

Habitat Conservation Plan Implementation: Keeping Promises for Adaptive Management  
within a “No Surprises” Policy

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## Abstract

Adaptive management is an approach to problem solving that acknowledges uncertainty. Adaptive management involves a systematic and rigorous process of learning from the outcomes of management actions, accommodating change and improving management. Plans, policies or management strategies influenced by new information and learning, are modified.

This study examines the implementation of adaptive management for endangered and threatened species covered in Habitat Conservation Plans (HCP). Introduced in 1982 as an amendment to the Endangered Species Act (ESA), Habitat Conservation Plans are negotiated agreements that mitigate the incidental “take” (killing, harming) of endangered and threatened species during a development or resource extraction project. However, scholars found the scientific basis of approved HCPs to be inadequate and the efficacy of prescribed mitigation measures untested implying the need for adaptive management during implementation.

This case study evaluation investigates HCP landowner compliance and progress within the parameters of the federal 1994 “No Surprises” policy. That policy limits landowner liability and responsibility for additional conservation action due to failed mitigation measures during HCP implementation. “No Surprises” assumes we can predict all the consequences of implementing a HCP. The policy seems to work against the objectives of adaptive management to improve scientific knowledge and modify action. The cases include the Central Cascades HCP implemented in the Central Cascades of Washington and the Orange Central Coastal County HCP implemented within a nature reserve in Orange County, California. The study assesses the strengths and weaknesses of adaptive management implementation in protecting endangered species and their habitat, and 2) recommends mid-course corrections for improving adaptive management before HCP maturity.

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## Chapter 1

### 1.1 Research Purpose and Goals

The purpose of this research is to examine the implementation adaptive management in Habitat Conservation Plans. Established under a 1982 amendment to the Endangered Species Act (ESA), a Habitat Conservation Plan (HCP) is a negotiated agreement intended to reconcile conflicts between species conservation and private interests. Specifically, the HCP is designed to mitigate an incidental “take” (killing, harming) of endangered and threatened species during a development or resource extraction project. Private landowners receive a permit to proceed with their projects if they agree to prepare and implement a HCP. The U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Services (NMFS), otherwise referred to as the “Services”, administer the Habitat Conservation Planning Program.

HCPs have been a source of controversy in the environmental and scientific communities. Environmental and conservation advocates are concerned about the compromise to species survival and recovery as a consequence of land conversion and development projects. Scholars have found the scientific basis of approved HCPs to be inadequate and the efficacy of prescribed mitigation measures untested (Kareiva *et al.*, 1999, Noss *et al.*, 1997). These claims have implications for HCP implementation effectiveness and the HCP Program’s ability to meet the goal of species survival and recovery as mandated by the Endangered Species Act.

Acknowledging the uncertainties in the HCP at the time of permit issuance, the Services encourage adaptive management, particularly for regional scale HCPs “that would otherwise pose a significant risk to species” (FWS/NMFS 1996, 2000). Adaptive management involves a systematic and rigorous process of learning from the outcomes of management actions, accommodating change and improving management. It is assumed that HCPs with adaptive management commitments will result in continuous probing and improved understanding of biological responses to mitigation strategies leading to species/habitat improvements.

However, HCP landowners have assurances under a “No Surprises” policy that should their HCP prove ineffective, or should conditions adversely change, no additional land restrictions or financial compensation will be required. In other words, landowners are absolved from providing additional mitigation due to unforeseen circumstances as long as the HCP terms and conditions are implemented in good faith (USFW and NMFS, 1996 and 2000). Instead, the public and new HCP applicants bear the burden of providing additional mitigation. It is only under “changed circumstances” -- situations that could reasonably be anticipated -- are HCP landowners expected to provide additional protections. But, “changed circumstances” and subsequent measures to address them must be identified in the HCP. The irony of the “No Surprises” policy is that it contradicts the notion of uncertainty acknowledged by adaptive management and inherent in ecological systems. Ecological systems are influx, unpredictable, and nonlinear.

