations of the problem by different scientists depending on their discipline	well defined on a broad level, but controversial specification of more detailed problems by science groups	well defined on a broad level, but long discussions among scientist to agree on a common interpretation and specification
Approach	rather environmental; habitat conservation prior to social and economic strategies	attempt to balance environmental, social and economic issues	attempt to balance environmental, social and economic issues
Major Issues	protection of old-growth forest and associated species; conservation of aquatic systems and anadromous fish, maintenance of a certain level of timber harvest; adaptive management	protection of old-growth forest; maintenance of biodiversity; ecosystem health (forests, rangelands, riparian, and aquatic); landscape disturbances, adaptive management	condition of old-growth forest; landscape disturbances (e.g.fire); population and resources; biodiversity; analysis of rangelands; analysis of watersheds
Time	initially 60 days, later extended to 90 days	initially nine months, later extended to three years; parts of the assessment continued for years after the time limit	initially two and a half years, later extended to three years
Scientists	agency and academic scientists	only agency scientists	mostly academic scientists, scientists from agencies and other private institutions as special consultants
Data Collection	mostly based on existing data	based on existing data combined with a multitude of own research	mostly based on existing data
Role of Scientists	opting and evaluating management alternatives → big influence on policy	developing broad concepts for ecosystem management → only moderate influence on policy	providing synoptic information on the Sierra Nevada, no concrete management recommendations → only indirect influence on policy
Science Integration	disciplinary organization, not very successful integration except in the elaboration of option 9	disciplinary organization, integration partly realized in the elaboration of an integrative science report	science sub-teams comprised of various disciplines; successful integration in the science team, but failure to realize an integrative science report
Managers	no manager participation except for informal consultation of managers	formal manager participation	manager participation as a part of public involvement
Public	no public participation	great emphasize on public participation; open science meetings	emphasize on public participation but no open science meetings
Science Policy Model	rather technocratic	rather democratic	democratic and technocratic elements
Outcomes and Implementation	final ROD requires implementation of FEMAT into the NFP; loss of flexibility during the process; NFP to the most part realized	no final decision; only voluntary implementation of ICBEMP information by agencies	science report, not designed for direct implementation; indirect influence on policy decisions and management

Table 1: Comparison of FEMAT, ICBEMP and SNEP

"Large-scale projects such as ICBEMP allow us to first look at the ground around us, then climb the mountain for a broad-scale view, and then return to the ground with both perspectives to make the decision. We understand how the part fits into the whole and how the whole fits with the part." [154]

The experience of bioregional assessment strongly affected the participating scientists. Most interviewees felt extremely satisfied about their involvement in the large projects. They valued the utilitarian context, and interdisciplinary exchange unknown to their traditional mode of research. Despite the hardships and the break in their scientific career, scientists acknowledged that bioregional assessment had an important impact on their professional life. It provided a chance for learning and adopting new ideas, which many scientists later integrated into their regular research. They also stayed in contact with their assessment colleagues, and shared their experiences with fellow scientists.

In summary it can be concluded, that bioregional assessment provides a new challenge for scientists in natural resource policy. These scientists play a role that far exceeds their traditional, disciplinary ken and forces them to deal with much broader and much more practical issues. The experience shapes their scientific self-image, and the new scientific self-image goes on to influence their further research, which may contribute to the improvement of science and management in large ecosystems.

[154] Hahn in "Bioregional Assessments", 1999, p. 298

5 Results: Categories

During the process of data analysis and integration a number of categories were developed that combine and rearrange some of the categories introduced in the data presentation. The author considered the following categories and sub-categories relevant to the emerging theory:

The Role of Science in Natural Resource Policy

- **Changes in the Role of Science in Natural Resource Policy**
  - Science Based Decision Making
  - Science and Complexity
- **Implications for the Scientific Community**
  - Science and Context
  - Interdisciplinarity
  - Different Scientific Cultures
  - Institutional Changes
    - Change within Universities
    - Science Networks
    - Science Advisory Boards
    - Change within Agencies
  - Adaptive Management
  - Science and Management
  - Science and the Public
  - Science and Policy Making: Science Advocacy

Characteristics of Bioregional Assessment

- **Bioregional Assessment as a Result of Crisis**
- **Bioregional Assessment and Large Scales**
- **Bioregional Assessment and Bioregionalism**

6 RESULTS: GROUNDED AND EXISTING THEORY COMBINED

This part places the case studies and general interview results into the context of contemporaneous science research. The concepts and categories generated from the interviews are enriched by existing theory and findings from separate studies.

6.1 <u>Changes in the Role of Science</u>

According to the interviews, a change in the role of science in natural resource policy has occurred, that challenges the traditional model of science. Literature reaches the same conclusion: *"Scientists have become more actively engaged in the creation and evaluation of policy."* [155] The next section summarizes the various aspects of this new role.

6.1.1 Science Based Decision Making

Society is calling for more science based decision making in environmental policy. This demand is not new. Since the 1970s, environmental legislation established standards for integrating science advice into policy and management. What is new is the emphasis which politicians, judges, interest groups, and citizens place on the quality and credibility of science consulted for natural resource decisions.[156] Legal requirements are continuously amplified, in order to improve the quality of science supporting agency decision making; a development that is illustrated by the promulgation of the Data Quality Act in 2000.

Along with their scientific information, scientists themselves are called to enter the policy arena.[157] In 2001, Steel et al. presented their study "Science, Scientists and the Environmental Policy Process," [158] in which ecological scientists, agency resource managers, interest groups and the attentive public had been interviewed about their attitudes towards science role in natural resource policy. The results revealed that environmental non governmental organizations and the attentive public had high confidence in the credibility of scientific data and encouraged scientists to take a more active role in policy, while managers and scientists were more reluctant to promote science policy involvement. The public obviously trusts scientist's ability to solve those problems which politicians, judges, and a multitude of different stakeholders have failed to address in a conflict laden policy process. People are weary of democratic struggles and turn to scientists as an authority which they believe to hold the ultimate truth.[159] In FEMAT and ICBEMP, for example, scientists were invited to resolve contention, as they were the only group untainted by general distrust.

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[155] Clark et al. "Integrating Science and Policy in Natural Resource Management", 1998
[156] see Clark et al. "Integrating Science and Policy in Natural Resource Management", 1998
[157] Ravetz, 1987, according to Steel et al., 2001, p. 3
[158] Steel et al., 2001,
[159] Walters, 1997

6.1.2 Complexity

The most important reason for society to demand science based decision making is the complexity of the issues.[160] Society has realized that many environmental problems are too complicated to be addressed by scientific laymen. Informed decision making depends on continuous consultation of scientific knowledge, and the collection and interpretation of knowledge depends on scientists, who understand the technical details.[161] Science, therefore, has become indispensable to policy.[162] The debates surrounding the management of large ecosystems illustrate the difficulty citizens, managers, politicians and scientists have in dealing with complex systems.

6.2 Implications for the Scientific Community

Society calls for more science based decision making and increased scientific involvement in policy. But how do these demands effect the scientific community? If scientists want to meet the challenge, the scientific community cannot hold on to its traditional manners. The disciplinary structure and closed culture are maladapted to interactions with managers, policy makers, and the general public in a multidisciplinary context.[163]

In, " The new Production of Knowledge," Gibbons et al. summarize major attributes of change in the scientific community.[164] The author's concept distinguishes between the traditional and the new mode of knowledge production, called Mode 1 and Mode 2. In Mode 1, scientists hold the monopoly of knowledge production in a mostly academic environment. The cognitive and social norms of a particular disciplinary community determine the choice of problems, methods and diffusion of scientific research. Mode 1 research is organized along hierarchical structures, that accept peer review as the principal kind of quality control. As opposed to Mode 1, Mode 2 exceeds the mere scientific environment of knowledge production, and involves a heterogeneous set of experts and practitioners in generating knowledge. Due to the fact that problems are not defined and solved along single disciplines, but emerge from an application oriented context, transdisciplinarity is crucial to this mode. Mode 2 occurs within heterarchical and transient structures that flexibly adapt to the context of application. Science in Mode 2 attempts to be socially accountable and reflexive, and therefore necessitates problem oriented criteria of quality control in addition to the "classic" peer review. Mode 2, however, does not supplant but rather supplements knowledge production in Mode 1.

[160] see Steel et al., 2001
[161] Clark et al. "Integrating Science and Policy in Natural Resource Management", 1998
[162] Meidinger, Antypas, 1996
[163] see Holling, 1995
[164] see Gibbons et al., 1994

Table 2, drawn from Reusswig and Schellnhuber, illustrates the challenges for the scientific community in a globally changing environment of knowledge production. The authors take a perspective that confirms the findings of Gibbons et al.

Traditional Science System	**Challenges of Global Change**
disciplinary and sectoral	interdisciplinary and transsectoral
linear	complex
certainty	uncertainty
basic or applied research	Implementation oriented basic research
aggregate	system
object oriented	object oriented and reflected
value-neutral	implication of values

Table 2: Global Change and its Challenges for the Traditional Science System[165]

The following section will explore seven implications for the scientific community as it faces the challenge of new roles for scientists in society: the importance of context, interdisciplinarity, differences in scientific culture, institutional changes, science management interaction, science and the public, and science advocacy.

6.2.1 Context

When scientists use scientific methods to solve societal problems, they inevitably place their research into a broader context. Commercial research has always focused on utilitarian aspects. Today public research institutions are expected to produce results which are applicable to practical purposes. As agency and academic scientists increasingly volunteer for science advisory boards, scientific councils, or bioregional assessments addressing "real world" problems, a general shift from basic to more applied research is occuring.[166]

6.2.2 Interdisciplinarity

Disciplinary division of scientific labor is a necessary condition for effective research in a traditional, academic environment.[167] The applied context and complexity of problems, however, are some of the many reasons why interdisciplinarity is indispensable to broad natural resource management projects. Although the world of science is still divided by differences in disciplinary culture and language, several characteristics of the scientific community such as shared methods and theory facilitate interdisciplinary exchange. FEMAT, ICBEMP and SNEP illustrate the chances and difficulties for scientists to transcend their disciplinary environment.

[165] according to Reusswig and Schellnhuber in „Umweltforschung quergedacht. Perspektiven integrierter Umweltforschung und -lehre", 1998, p. 266
[166] Gibbons et al., 1994, p. 4
[167] Clark et al. "Integrating Science and Policy in Natural Resource Management", 1998

The new science orientation towards application and context fosters inter- and trandsdisciplinary collaboration.[168] Scientists are forced to address problems that far exceed their disciplinary ken. According to Reynolds, three kinds of scientific problems can be distinguished.[169] The first intellectual type of problem occurs within a traditional discipline. Problems of the second type are also intellectual, but transcend the boundaries of a single discipline and therefore require a multidisciplinary solution. Problems of the third type are distinctly multidisciplinary; they are generated by society that calls for quick techno-scientific solutions. However, due to the fact that problem definition is the result of human action, the same problem may be treated as a problem of the first, second, or third type.[170]

The three problem concept is well reflected in the bioregional assessments presented in this study. FEMAT and ICBEMP, in particular, were facing very complicated “third kind” policy problems that called for a transdisciplinary solution. However, although they addressed these problems by a multidisciplinary science approach, they failed to collaborate across disciplines and produce an integrative solution. In part, this failure was due to the division of scientists into disciplinary sub-teams that was used by both projects. Each sub-team tried to define its own research question, that was answerable within its own disciplinary ken. The third kind problem was eventually broken down to many different first kind problems, and the final integration suffered from the variety of problem perceptions among the science teams. After a yearlong struggle over the nature of the problem, SNEP was more successful in interdisciplinary communication. The science team was less divided, and thus managed to address the problem on a more comprehensive “third kind” level.

The discrepancies in problem definition were a result of the well-known barrier between distinct disciplinary cultures. For all three assessments, the interviewees stated difficulties in interdisciplinary communication, due to their different languages, methodologies and modes of thinking. These problems occurred between different disciplines as well as between subjects of the same discipline. Although for example landscape ecology and fish taxonomy may be considered subjects of the same meta-discipline “biology,” their language and general attitudes differ widely.

Nevertheless, several characteristics of science facilitate boundary crossing between disciplines**.** According to Klein boundaries are determined more by method, theory, and conceptual framework than by subject matter.[171] A scientist from one discipline may be unified with a colleague from another by sharing the same theoretical approach. In FEMAT and ICBEMP, for instance, the concept of adaptive management was promoted by scientists of different disciplines who agreed upon the need for more flexibility in management

[168] Gibbons et al., 1994, p. 3
[169] Reynolds, 1988, according to Klein, 1996, p. 48
[170] Klein, 1996, p. 49
[171] see Klein, 1996, pp. 38-56

processes. Furthermore, interdisciplinarity is facilitated by working on the same object. Forestry is a good example for a meta-discipline uniting different subjects with their particular theories, methods, and approaches under a common theme.[172]

6.2.3 Different Scientific Cultures

Disciplinary culture and personality often determine a scientist's capacity to work in an interdisciplinary or transdisciplinary environment. The interviews clearly distinguished two kinds of scientists: one who tends to work in a more political, context oriented environment, and another who prefers specialized, more narrowly defined basic research. Holling, accordingly, identifies two streams of science, represented by different types of scientists.[173] Like Mode 1, the first stream is a science of parts that emerges from traditions of experimental science. An example might be molecular biology which generally uses " bench science" methods. Similar to Mode 2, the second stream is a science of the integration of parts, that deals with complex, multidisciplinary problems. The scientists involved in this stream are more generalist and implementation oriented, for example, ecologists who follow a systems approach or social scientists who are interested in socio-political issues. According to the interviews, scientists self-select themselves, whether they want to be part of the more open, political science field or stay in a traditional environment. The generalists often provide a link between basic scientists and managers or policy makers. However, according to the interviewees there is only a small number of scientists who are able to combine sound scientific knowledge with a broad and open mind.

6.2.4 Institutional Change

In universities and public research organizations, the traditional model of science is thoroughly institutionalized. According to Weingart, however, changes in the role of science likewise necessitate changes in its institutional circumstances.[174] The interviewees mentioned that science in the previous ten years had been institutionalized as part of the political discussion. The following section will explore the nature of institutional change in science policy relations.

Future scientists need to be prepared for the new challenges. Since the late 1960s, there have been many attempts to integrate "contextual studies" into scientific training, in order to form a more "critical " and "self-aware" scientific perspective.[175] Despite diverse approaches to reform the way scientists are educated, these pleas are still relevant. This is particularly true for universities with the primary responsibility of specialist training, as they must adapt their scientific training and research organization to the new demands of society.[176] One approach

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[172] Oesten et al. in Forstw. Cbl. 118, 1999, pp. 368-380
[173] Holling, 1995, p. 13
[174] Weingart, in "Praxis-Herausforderung-Ideologie", 1987, pp. 159-166
[175] Edge in "Handbook of Science and Technology Studies", 1995, p. 13
[176] Gibbons et al., 1994, p. 70

to educational reform would be to teach students about "*science, its institutionalization and social structure, its values and practices, so as to stress ideas about its social nature and its relationship with other social institutions.*" [177] Future scientists must learn to be aware of the social roles they might eventually assume, reflecting their scientific experience from a critical point of view.

As Gibbons observes, the various institutions of knowledge production have proliferated throughout the last decades.[178] The multitudes of research sites and their connections, supported by means of modern communication are building networks across disciplinary, geographical, and political boundaries. A complex system of interaction is emerging that is characterized by ordered as well as chaotic elements.[179] According to chaos theory, random disturbances in non-linear complex systems can produce unpredictable events and relationships, that reverberate throughout the system, and create novel patterns of change. Therefore, a random disturbance, such as an environmental accident, can provoke a crisis in society. The elements of this crisis "reverberate" through the societal system and can eventually produce major changes in the scientific network that is part of this system; scientists are likely to weaken disciplinary loyalty and institutional control.[180] The reorganization of the Pacific Southwest Research Station of the United States Forest Service is a good example for observing how interdisciplinary, bioregional scientific work in SNEP led to organizational and institutional change (see data presentation, p. 78).

Besides universal reform and networking, special platforms for scientific advice facilitate science policy integration. Many agencies, e.g. EPA, are supported by permanent science committees that influence interagency decision making.[181] In recent years, science consultation has also appeared in project oriented, temporary forms like bioregional assessments. The major advantage of such temporary organizations is their flexibility; a science team can be optimally organized in order to meet the demands of the particular problem (although FEMAT, ICBEMP, and SNEP in part missed this opportunity.)

Traditionally, agency scientists work in a much closer relationship to policy and management than their academic colleagues.[182] They face the two-fold challenge of abiding by their agency's mission, while concurrently performing credible scientific research.[183] With a changing role of science in natural resource policy, this quandary may intensify, because agency scientists are asked to provide a link between independent external science and internal research application. In FEMAT, for instance, academic scientists played a major role

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[177] Edge in "Handbook of Science and Technology Studies", 1995, p. 14
[178] Gibbons et al., 1994, p. 137
[179] Morgan, 1997, p. 262
[180] Gibbons et al., 1994, p. 138
[181] see Jasanoff, 1990
[182] see Jasanoff, 1990
[183] Shannon et al, 1996

in the elaboration of Option 9, but the implementation of Option 9 into the NFP was shaped by agency scientists.