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Little is known about the performance of HCPs (Thomas and Schweik, 2000) in protecting endangered and threatened species. Adaptive management is essential for enhanced HCP performance, yet few scholars have evaluated the extent of adaptive management implementation.

This research examines adaptive management implementation for the Central Cascades Habitat Conservation Plan and the Orange Central-Coastal County Natural Communities Conservation Program (NCCP) and Habitat Conservation Plan. The following research questions are posed to formatively examine adaptive management for endangered species covered in the case studies:

- 1) What is the extent of adaptive management implementation in the HCP?
- 2) How do adaptive management approaches influence early stage outcomes?
- 3) How do adaptive management approaches vary with ecosystem characteristics?

The assessment of early stage outcomes establishes the foundation for future evaluations of the role of adaptive management in HCP interim and long-term outcomes. Moreover, research on adaptive management implementation can reveal how habitat conservation planning as a policy choice is advancing the Endangered Species Act goal of species survival and recovery.

### 1.2 Research Objectives

The primary objectives of this research are fivefold:

1. To develop an understanding of adaptive management.
  - ❖ To synthesize the adaptive management literature to capture a consistent definition of adaptive management and obtain an understanding of the various implementation approaches.
  - ❖ To review case examples of adaptive management implementation from the literature to identify success stories and to gain insight on lessons learned.
  - ❖ To develop criteria for evaluating HCP adaptive management implementation based upon the theoretical and case study literature.
2. To obtain a thorough understanding of the HCP program to ascertain Congressional intent.
  - ❖ To conduct a review of the Endangered Species Act congressional record, federal register, and agency guidance documents on HCPs for clarity.

## Chapter 1

- ❖ To identify elements related to HCP implementation in my review of the above for inclusion as criteria for case specific evaluation.
3. To elucidate adaptive management implementation for the Central Cascades and Orange Central Coastal County HCPs.
    - ❖ To assess how private landowners conceptualize and implement adaptive management for endangered species and habitats.
    - ❖ To evaluate the extent to which the adaptive management is implemented, using the literature derived adaptive management cycle as a guidepost.
    - ❖ To evaluate the approach to adaptive management by comparing the literature with findings from document reviews, interview transcripts and direct observation.
    - ❖ To understand HCP implementation decision-making processes and the factors which influence the extent and approach to adaptive management implementation.
    - ❖ To assess the accomplishment of adaptive management components of the HCP as agreed to in the implementation agreement.
  4. To assess whether private landowners have achieved short-term objectives identified in the HCP.
    - ❖ To compare HCP short-term objectives identified in the HCP management and monitoring plan with annual and monitoring reports and reviews.
  5. To propose early recommendations to HCP permit holders based upon lessons learned from the case analyses and to inform the “Services” about the long term implications of adaptive management for species and habitat covered under these case specific HCPs and future HCPs.
    - ❖ To identify and assess the strengths and weaknesses of adaptive management implementation for HCP protected endangered species and habitat based upon the literature and in-depth case analyses.
    - ❖ To recommend improvements to the HCP program to ensure that learning and the reduction of scientific uncertainty is the clear intent of HCP implementation.

## Chapter 1

### 1.3 Relationship to the Literature

HCPs have been in existence since 1983, yet most of the HCP literature offers critiques on the HCP planning phase rather than the implementation phase. In particular, Beatley (1994), Bean *et al.*, (1991), Hood (1998), and Sheldon, (1998), described the HCP planning process; and Noss *et al.*, (1997) advocated conservation biology principles for plan implementation.

Research conducted by the following scholars gave impetus to my study of HCP implementation characterized as adaptive management. In their scientific quality assessment of 48 HCPs, Karieva *et al.*, (1999) observed either an absence of basic natural-history information or straightforward monitoring protocols, as well as inadequate reporting in HCPs. However, “there was no evidence that the quality of data regarding status, take and impact influenced the approach to reduce the impact of the HCPs.” Alluding to the need for adaptive management, the authors recommended that plans reflect estimates of impact, mitigation, and monitoring uncertainties and that HCP permit holders respond to monitoring results during HCP implementation.