Many participants of FEMAT had hoped that the NFP would establish new modes of ecosystem management, such as adaptive management and social learning. The agencies, however, mostly failed to implement these concepts on the ground; not only because they feared the legal consequences of more risky management strategies, but also because of institutional barriers. As described above, two things are crucial to adaptive management and social learning - flexibility and learning. Both features are hard to integrate into established institutional processes; they require organizational changes and regulatory reform.[184]

Frequently used images of learning, developed by Argyris and Schon in 1970s, are the "single-loop" and the "double-loop." In a single-loop learning process, learning refers to detection and correction of error in relation to a given set of operating norms.[185] Double-loop learning means to extend the learning process by questioning the relevance of the operating norms. Single-loop learning occurs in most organizations, in forest agencies, for example, that have always focussed on timber production as their major target. Silvicultural, dendrological and economic knowledge enabled forest managers to realize maximum timber sale revenues. They learned to optimize management activities under the conditions of a particular environment, in order to comply with the "operating norm" of timber production. In contrast, adaptive management relies on double-loop learning. Questioning the operating norms, such as timber production or species conservation, pertains to the adaptive management process that is very demanding with respect to management skills and organizational structure. If prescriptive standards and guidelines predetermine the operating norms, managers cannot apply flexible learning mechanisms.

6.2.5 Scientists and Managers

The science management relationship is essential to learning and adaptation.[186] Resetting operating norms in a vulnerable ecosystem is strongly associated with risk, especially when uncertainty regarding the system is high. Managers, therefore, need to integrate the most recent scientific knowledge into their decisions, in order to adapt such diverse activities as timber harvest, recreation management, habitat conservation or fire prevention to the needs of the ecosystem as well as to the demands of the different users. To improve the science management interaction, however, boundaries between the science and management worlds must be overcome. Scientists must place their work into a transdisciplinary context and learn to communicate with managers and their cultural peculiarities. As a result, communication is hindered by the scientific rhetoric which often gives the impression that scientific work is tidy and objective, because it fails to reveal the implicit values and uncertainties to the outside

[184] Lee, 1993, p. 63
[185] see Morgan, 1997, pp. 86-89
[186] Shannon et al. "Organizing for Innovation", 1995

observer.[187] Furthermore, scientists tend to propose broad, expansive goals, but are reluctant to give specific management advice. Managers, however, need more specific, operational goals that are realistic in regard to regulatory constraints and limited resources. As many interviews revealed, a very high level of distrust still persists between scientists and managers.

6.2.6 Scientists and the Public

In democratic, participatory natural resource management projects, scientists are forced to interact with interest groups and the general public. Unfortunately, the communication problems described for scientists dealing with managers are even worse for scientists dealing with the "unwashed" public.[188] The public meetings held in SNEP and ICBEMP illustrated that many scientists are unable to make scientific information comprehensible to public non-specialists. They produced misunderstandings which confirmed the public suspicions that scientists were not thoroughly open about the controversial issues of the assessments.

However, scientist's interaction with the public refers to more than an unidirectional exchange that demands scientists to deliver information to interested citizens. It has been widely recognized that local people themselves, based on their tradition, experience, and culture, can contribute knowledge to natural resource science.[189] According to a bioregional approach, Goldstein suggests that modern science be integrated with place-based knowledge in order to create a place-based science. The concept relies on the notion that *"intuition and instinct form as much a basis for bioregional epistemology as number and experience."* [190] Place-based knowledge is constantly regenerated through the active participation of the individual with place and culture, and therefore cannot be replaced but only complemented by modern science. A successful combination of both kinds of knowledge necessitates bioregional institutions that coordinate the scientific and the local production of knowledge, and enable scientists to collect and systemize local information in order to make it useful for science and management purposes.[191] Bioregional assessments can provide such platforms for integrating science with local knowledge.

6.2.7 Science and Policy: Science Advocacy

The previous section has explored major characteristics of the new role, scientists play in natural resource policy. The most controversial question, however, remains to be addressed.

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[187] Wynn, 1982, according to Meidinger, Antypas, 1996
[188] Funtowicz and Ravetz, 1999, according to Steel et al., 2001, p. 9
[189] Goldstein in "Bioregionalism", 1999, pp. 157-170
[190] Mazza, 1997, according to Goldstein in "Bioregionalism", 1999, p. 167
[191] Goldstein in "Bioregionalism", 1999, pp. 157-170

"If the role of scientists is to leverage policy and management changes based on the authority of credible scientific research, what norms should govern them as they play this role?" [192]

Should scientists be allowed to advocate particular solutions? Critics of the positivist perspective assert that advocacy is a natural characteristic of science. The following section will explore some of their major arguments, derived from interviews and literature.

- Science advocacy can develop from practical considerations. In order to receive funding and resources, scientists are forced to communicate the social importance of their research. Thus, scientists tend to promote solutions that secure continuous involvement of their own discipline.

- Scientists are children of their discipline and share its implicit culture and values.[193] Their disciplinary background determines their choice of research, their methods, and their way to define the problem.[194] Due to their differences in perception, an economist may focus on employment in the logging industry and ignore the risk of species extinction, whereas an ecologist may focus on species protection and ignore the risk of unemployment evoked by the shut-down of national forests.

- Science is an evolving process that is subject to *"continuous modification through ongoing experience."* [195] In forestry, for instance, the paradigm has shifted from the application of technical solutions to economical problems (e.g. rationalization) to the development of adapted solutions for multiple use problems (e.g. sustainable resource management).

- Science is always controversial. Within one discipline, scientists differ in their explanation of reality and establish a variety of theories. According to Nelkin *"scientific controversies are a means of negotiating social relationships and of sustaining certain values, norms, and political boundaries at a time of important scientific and technological change."* [196] Changing paradigms and scientific controversy exacerbate science policy interaction.[197] Politicians are uncertain as to how to use scientific information in political decision making and may simply choose the information that best supports their own opinion. Scientists, therefore, face the risk of getting used by politicians who coerce them into the advocacy role of "your scientist versus my scientist."

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[192] Shannon et al., "Science Advocacy is Inevitable: Deal with It", 1996
[193] Kuhn, 1962
[194] Shannon et al., "Science Advocacy is Inevitable: Deal with It", 1996
[195] Ravetz, 1987, according to Meidinger, Antypas, 1996, p. 11
[196] Nelkin, 1987, according to Meidinger, Antypas, 1996
[197] Gordon in "Bioregional Assessments", 1999, pp. 44-54

- According to Shannon, unifying concepts, so called “master metaphors,” are an important element of natural resource science.[198] They help to organize data and guide the scientific analysis, but they also include underlying assumptions and normative implications about appropriate policy. The case studies contain a number of examples for master-metaphors. FEMAT was assigned to aim at “long-term ecosystem health” and “sustainability,” ICBEMP relied on “ecological integrity” and “economic resiliency,” and SNEP followed a “philosophy of transparency and disclosure”.

- Modern natural resource science problems are too complex to be studied without making value based decisions.[199] They are what Weinberg calls “transscientific,” [200] transcending the sphere of scientific knowledge and experience into norms and policy. The large scales and the great number of variables involved in natural resource problems are unmanageable, if scientists refuse to make choices about research topics and management options.

The interviews demonstrated that many contemporary scientists have adopted a more or less constructivist perception of the nature of science. They neither believe that science is unbiased, nor that science can provide policy makers with the ultimate truth. However, assuming that scientists represent a multitude of biases and values, how can society base its decisions on the “best available science?” The new role of science, characterized by the call for more and better science, and more science policy involvement is caught in a paradox of advice and legitimacy. Questioning, whether scientific advisors can be dispassionate and value-neutral, means questioning the legitimacy of scientific advice in the political process.[201]

Scientists, however, must deal with the reality of their new role, and define their own position at the science policy interface. Four types of roles for scientists in policy making were identified in the interviews: the independent scientist, the scientist as a policy advisor, the scientist as a policy partner, and the scientist as a policy maker. The first type, independent scientist, can be considered as the traditional mode I scientist who refuses to leave his exclusively scientific environment. All the other types recognize that there is a role for scientists in the political process, but differ in their attitude towards science advocacy. The policy advisor believes that scientists have the mission to provide good information for the political process. They can assess different management and policy options and evaluate their outcomes, but they should refuse to develop management or policy alternatives and make recommendations to the policy maker. Although the policy advisor admits that each scientist is guided by his own norms and values, science must be organized in such a way that a distinction between fact and value, between “the scientist and the citizen,” remains possible.

[198] Shannon et al., “Science Advocacy is Inevitable: Deal with It“, 1996
[199] Shannon et al., “Science Advocacy is Inevitable: Deal with It“, 1996
[200] Weinberg, 1972, according to Meidinger, Antypas, 1996
[201] Jasanoff, 1990, p. 9

According to the policy partner, advocacy is a natural characteristic of science. Scientists use their scientific knowledge to develop management options and present them to the policy maker, who makes the final decision. Fact and value are not clearly separable; thus, adequate criteria are necessary to evaluate the quality of science in a non-traditional context.[202] The policy maker openly advocates particular solutions. The border between science and policy becomes fuzzy, because scientists who engage with political parties or interest groups, necessarily utilize the means and language of policy, and eventually make policy decisions. The policy maker type is often accused of running a strong risk of losing scientific credibility, because scientists who advocate particular policies and discuss scientific controversies in public, easily loose this credibility. Critics also argue that if scientists gain too much power in the policy arena, other groups loose power. Thus, scientists could get involved in a power struggle which might ruin their public reputation and weaken their role as valuable political advisors in general.