In their case study presented at the Association for Public Policy Analysis and Management Annual Research Conference, Craig and Schweik (1999) presented a multi-method framework for evaluating implementation of the Coachella Valley HCP. The authors incorporated remote sensing in their evaluation framework to address institutional rules, monitoring and enforcement. Specifically, inquiries were made about the legal and ecological weaknesses of the HCP and the political feasibility of adaptive management. The authors concluded that HCP performance should be evaluated and findings should be incorporated under an adaptive management framework.

In his progress assessment of the Orange Central Coastal County NCCP-HCP, the first pilot of Southern California’s NCCP, Pollak (2001) found implementation of adaptive management to be at its infancy. He also discovered that monitoring protocols were still in development and found the ability to fund and coordinate monitoring activities to be uncertain.

### 1.4 Research Methodology and Methods

A qualitative methodology was chosen to elucidate the how, why and latent meaning of adaptive management implementation. In particular, a case study can reveal whether adaptive management has produced new information about the effectiveness of prescribed mitigation measures. Moreover, the process of learning by private landowners about species response to management actions can also be highlighted in depth.

To better illuminate particular circumstances that influence short-term outcomes, data triangulation was sought through the collection of place-based information across multiple sources and diverse perspectives. Thus, research findings are placed in the context of what was implemented and the local circumstances that affected variation in implementation and outcomes (Patton, 1990).

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The Central Cascades HCP and the Orange Central Coastal County NCCP/HCP reflect the diversity of HCPs designed for adaptive management implementation for forestry and urban development land uses. Both plans are in the eighth year of implementation with durations spanning seventy-five to one hundred years. A formative evaluation involving the assessment of process and progress is therefore conducted in recognition of the early stage of plan implementation. Some species and community responses to habitat alteration involve long time horizons before conclusive statements can be made about implementation effectiveness. However, an early evaluation can inform improvements to adaptive management implementation before HCP maturity.

In addition, HCPs are case specific as the socio- economic and biophysical conditions vary depending upon local politics and geographic location. Subsequently, cases are viewed as projects for which to explain site differences. While universal statements about HCPs are not the intent of this research, some similarities in adaptive management implementation are expected.

The iterative process of data analysis involved interpretation and intuition to: 1) make meaningful connections between the research questions, primary and secondary data and findings to create a chain of evidence, and 2) use multiple data collection methods through triangulation to check validity (GAO, 1990). A chain of evidence was established through subject interviews, documents, and observations that were carefully examined to find constructs, themes, and patterns. Patterns were identified to assess the consistency or inconsistency of findings and to consider alternative explanations for results. A logic model and a conceptual model were integrated into the data analysis process. These models are found in Chapter 3.

Document reviews, interviews and observations were conducted to triangulate data across multiple sources and diverse perspectives to better capture multiple realities. The collection and analysis of secondary data sources consisted of HCPs, Implementation Agreements, Annual Reports, Management Plans, correspondence, minutes of meetings, five year reviews, maps, technical reports and publications that took place between February 2003 and July 2005.

The review of key documents was supplemented with interviews. Twenty- eight interview questions were derived from the evaluation and adaptive management literature. My semi-structured interview guide that represents a mix of descriptive, normative and cause and effect evaluation questions is found in Appendix C.

## **Chapter 1**

### **1.5 Organization**

There are eight chapters following this introduction. Chapter two contains a literature review to include a discussion of the Endangered Species Act and an overview of the Habitat Conservation Planning Process. The scientific theory from which adaptive management is derived is also addressed. Chapter three describes my research methodology. This chapter provides a justification for the cases selected and my approach to data collection, analyses and interpretation. Chapters four through seven represent my case studies.