Scientists in SNEP and ICBEMP took a role between policy advisors and policy partners who evaluated policy options without making concrete policy recommendations. On the contrary, scientists in FEMAT came close to being policy makers who framed option 9 and thereby pre-defined the president's final choice (see key findings from the cases, p. 89).

6.3 Characteristics of Bioregional Assessment

6.3.1 Bioregional Assessment as a Result of Crisis

The following paragraph connects bioregional assessment, and the case studies in particular, to Holling's concept of ecosystem dynamics that was presented in the introduction.

According to the four-phase cycle of adaptive renewal, the release phase or crisis of a system (human and ecological) is followed by a phase of reorganization (see introduction, pp. 11-12). Gunderson suggests that many bioregional assessments serve as a temporary institutional structure which avails to make the transition from crisis to reorganization.[203]

Bioregional assessment also reflects the image of panarchy, cross-scale interaction between low and broad levels of a system (see introduction, pp. 12-13). During the revolt phase, a crisis on a low level can trigger a crisis on a broad level, as the decline of the northern spotted owl eventually triggered a nationwide political discussion about forest management practices in the Pacific Northwest. During the remembrance phase, a broad level supports the reorganization of a low level, as FEMAT provided knowledge and experience for the regional sub-level organization of CLAMS.

FEMAT was a reaction to an ecological, legal, and political crisis. It built a temporary institution that attempted to reorganize ecosystem management in the Pacific Northwest. By

[202] Meidinger, Antypas, 1996
[203] Gunderson in "Bioregional Assessments", 1999, pp. 27-40

dint of the Northwest Forest Plan as its major outcome, it succeeded in the establishment of new organizational structures that became manifest in the reserve systems, and the adaptive management areas. Although ICBEMP also emerged from crisis it did not provide the transition from crisis to reorganization of forest management in the Columbia Basin, due mainly to political reasons. Policy and science "cycled" antithetically; either politicians were ready to make a decision, or scientists were ready to present results, but the two systems failed to interact.

Since SNEP was not exactly crisis driven, the four-phase-model of adaptive renewal seems unsuitable to explain its function. On a second look, however, the cycle of exploitation, conservation, release, and reorganization applies to SNEP as well. Holling describes the release phase of an ecosystem as a sudden catastrophe that destroys the "overconnected" system of conservation. Humans are surprised in the face of catastrophe, because they tend to manage for stability and prevent crisis. Per contra, in an adaptive approach managers accept surprise as a major element of system evolution, and prepare a system for major changes and catastrophes. The key property that supports a system throughout phases of crisis and reformation is resilience. *"Resilience is defined by the adaptive capacity of a system; i.e., how much of a disturbance a system can absorb before it configures in a qualitatively different stability domain."* [204] In that respect, SNEP can be considered an attempt to increase resilience of the Sierra Nevada Ecosystem. Instead of initiating post-catastrophic reorganization, the SNEP report intended to provide comprehensive information on the system that would help managers and policy makers to adapt their decisions to the risks and chances identified for the Sierra Nevada.

6.3.2 The Matter of Scale

Broad scale ecosystem assessments always deal with particular problems that are due to the large size of the project area. The following list will summarize some of the major restraints.

Transportation and Location:

The choice of location for the science team meetings constitutes a certain dilemma. Pooling the science team in one place facilitates science coordination, but separates scientists from their non-scientific environment. In order to meet with local communities, managers or the public, they must travel over far distances. Contrariwise, if scientists are distributed across the entire assessment region, they may become familiar with their local environment, but loose contact with their fellow researchers.

Assessment and Planning Units:

While the assessment units are defined by ecological criteria, the planning units still accord with political boundaries. The discrepancy between assessment and planning units hampers the implementation of the scientific findings. Moreover, in a broad level assessment scientists

[204] Gunderson in "Bioregional Assessments", 1999, p. 36

come to broad level results which may be unadaptable to site-specific conditions: *"Our managers need a local road map and we could be dropping a world atlas on them."* [205]

Uncertainty:

Scientific uncertainty remains a significant problem whenever large systems are assessed. Scientists must make too many choices about which site to study and what science to use that reduce the certainty of their statements. Furthermore, uncertainty increases with the number of different levels on which data is collected, because scientists loose information during the process of data integration and synthesis across levels.[206]

Risk:

A quantitative risk assessment of large ecosystems is almost impossible. FEMAT, ICBEMP, and SNEP, therefore, limited their risk analyses to the qualitative identification of different kinds of risk.

6.3.3 Bioregional Assessment and Bioregionalism

Two definitions for a bioregion were distinguished in the introduction: the bioregionalist definition, wich considers a bioregion to be a complex structure of nature, culture, and tradition; and the definition used for bioregional assessment, which defines a bioregion as a land unit that is demarcated by ecological instead of political boundaries.[207] The question arises as to whether FEMAT, ICBEMP, and SNEP displayed any characteristics of the bioregionalist definition.

FEMAT followed a technocratic approach that excluded any kind of local participation and contradicted the bioregionalist vision. Per contra, ICBEMP had a democratic structure and collaborated with public interest groups, managers, and Native American Tribes. The debate about salmon conservation, in particular, involved cultural and traditional attitudes towards fish and watershed management. ICBEMP, therefore, approached the bioregionalist definition of a bioregion, because it recognized the complex interrelations between nature, culture, social structure, and economic interests present in the Columbia Basin. SNEP also showed some bioregionalist aspects; it attempted to integrate local knowledge and displayed its landscape orientation by including public and private property in the assessment area.

In summary, all three bioregional assessments represent a socio-ecological approach that widely differs from the bioregionalist movement. They were initiated by top-down mandate, emphasized scientific data processing, and crossed cultural boundaries. Other bioregional assessments, however, may prove to be much closer related to the bioregionalist idea.

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[205] Hahn in "Bioregional Assessments", 1999, p. 295

[206] Agee in "Bioregional Assessments", 1999, pp. 288-292

[207] Herring in "Bioregional Assessments", 1999, p.1; McGinnis in "Bioregionalism", 1999, p. 3

7 Findings for the U.S.

This chapter summarizes the major findings based on the results of the U.S. case studies. It returns to the initial research problem, and addresses the assumptions that were presented in the introduction.

1. *In the U.S., the role of science in natural resource policy has changed in the last years and decades. Scientists become more involved in policy making.*

Throughout the last years and decades, the role of science in natural resource policy has undergone significant changes. A new mode of knowledge production supplements the academic traditions of generating science in a disciplinary community. Society demands scientists to place their research into the context of application and to provide a scientific fundament for decision-making in the political process.

The new role of science constitutes a great challenge for the scientific community. Although most scientists were trained in a narrowly defined disciplinary environment, they are now expected to conduct research and integrate data in an interdisciplinary and transdisciplinary context. Hence, they must improve their communicational skills in order to interact with other disciplines, managers, policy makers and the public. By increased policy involvement, however, scientists risk engaging in political power struggles that make them lose scientific credibility. The debate surrounding science advocacy illustrates that people disagree as to whether scientists can promote particular concepts in a political process without forfeiting their objectivity.

2. *This is due to a more systemic and less institutionalized approach.*

Natural resource management problems are extremely complex and demand comprehensive solutions that integrate their ecological, social and economic dimension on various systemic levels. If scientists want to understand an ecosystem in its complexity, they must take a broad, systemic perspective that transcends their disciplinary ken. A more systemic approach, however, does not implicate less institutionalization, but demands institutional reform. Temporary structures, such as bioregional assessments, can avail the reorganization of traditional resource management institutions, such as the federal land management agencies for example, in order to establish more flexible science based management mechanisms. Furthermore, the current development of new institutional structures and networks amends interdisciplinary communication and exchange.

3. *Bioregional assessment is part of this approach and has helped to shape it.*

Bioregional assessment embodies the new role of scientists in natural resource management. It demands scientists to collaborate across disciplinary boundaries and to integrate their research into a broader, implementation oriented context. Policy makers, not scientists, define the research problem, which is usually associated with controversy, complexity and uncertainty. The bioregional aspect, in particular, forces scientists to revise their traditional modes, because it implies interaction across space, scales and problem dimensions. *Table 3* summarizes the relations between science and the various elements of the bioregional system.

	Bioregion		**Science**	
	Type of Connection	***Examples***	***Type of Integration***	***Examples***
Space	landscape interaction	forests, riparian areas, stream networks, mountains, cities, industrial sites	spatial integration (interdisciplinary)	forestry, hydrology, geography, agriculture, aquatic ecology, urban planning
Scales	cross scale interaction	needle, tree, stand, forest / household, community, county, state / salmon, fish, water animal, watershed	cross scale integration (interdisciplinary, intradisciplinary)	biology, zoology, wildlife biology, owl-taxonomy / psychology, sociology, political sciences
Problem Dimensions	"type three" problem, generated by society	social, political, economic, ecological, cultural, legal	defining a common problem (interdisciplinary, transdisciplinary)	natural sciences, sociology, political sciences, economy, anthropology, law

Table 3: Science and Bioregional Assessment
The Connectivity within Space, Scales and Problem Dimensions as a Motivator for Scientific Interaction and Integration

A bioregion is a geographically determined area which contains a diverse pattern of different landscapes, ecosystems, and land uses. Many of these spatial elements are highly connected and interact with each other as, for example, stream networks, riparian areas, and forests. Not only species migration but also human activity depends on this connectivity of landscapes and ecosystems. In order to study the different parts of a region, a wide range of disciplines is necessary. However, if the connections and interdependencies of these various elements are to be assessed, the different disciplines must collaborate and integrate their findings across space.

A bioregion is characterized by different scales that interact with and depend on each other as demonstrated by Holling in his model of panarchy (see pp. 12-13).[208] The term scale, of course, is not limited to the different levels of an ecosystem but also refers to spatial / geographical, administrative, institutional, economic, and other structures. One of the biggest challenges scientists are facing in bioregional assessment is the necessity to integrate their findings across all scales that may be relevant for answering a policy question. This not only

[208] Holling et al., 1995, pp. 20-28

involves interdisciplinary coordination, but also emphasizes the exchange between scientists within a particular discipline. A forest ecologist dealing with forests as ecosystems and a taxonomist dealing with a particular species may both be considered as forest biologists, although they work on completely different scales. The success of their collaboration will depend on the ability of the taxonomist to explain his rather specialized knowledge to the forest ecologist as well as on the ability of the forest ecologist to integrate the specialist's findings into a larger picture at a broader scale.

The bioregional assessments conducted in the U.S. have demonstrated the difficulty of dealing with the different dimensions of policy problems that are mostly type three problems (see p. 103.) [209] In order to address these problems, scientists are forced to work in an interdisciplinary and even transdisciplinary context and to overcome language, cultural, methodological and even value differences.

The development of bioregional assessments is strongly related to the development of science in natural resource policy in general. Without the changes that redefined the role of scientists in natural resource policy, bioregional assessment never would have been possible. The history of FEMAT (ISC, Gang of Four, SAT) illustrates how bioregional assessment emerged from a conflict-laden process, in which scientists grew more and more influential throughout the various efforts to find a solution for species protection in old-growth forest. On the other hand, bioregional assessment provides a complex ecosystem context, which forces scientists to accept and develop their new role, and thereby contributes to the continuous development of a new mode of research.

[209] Reynolds, 1988, according to Klein, 1996, p. 48

CHAPTER VI
BACK TO EUROPE

1 CIPEL VERSUS BIOREGIONAL ASSESSMENT

This chapter returns to the initial case study about CIPEL. It contrasts CIPEL to the bioregional assessment cases in the U.S. and integrates the findings from the European case with the theoretical concepts and categories that were developed throughout the previous chapters. Next, a selection of projects that could be objects of study in the European context, is presented. The final section presents a number of questions by stating five hypotheses that compare the situation in the U.S. and Europe and could provide guidance for further research in Europe.

1.1 Differences and Similarities

Several characteristics distinguish CIPEL from the northern American projects. The following section outlines the most important differences and similarities between CIPEL and the bioregional assessments in the Pacific Northwest.

1.1.1 Functions

As opposed to the bioregional assessments in the U.S. Pacific Northwest, the scientific assessment of ecosystem conditions is only one part of the CIPEL activities. The organization is responsible for developing and implementing management alternatives, setting goals to improve the protection of Lake Geneva, and coordinating water protection strategies across national boarders.

1.1.2 Structure

CIPEL is a permanent organization that was established more than 40 years ago. Although the members of the organization, mainly managers and scientists, meet at regular intervals, CIPEL constitutes only a small part of their duties. In accordance with its functions, CIPEL is not merely organized around a science team, but consists of a political part (the international commission), a scientific part (the scientific council), and a managerial part (the operational committee).

1.1.3 Initiation

Crisis and controversy were important factors for the initiation of bioregional assessment in the United States. In contrast, CIPEL operates in a rather peaceful political environment, although it was initiated to address the complex problem of water pollution. This “lack of controversy” may be because CIPEL became an organization after the most significant reasons for water pollution and the nature of the necessary actions were relatively evident.

However, similar to FEMAT, ICBEMP, and SNEP, CIPEL originated from a governmental initiative.

1.1.4 Approach

CIPEL's mission as an organization is water protection. Thus, the underlying approach of CIPEL is ecologically oriented and disregards participation in the negotiation of conflicting social or economic interests.

1.1.5 Managers

The role of managers is probably the most striking difference between CIPEL and bioregional assessments in the United States. In FEMAT, scientists developed management options, whereas in ICBEMP and SNEP the development of management options was reserved to managers within a different organizational structure. In contrast, the operational committee of CIPEL constitutes a group of managers within an organizational structure that elaborates management alternatives and arranges for the implementation.

1.1.6 Scientists

Scientists in CIPEL play an important but not a central role. They collect and interpret data, develop scenarios, and provide scientific advice for management. Contrary to the bioregional assessments in the U.S., the objectives in CIPEL are not defined by policy makers but by scientists themselves. In summary, scientists in CIPEL set the target but do not have the power to frame particular solutions.

Unlike assessments in the U.S., the range of disciplines in CIPEL is rather limited and omits socio-economic as well as broad ecological knowledge. The contextual aspect of science in CIPEL, however, is quite strong, because scientists develop possible scenarios of ecosystem evolution and define objectives for application.

Although the changes are not as apparent as in U.S. bioregional assessments, the role of science in CIPEL has also undergone a certain evolution. With the introduction of the first action plan, CIPEL became a much more implementation oriented structure that connected scientific observation and advice to policy and management. The complexity of the issues and the context of application forced scientists to cross their disciplinary boundaries and define applicable goals.

1.1.7 Public Participation

As in FEMAT, public participation plays a very minor role in CIPEL. Moreover, the politicians trust the scientific expertise to set objectives and develop measures for improvement. Scientists and agency experts, therefore, are relatively independent in their activities and decisions. In summary, CIPEL can be characterized as a rather technocratic approach towards science policy involvement.

1.1.8 Bioregionalism

Similar to ICBEMP, CIPEL is organized around a watershed basin. Lake Geneva and its tributaries build a stream network that scientists study at an aquatic ecosystem level. As opposed to bioregional assessment, however, CIPEL neglects the areas in-between the stream network, and thus fails to comply with any of the definitions of a bioregion given in this paper. Nevertheless, CIPEL shows certain similarities to the U.S. bioregional assessments in that the scientific assessment or scientific observation accords with ecological boundaries, whereas the implementation is realized within political units.

1.2 CIPEL and the Implications of Theory

The following paragraphs place the more general statements of the CIPEL interviews in the context of the theoretical concepts that were presented in the previous chapters.

1.2.1 Managers and Scientists

Similar to scientists in the U.S., the CIPEL scientists interviewed identified difficulties in communication between scientists and managers. Both U.S. and CIPEL scientists referred to a "high level of distrust" between scientists and managers that was ascribed to their "cultural" differences concerning, for example, scientist's high expectations versus manager's need to take immediate action.

1.2.2 Different Scientific Cultures

Consonant with their American colleagues the interviewees in CIPEL distinguished two types of scientists in the science policy context. Similar to Holling's "first stream" and "second stream" scientists, they described the "specialist" who focuses on details and the "generalist" with a larger understanding of complexity who is more likely to get involved with policy making. In both groups, scientists used the metaphor "looking through the microscope" to illustrate the specialist. One interviewee in CIPEL reflected Holling's concept of "science of parts" versus "science of the integration of parts". He introduced the example of the human body and its parts to explain, how important it is for scientists to develop a holistic understanding of the ecosystem, because *"you can't heal one organ if you don't have an idea of the whole body."*

1.2.3 Science Advocacy

In the interviews about CIPEL, science advocacy was not a major issue. Some respondents, however, emphasized that they saw a clear boundary between science and policy making, and that they disapproved of scientists who attempted to advocate particular solutions.

In both interview groups, scientists struggled with the double role of being a scientist and being a citizen, and agreed that scientists should avoid mixing their personal with their professional opinion. Scientists in CIPEL also criticized that political interest in scientific information was often limited to mediagenic issues and that politicians tend to use science in order to support their own political agendas. In general, the scientists in CIPEL probably belong to the second type of science policy roles identified earlier, the policy advisor.