Chapter four and five describe the Central Cascades HCP and provide an assessment of adaptive management implementation. Correspondingly, chapters six and seven provide an overview of the Orange Central Coastal County NCCP-HCP and an assessment of adaptive management implementation. Chapter eight is a comparative analysis of the two cases including a discussion on case similarities and differences. Chapter nine summarizes case conclusions, identifies lessons learned, and recommends improvements for adaptive management implementation. Insights for future research are also shared.

## Chapter 2

### 2.1 Introduction

This chapter is organized into six sections. Sections 2.1 and 2.2 summarize the Endangered Species Act (ESA) and its implications, followed by a discussion of the habitat conservation planning, approval and implementation process. Also discussed is the “No Surprises” clause, a component of the Habitat Conservation Planning Program that has a direct impact on adaptive management implementation. Finally, an overview of the current status of HCPs is provided.

Section 2.3 presents the theoretical underpinnings of the ESA. Adaptive management is defined in Section 2.4 and includes a discussion of the range of interpretations and case examples of adaptive management implementation. The relationship between Conservation Biology and adaptive management, and ecosystem characteristics and adaptive management approaches is explained. Section 2.5 summarizes existing HCP research related to implementation. Finally, Section 2.6 represents a discussion on the value of adaptive management for HCPs.

### 2.2 The Endangered Species Act of 1973

Section 9 of the ESA prohibits the “taking” (harm, harass, shoot, pursue, hunt, wound, kill, trap, capture, or collect) of listed endangered or threatened species. Prohibition also extends to indirect activities that significantly modify or degrade habitat (50 CFR §§ 17.3). The only acceptable taking is that which would occur during scientific research and other conservation actions (FWS/NMFS1996 & 2000). Violators of this law have no recourse under the law for exemption and thus are subject to criminal and civil penalties. A species is endangered when it is “in danger of extinction within the foreseeable future throughout all or a significant portion of its range” (50 CFR §§17.3). A species is threatened when it is “likely to become endangered within the foreseeable future throughout all or a significant portion of its range” (50 CFR §§ 17.3).

The purposes of the 1973 ESA are to conserve endangered species "and the ecosystems on which they depend" (16 U.S.C. §1531). The Act recognizes the extinctions of species as a consequence of economic growth and development and seeks to conserve the ecological, aesthetic, scientific, educational, recreational and historical values of fish, wildlife and plants (Sheldon, 1998).

Section 7 of the ESA requires federal agencies to consult with the FWS and the NMFS (the “Services”) to ensure that federal actions are not likely to jeopardize the continued existence of listed species or result in "the destruction or adverse modification" of their critical habitat (16 U.S.C. §1536). Sections 9 and 10 of the ESA address habitat modification by nonfederal, private development (16 U.S.C. §1536).

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### 2.2.1 Private property rights

The ESA was considered an infringement on private property rights. Landowners conducting otherwise legal activities such as land clearing, tree cutting and road building on private land were subjected to civil and criminal penalties when such activities occurred on land inhabited by endangered or threatened species. Several attacks in the media over the stringency of the ESA and legal challenges in court gave impetus to Congress to amend the ESA. Congress recognized that the ESA constituted an absolute ban on the “taking” of listed species. Furthermore, Congress acknowledged that there was no mechanism in the ESA to allow for “take” that might incidentally occur (Sheldon 1998). An amendment to the ESA would relieve the burden on private landowners to protect species by providing an incentive to conserve habitat.