1.2.4 Changes in the Scientific Community

In agreement with their American colleagues, the scientists in CIPEL reported observing changes in the scientific community during the last 10 to 15 years. They even identified the same aspects of change: broader ecosystem categories, more context orientation, more applied research, and more interdisciplinary modes of research.

2 OUTLOOK: BIOREGIONAL ASSESSMENT IN EUROPE

The previous section demonstrates the great differences existing between CIPEL and the bioregional assessments conducted in the United States. Although CIPEL provides interesting insights into the role of science in managing large ecosystems, there may be other projects or organizations in Europe that are closer to the American approach of bioregional assessment. This section presents some ecosystem related initiatives that might be worth studying in the European context.

As shown in chapter IV, CIPEL is not the only example of managing ecosystems at the watershed level. The European framework directive, for example, aims at the reorganization of water management activities by hydrographic basin in all member states (see chapter IV, p. 28). The directive may be interpreted as part of a general tendency to support more integrative approaches towards watershed management. Once a region is defined as a hydrographic basin, it may become the object of a more bioregional initiative such as ICBEMP. It will be interesting to see, if the watershed approach fosters the integration of watershed management with management efforts of related sectors dealing, for instance, with riparian areas, forests, or pastures.

A project that emphasizes the role of science in regional landscape planning and the improvement of science management relationships is the "Hohenlohe Cultivated Landscape Project." [210,211] The Hohenlohe project intends to open up new paths for the transfer of technical information to practical application in agriculture. It involves interdisciplinary research teams who work with various actors to develop concrete projects for sustainable land use within the area under study. The region was chosen because of its diversity of landscapes and agricultural structures. The whole process is scientifically monitored and the project itself thus constitutes part of the research subject. Although the project area is not delineated by bioregional borders, the interdisciplinary approach and the emphasis on science-management communication is certainly relevant to a study about the role of science in large ecosystem projects.

Two other approaches resulting from international initiatives may be interesting to study in the European context, especially where the bioregional part is concerned: the UNESCO "Man and Biosphere Programme" and the World Wildlife Fund (WWF) ecoregions. The UNESCO "Man and Biosphere Programme" suggests the establishment of "biosphere reserves" that are nominated by the national governments and intended to reconcile biodiversity protection with sustainable land use.[212] They are designed to serve as "living laboratories" in which integrated management of land, water, and biodiversity can be tested and demonstrated. The biosphere

[210] bmb+f, BEO, "Integrated Environmental Protection for Sustainable Agriculture", 1999
[211] Gerber, Konold, "Culterra 29", 2002
[212] UNESCO, homepage, "The MAB programme", last update 2003, http://www.unesco.org/mab/nutshell.htm

reserve must fulfill three major functions: conservation of biodiversity, development of economic and human activities in an ecologically sustainable manner, and logistic support for an international network of research, monitoring, and communication. There are over 140 biosphere reserves located on the European continent, some of them dating back to the 1970s, which may provide useful knowledge about landscape integration and scientific communication across political borders.

The "Ecoregions of the World Project" is conducted by the WWF-US Conservation Science Program. Ecoregions are defined as *"relatively large units of land containing a distinct assemblage of natural communities and species, with boundaries that approximate the original extent of natural communities prior to major land-use change."* [213] The main goal of the project is to create high resolution maps that can serve as a reference for local and regional conservation activities. The ecoregions are delineated by the distribution of species and natural communities and are often based on existing biogeographical systems. After the mapping, the regions are ranked by the distinctiveness of their biodiversity features and then priorities for further examination are developed. The prioritized ecoregions may become subject to assessments or sustainable use projects with an even finer level of resolution.

The Danube-Carpathian Region is an example for a European ecoregion identified as particularly valuable in terms of distinctiveness and representative value of biodiversity.[214] Since 2000, a large international cross-border initiative is working on creating a "Green Corridor" of natural wetlands along the Lower Danube River. Local communities are expected to benefit from the protection, restoration and sustainable management of the Lower Danube floodplains. The definition of ecoregions comes very close to the definition of bioregions used for bioregional assessment.

In general, the European landscape of ecosystem projects is characterized by a high variety of different projects that take place at all political and geographical levels. Probably due to higher population density, bioregional projects in Central Europe seem to focus on smaller areas than those in the United States. These areas are often demarcated by watersheds or biogeographical features, whereas wide ranging species seem to play a minor role in defining ecological boundaries.

[213] Olson et al., November 2001/Vol.51 No.11, BioScience, p. 933

[214] WWF, "A Green Corridor for the Danube", last update 2003, http://archive.panda.org/livingwaters/danube/

3 QUESTIONS FOR FUTURE RESEARCH

This section integrates the results of this study with additional literature in order to define possible directions for further research in the European context. Five propositions are introduced that clearly identify questions relevant for studying bioregional assessment from a comparative perspective.

1. *Due to the contentious legal environment that forces the public agencies to continuously prove the quality of their scientific information, scientists in the U.S. are more likely to be confronted with an advocacy role than their European colleagues.*

The interviews conducted in the U.S. revealed that agency decisions occur in a particularly contentious legal environment. According to Brickman et al.,[215] agency jurisdiction plays a much more important role in controlling political decision making in the U.S. than in Central Europe. The multitude of lawsuits is rooted in the conflict oriented approach of the American political system that is characterized by transparency, competitiveness, pluralism, and the requirement that the public agencies follow formalized procedures when making regulatory decisions.[216] In order to comply with their legal accountability, agencies are forced to continuously prove the objectivity and credibility of their information and to establish technical and scientific capacity sufficient for both analysis and implementation (see introduction, p. 8).[217] Scientists, therefore, are likely to become openly involved in regulatory conflicts, and scientific controversies are discussed in public meetings as well as in the media.

In Europe, science consultation processes are much more confidential and less likely to involve open polarization of expert opinion.[218] Thus, the public has limited insight into scientific controversies and the scientific influence on regulatory decision making. As a consequence, science advocacy is not as obvious in the public and scientific debate.

During the last years, however, this trust in science seems to be decreasing in Europe as well. In the context of risk assessment, European regulation emphasizes the precautionary principle that requires precautionary action if the scientific information about a potential danger or risk is sufficient to warrant action. According to Vogel, the precautionary principle stresses the importance of scientific knowledge for regulatory decisions, but at the same time demonstrates the scepticism that scientific knowledge may not always be an adequate guide to policy makers.[219]

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[215] Brickman, Jasanoff, Ilgen, 1985, p. 304
[216] O'Riordan, Wynn, in "Riskante Technologien: Reflexion und Regulation", 1993, pp. 198-199
[217] Brickman, Jasanoff, Ilgen, 1985, p. 309
[218] Brickman, Jasanoff, Ilgen, 1985, p. 310
[219] Vogel, 2001, p. 16

2. *Due to less participatory policy models and a more positivist perception of science, a technocratic approach towards science policy integration prevails in Central Europe.*

The cases that were analyzed in the U.S. laid much more emphasis on public participation (the absence of public participation in FEMAT was widely criticized) than CIPEL. Although participatory models of policy making have now increased on both continents,[220] the U.S. administrative process provides more opportunities for various interested groups as well as the general public to participate in regulatory proceedings.[221] In France and Germany for example, the administrative authorities have more discretion to decide which interest group representatives shall be heard, because the legal requirements for public participation are less specified. Interest groups, therefore, seek to influence policy by maintaining good relationships with the public agencies.

As described above, scientific debates in the U.S. occur in a more public context than in Central Europe. Society, therefore, has the opportunity to witness scientific controversies and science advocacy - a situation that promotes a more constructivist general perception of science.[222] In Europe, a rather positivist view persists which perceives science as a way to discover the "ultimate truth."[223] The public is more likely to trust in the objectivity and rationality of scientific advice and agency expertise.[224]

A positivist perception of science combined with only minor public participation promotes technocratic models of science policy advice (see introduction, p. 10). CIPEL embodies this kind of technocratic model whereby scientists define their roles as providing objective information for management decisions and policy making, rather than providing advice or recommendations.

However, especially with the continuous development of the European Union, political participation and representation of civic interests are increasingly required and participatory models of policy making are being used in many European countries.[225,226] It will be interesting to see if this increased public participation affects or changes the way in which the interested public perceives science and its evolving role in shaping policy.

3. *The complexity of natural resource management problems and the redirection towards more implementation oriented contexts promote changes in the role of scientists in the U.S. as well as in Central Europe.*

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220 O'Riordan, Wynn, in "Riskante Technologien: Reflexion und Regulation", 1993, p. 187
221 Brickman, Jasanoff, Ilgen, 1985, p. 43
222 Brickman, Jasanoff, Ilgen, 1985, p. 310
223 Sitter.Liver in "Der Einspruch der Geisteswissenschaften", 2002, p. 279-280
224 Brickman, Jasanoff, Ilgen, 1985, p. 310
225 Vogel, 2001, p. 10
226 Joint FAO/ECE/ILO Committee on Forest Technology, Management and Training, 2000

The cases of bioregional assessment in the U.S. and CIPEL both constitute complex ecosystem contexts in which scientists are forced to provide information that is useful for management and policy decisions. Changes within the scientific community are promoted by an increased focus on direct implementation of scientific advice and recognition of the various dimensions inherent to modern scientific problems. In the U.S. assessments, for example, social scientists joined with biophysical and ecological scientists in large ecosystem assessment projects. Contrary to other efforts in Europe, CIPEL does not yet utilize social science expertise; the CIPEL interviewees, however, suggested the need for the involvement of social scientists.

4. *The disciplinary culture of the scientific community in Central Europe faces the same difficulties with interdisciplinary and transdisciplinary boundary crossing as its counterpart in the United States.*

The scientific community is characterized by a number of particular features that appear in Central Europe as much as in the United States. These features include the disciplinary structure of knowledge, the cultural differences between disciplines, and the particular difficulties scientists have interacting with managers, policy makers, and the public. European scientists identify the same problems to be overcome in crossing traditional disciplinary boundaries as their American colleagues.[227]

5. *The high population density in Central Europe means that landscape oriented ecosystem management must integrate social and economic demands into projects promoting biodiversity and nature conservation to a much greater degree than in the United States.*

Due to the fragmented patterns of land allocation and the high population in Central Europe, areas of timber harvest, nature conservation, recreation, etc. are often impossible to separate. Thus, ecosystem management projects in Central Europe are forced to apply multiple use and integrative management approaches in order to reconcile environmental with social and economic interests. This necessity for multi-functionality in ecological assessments is likely to affect both, how the assessment boundaries are drawn as well as the range of scientific disciplines engaged in the assessment. In addition, the multi-ownership context is likely to lead to an assessment form more like SNEP wherein the institutional factors were clearly taken into account, than FEMAT which focused only on one large public ownership.

[227] For a synoptic view on strengths and weaknesses of interdisciplinary exchange in the context of the German environmental research see Daschkeit, 1998

CHAPTER VII

WHAT HAVE WE LEARNED?

FINAL CONCLUSION

The purpose of this chapter is to summarize the major findings in a final conclusion that integrates the questions and conclusions stated in the two previous chapters.

The results of this study show that the role of scientists in natural resource policy has significantly changed in the last years and decades. There is evidence that these changes have occurred in the United States as well as in Central Europe. The new role that scientists are playing is characterized by the following features:

- More Interdisciplinary and Trandisciplinary Collaboration: The complexity of the issues that scientists interested in natural resource management are facing today forces them to overcome traditional disciplinary boundaries and to improve their communication with other scientists, managers, and the public.
- More Applied and Implementation Oriented Research: If scientists face policy problems, they are expected to orient their research towards a politically realizable outcome.
- Science Advocacy: The political context is often controversial, and thus makes it difficult for scientists to stay objective and untainted. Scientists must decide to what extent they want to be involved in policy as advocates for particular solutions. Their positioning in the political field, however, is strongly related to whether they perceive science from a positivist or constructivist perspective. As a result of this study, four types of roles for scientists in policy making were distinguished: the independent scientist, the policy advisor, the policy partner, and the policy maker.

Bioregional assessments can be characterized as an outcome of the new role that scientists are playing in natural resource policy. At the same time, bioregional assessments as well as many other large scale ecosystem projects foster this new development. Three aspects of these projects particularly promote interdisciplinary and transdisciplinary collaboration:

- Space: Scientists are forced to integrate their findings across large spatial areas.
- Scales: Scientists must integrate their findings across a variety of different scales (spatial, institutional, economic, etc.)
- Problem Dimensions: Scientists must address the different dimensions of the problem (social, ecological, economic, political, etc.)

Although the role of science is changing in Europe as well as in the United States, the differences in the cultural, political, and legal framework can be detected in the way in which Europe approaches ecosystem management and in the role that scientists play in the effort. In order to define questions for further research, the author suggests a number of issues that might be interesting to look at in the context of science and bioregional initiatives in Central Europe:

- Science Advocacy: The debate about science advocacy seems to be of minor importance in the European context. The U.S. legal system which allows the different stakeholders to challenge the quality of scientific results openly in court is unknown to the less conflict oriented political systems dominating in Central Europe.
- The Perception of Science: Probably as a result of the rather confidential discussion of scientific conflicts, people in Central Europe are more likely to believe that scientists hold "the ultimate truth."
- Public Participation: Although public participation is growing in Central Europe, public involvement in policy has traditionally been stronger in the United States. Public participation affects the role of science in natural resource policy, because it determines the choice between more technocratic and more democratic models of science policy advice.
- Bioregional Projects: The European landscape of projects and institutions displaying bioregional aspects is large and diverse. In general, bioregional initiatives in Central Europe seem to focus on smaller areas often demarcated by watersheds or biogeographical features. High population density and landscape fragmentation may be an important factor in comparing bioregional efforts in the U.S. and Europe.

The results of this study are based upon a combination of social research and literature review. Particularly in regard to the case studies, however, one must notice that this paper concentrates on how scientists describe their world. According to Maturana and Varela, *"a system's interaction with its environment is really a reflection and part of its own organization."* [228] The scientific community or system, therefore, describes its environment from a scientific point of view that reflects its particular characteristics and peculiarities. Moreover, when scientists choose science as the object of their study, they look at themselves in a neverending mirror. The researcher does not attempt to escape the circularity of this system. However, the reader should keep in mind that the scientific perception of science is only one part of the story, and that other systems such as managers or politicians could reflect the role of science from completely different perspectives.

[228] Morgan, 1997, p. 254

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ANNEX I

LIST OF ABBREVIATIONS

CIPEL

CIPEL:	Commission Internationale pour la Protection des Eaux du Léman
COP:	Comité Opérationnel
CS:	Conseil Scientifique
R.-M.-C. :	Rhône-Méditerranée-Corse (Water Agency)

UNITED STATES

BLM:	Bureau of Landmanagement
CLAMS:	Coastal Landscape Analysis and Modeling Study
EIS:	Environmental Impact Statement
EPA:	Environmental Protection Agency
ESA:	Endangered Species Act
FACA:	Federal Advisory Committee Act
FEMAT:	Forest Ecosystem Management Assessment Team
FOIA:	Freedom of Information Act
FS:	U.S.D.A. Forest Service
FWS:	U.S. Fish and Wildlife Service
ICBEMP:	Interior Columbia Basin Ecosystem Management Project
ISC:	Interagency Scientific Committee
NEPA:	National Environmental Policy Act
NFMA:	National Forest Management Act
NFP:	Northwest Forest Plan
NPS:	U.S. National Park Service
ROD:	Record of Decisions
SAT:	Scientific Assessment Team
SNEP:	Sierra Nevada Ecosystem Project

ANNEX II

CIPEL: LIST OF INTERVIEWEES

PERMANENT OFFICE

Aline Clerc
Discipline: agricultural and environmental engineering
Function in CIPEL: coordination engineer for the action plan
Agency / Institution: permanent employee of CIPEL, Lausanne, Switzerland

François Rapin
Discipline: geology
Function in CIPEL: office director, member of the office of the technical sub-commission
Agency / Institution: permanent employee of CIPEL, Lausanne, Switzerland

SCIENTISTS / MANAGERS

Roger Revaclier[229]
Discipline: chemistry, biology
Function in CIPEL: member of the science council as biology specialist
Agency / Institution: "Service Cantonal d'Hydrobiology", Geneva, Switzerland

Daniel Gerdeaux
Discipline: fish ecology, water ecosystem management
Function in CIPEL: president of the science council, member of the operational committee
Agency / Institution: "INRA-UMRA / CARRTEL" (Research Institution), Thonon-les-Bains, France

[229] No time for an interview but answered questionnaire

Claude Lascombe

Discipline: hydrobiology, ecology

Function in CIPEL: member of the science council and the operational committee

Agency / Institution: "Agence de l'Eau Rhône-Méditerrannée-Course", Lyon, France

Charles Stalder

Discipline: chemistry

Function in CIPEL: president of the working group "industrial pollution", member of the operational committee

Agency / Institution: "Service des Contrôles de l'Assainissement", Aire, Switzerland

Marc Bernard

Discipline: natural sciences, limnology, water chemistry

Function in CIPEL: member of the working group "renaturation", member of the operational committee

Agency / Institution: "Service Cantonal de la Protection de l'Environnement"

ANNEX III

CIPEL: EXAMPLE INTERVIEW GUIDELINE

INTERVIEW PERMANENT OFFICE

Introduction

- Je me présente.