### 2.3 Habitat Conservation Planning

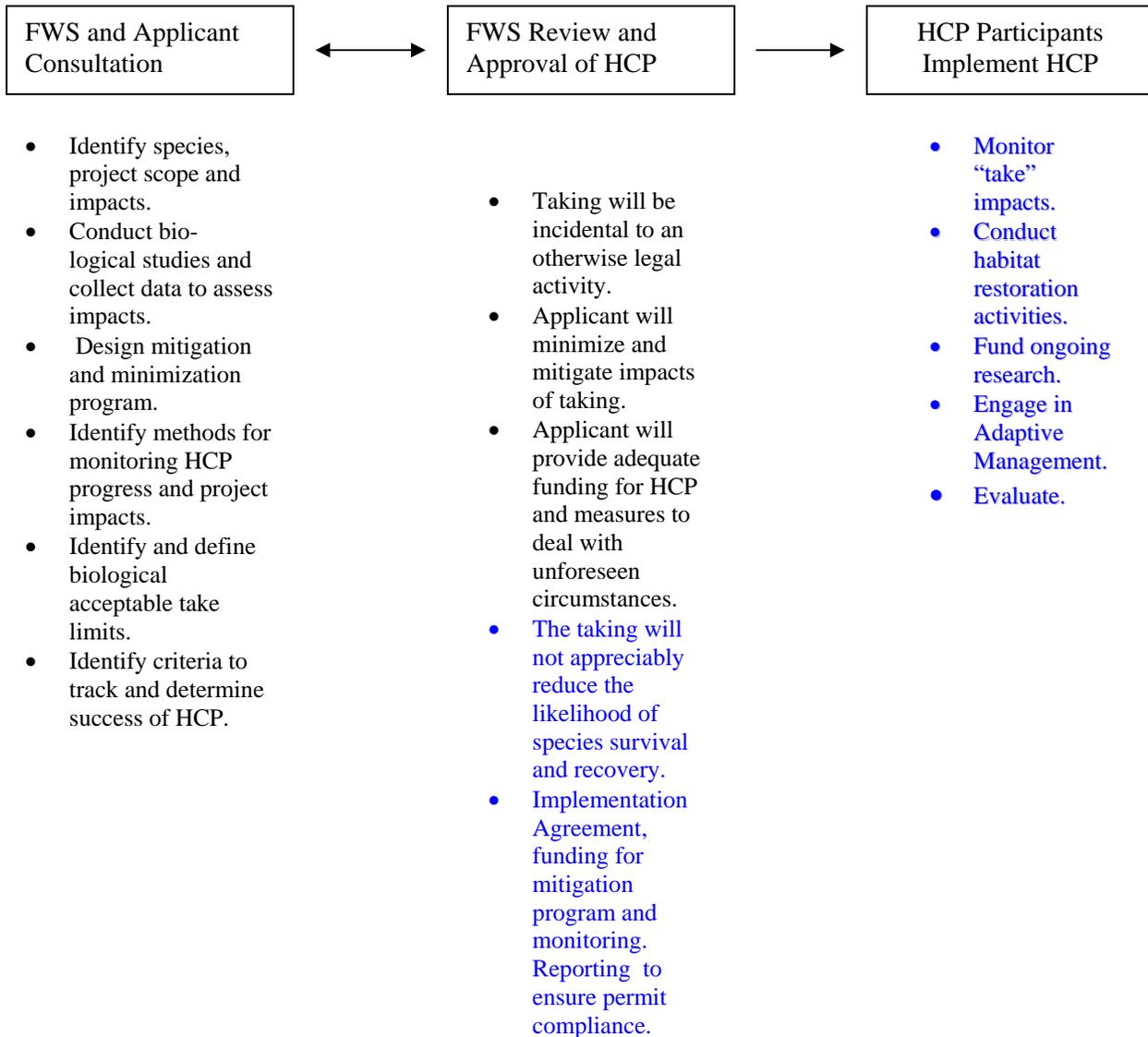
Resistance toward the “prohibitive policy” (Yaffee 1982) of the ESA led to a 1982 amendment found in Section 10 [a][1][b], Habitat Conservation Planning (16 U.S.C. §1539, 50 CFR 17.22). The amendment provides an exception to Section 9 by authorizing the Services to issue a federal incidental take permit.

The permit authorizes the taking of federally listed wildlife or fish by nonfederal and private entities who are conducting otherwise legal land use activities. This exception is granted as long as private entities agree to prepare and implement a habitat conservation plan.