Questions Personnelles

- Est-ce que je pourrais demander quelle est votre profession originalement ?
- Quel type de travail est-ce que vous faites dans la CIPEL ?
- Depuis combien d'années?

Questions sur la CIPEL

Histoire

- Il y avait la convention du Lac Léman en 1963, qu'est-ce que ce passait entre 1963 et 1991, l'initiation du premier plan d'action ?

Motivation

- Qui a pris l'initiative de développer les Plans d'Actions, premier et second ?
- Compréhension publique envers les problèmes de pollution du Lac, est-ce que la conscience du public a changé depuis le début du projet?
- Qui a défini les objectifs pour les Plans d'Actions ? La politique ? Des experts ?

Organisation

- Organisation de la coopération entre la délégation suisse et la délégation française, est-ce qu'il y a des contacts entre les assemblées générales ?
- Qui assure la coordination entre la commission et la sous-commission technique, c'est le secrétariat où ce sont plutôt des échanges d'information directes ?
- Est-ce qu'il y a des employées permanentes à part du secrétariat ?
- Quelles sont les autres activités de la CIPEL à part de la gestion du plan d'action ?
- (Entre autre la CIPEL contribue à la coordination de la politique de l'eau autour du Lac entre F et CH. De quelle façon ?)

Financement

- Est-ce qu'il y a des mesures financières mis a part le financement par l'état ?
- Qui porte les frais, en F et en CH, les Départements et Cantons où des entités plus hautes de l'état ?

Directives

- Recommandations de la CIPEL présentées aux gouvernements:
  - Combien ont-elles été mis en œuvre aux niveaux politique et légal ?
  - Dans quelle mesure la commission est-elle un organe de décision ?

Mise en Oeuvre:

- Quelles sont les différences les plus importantes entre la Suisse et la France concernant la mise en oeuvre des plans ?
- Concertation bilatérale, sur quels points, comment et avec qui ?
- (Problèmes juridiques – quels sont-ils ?)

Participation et Rôles

La publique

- Quelles sont les groupes d'intérêt les plus importants (pêcheurs, industrie, tourisme, agriculteurs, associations pour la protection de la nature... ?)
- Est-ce qu'ils ont influencé le développement du plan d'action sauf pendant les rencontres-débats ?
- Qui a choisi les gens invités aux rencontres-débats ?
- (Est-ce qu'on a fait des modifications importantes au plan d'action après les rencontres-débats ?)
- (De quelle façon la grande publique participe-t-elle au sujet de la CIPEL? Par exemple est-ce qu'il y a beaucoup d'abonnées du « Lettre du Léman » ?)

La participation des scientifiques

J'essaie un peu de dessiner une image de "qui fait quoi" dans ce projet, quels sont les rôles des acteurs, avant tous les politiciens, les scientifiques et les techniciens qui misent en oeuvre les actions :

- Comment décririez-vous la rôle des scientifiques dans la CIPEL ? Dans les plans d'actions ?

- (Les scientifiques: ce sont eux qui définissent les problèmes et les objectifs ?)
- Est-ce qu'ils sont légitimés d'une façon ou l'autre de faire des décisions ?
- Comment est-ce qu'ils peuvent influencer les recommandations de la CIPEL aux politiciens ?
- Est-ce qu'il y a un échange régulier entre le comité opérationnel et le conseil scientifique ?
- Quelles sont les disciplines scientifiques représentées dans les groupes de travail ?
- Est-ce que les divers groupes de travail se rencontrent pour échanger des données, coordonner leurs travaux, préparer des présentations ?

Autres Questions

- (A votre avis, quels sont les problèmes du Lac Léman / plan d'action les plus importants ?)
- Je cherche quatre à cinq personnes pour faire des interviews, si possible du comité opérationnel / du conseil scientifique / Francois Rapin du bureau ? Des Suisses et des Francais ? Des experts et des techniciens ?

Ad hoc

ANNEX IV

CIPEL: QUESTIONNAIRE

QUESTIONS E-MAIL SURVEY

1. Comment expliquerez-vous votre tâche dans la CIPEL ?

2. Comment décririez-vous le rôle des scientifiques dans la CIPEL en général ?

3. Qui, dans l'organisation de la CIPEL, était le plus impliqué dans le développement des plans d'action ?

4. Selon mes informations, les disciplines les plus représentées dans la CIPEL sont la biologie et chimie de l'eau. Est-ce qu'il y a d'autres disciplines que vous aimeriez voir représentés où plus représentés dans les groupes de travail / au conseil scientifique ?

5. Comment voyez-vous la coordination entre les scientifiques qui collectent des données et les techniciens dans les agences qui sont chargés de la mise en œuvre ?

6. Au niveau de la collection des données aussi qu'au niveau de la mise en œuvre; quelles sont les différences les plus importantes entre la Suisse et la France?

ANNEX V

U.S.: LIST OF INTERVIEWEES

Jerry Franklin

Discipline: forest management, statistics, botany, pedology

Project: FEMAT, Gang of Four

Agency / Institution: professor of ecosystem analysis, University of Washington, Seattle

David Graber

Discipline: ecologist

Project: SNEP, science team

Agency / Institution: research administrator and scientific consultant for the National Park Service

Richard Haynes

Discipline: forest economy

Project: FEMAT, ICBEMP

Agency / Institution: forest economist and program manager with the U.S. Forest Service, Pacific Northwest Research Station, Portland, Oregon

Norman Johnson

Discipline: forest management, forest economics

Project: FEMAT, Gang of Four, SNEP

Agency / Institution: professor of forest policy and forest management, Oregon State University, Corvallis

Constance Millar

Discipline: plant and evolutionary genetics, climatology

Project: SNEP, science team, coordinating committee

Agency / Institution: principal research scientist, Sierra Nevada Research Center, U.S. Forest Service, Pacific Southwest Research Station

Thomas Quigley
Discipline: range science
Project: ICBEMP, science team leader
Agency / Institution: assistant research station director, Rocky Mountain Research Station

James Sedell
Discipline: aquatic ecology
Project: SAT, FEMAT, ICBEMP
Agency / Institution: research ecologist, with the U.S. Forest Service, Pacific Northwest Research Station, Corvallis, Oregon

Thomas Spiess
Discipline: forest ecology, landscape ecology
Project : FEMAT, CLAMS
Agency / Institution: ecologist with the U.S. Forest Service, Pacific Northwest Research Station, Corvallis, Oregon

George Stankey
Discipline: sociology
Project: FEMAT
Agency / Institution: research social scientist with the U.S. Forest Service, Pacific Northwest Research Station, Corvallis, Oregon

Ed Starkey
Discipline: zoology, biology, animal ecology
Project: FEMAT
Agency / Institution: research manager for the U.S. Geological Survey

Frederick Swanson
Discipline: geologist
Project: FEMAT
Agency / Institution: ecosystem team lader, research geologist with the U.S. Forest Service, Pacific Northwest Research Station, Corvallis, Oregon, professor at Oregon State University

ANNEX VI

U.S.: STANDARD INTERVIEW GUIDELINE

PERSONAL QUESTIONS

- What is your original profession / discipline?
- What job are you doing right now?
- Would you define yourself rather as a scientist or as a manager?
- <u>In which bioregioal assessment have you been involved?</u>

THE PARTICULAR BIOREGIONAL ASSESSMENT(S)

- Who initiated it?

<u>The policy problem</u>

- Was there a clear policy problem defined in advance?
- Who defined this policy problem? (Scientists / policy makers)
- How was science organized to address the policy problem? Were did the scientists come from?
- Was there a balance between ecological, economical and social interests in defining the problem?
- How was the scientific report organized?

<u>Science</u>

Disciplines

- Which disciplines were involved in the assessment?
- Which disciplines did you miss?
- Was the assessment based on interdisciplinary or rather multidisciplinary work?
- Did the scientists follow an ecological / systemic approach?

Role of Scientists

- Did scientists themselves develop general management scenarios to address the policy problem?
- Were scientists involved in the following planning process (if there was one)?

- Who made the decisions, (how) were scientists involved in decision-making?
- What value(s) / benefits did the involvement of scientists give to the assessment?
- Where were the limitations for scientists in the assessment (+ generally)?

Scientific Uncertainty

- How did you deal with it?

Managers

- Were managers involved in the assessment(s)?
- What happened to the assessment results (planning process, etc.)?
- Do managers still use the results of the assessment / get back to scientists to ask their advice?

Public

- Characterize the nature of public involvement in the process?
- To what extend does public involvement help the process?

Funding

GENERALLY IN THE UNITED STATES

- How do you see the role of scientists in natural resource policy in the U.S. today?
- Has the role of scientists changed in the last years, decades?
- Has the idea of bioregional assessment influenced the role of scientists in policy-making?
- What are the costs / benefits for scientists to get involved in bioregional assessment?

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