Section 10 [a][1][b] was modeled after the San Bruno Mountain Conservation Plan developed by the County of San Mateo for two endangered species of butterflies. The amendment does not mandate the specific components of an HCP, beyond the identifying the: (1) impacts likely to result from the proposed taking of the species; (2) measures that will be used to monitor, minimize, and mitigate such impacts; (3) funding that will be committed to undertake the measures; and, (4) alternative actions considered that would not have resulted in “take”, and the reasons why these alternatives will not be utilized. The HCP planning, approval and implementation process is described in Figure 1.

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**Figure 2-1 Habitat Conservation Planning Process**



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Critics of the HCP approval process note that the HCP approval criterion, the “taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild” is inconsistent with the explicit ESA species recovery-- reversing and arresting species declines-- and the implied ecosystem conservation goals. Reasons cited include the allowance for loss of species and the alteration of habitat. The Services view an HCP’s contribution to species recovery to be an integral product of an HCP, even though recovery is not explicitly mentioned as a Section 10 [a][1][b] requirement (FWS/NMFS 1996, 2000). The Services further recognize HCPs as encompassing all or much of a species’ range. HCPs also address crucial biological issues and provide for dependable conservation actions and long-term biological protections. Hence, the Services encourage the preparation of HCPs that produce a net positive effect for the species or contribute to recovery plan objectives (FWS/NMFS 1996, 2000).

Noss, *et al.*, (1997) argue that there are no clear standards for HCP approvals, leading to a range of possible standards for HCPs---those that contribute to recovery, to no net loss, and to no net loss that does not preclude recovery in the future. A HCP Handbook (FWS/NMFS 1996, 2000) describing the HCP planning and implementation process is available as a reference to private landowners. However, the handbook is not enforceable by law-- it is a guidepost to be interpreted flexibly on a case-by-case basis (Thomas 2000). Thus, HCPs are a negotiated solution for resolving conflicts between habitat and species conservation on the one hand, economic development and private property rights on the other. Each HCP is unique, representing a management decision based upon the historical, cultural and political contexts in which it is to be implemented.

### 2.3.1 Progress of Habitat Conservation Plans

Between 1982 and 1992 only twelve HCPs were approved, and in 1994 only thirty-nine HCPs were approved (Hood 1998, Sheldon 1998). The small number of approved plans was attributed to: (1) a lengthy planning and permitting process due to insufficient biological data and/or multi-stakeholder participation, (2) landowner uncertainty and fear of additional regulation, and (3) environmental opposition (Sheldon 1998).

In particular, landowners were concerned about having to provide additional mitigation measures that resulted in extraneous expenditures and land once agreements were finalized. This fostered a source of mistrust among landowners and state and local governments and uncertainty about what circumstances might compel a change in a HCP or who had to bear the subsequent financial burden (Sheldon 1998). The ESA recognizes that circumstances and information may change over time. Thus, the introduction of HCPs came with the expectation that under “changed circumstances” the HCP may need to be revised.

### 2.3.2 The “No Surprises” Policy

The “No Surprises” policy gave impetus to the proliferation of HCPs with over 200 HCPs approved between 1992 and 1997 and at least 200 in the development stage (Wilhere 2002). In 1994 the Secretary of the Interior announced a “No Surprises” policy That provides regulatory certainty to landowners that the Services will not increase the landowner’s conservation measures without consent. Specifically, landowners will not be required to commit additional land, water, or financial compensation or be held accountable to additional restrictions on the use of their land due to “unforeseen circumstances.”

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Permit holders would only be held responsible for mitigation measures as agreed in the HCP. This government commitment will be honored as long as the permit holder implements the terms and conditions of the HCP in good faith (FWS and NMFS, 1996 and 2000).

“Unforeseen circumstances” are changes in circumstances surrounding the HCP that were not or could not be reasonably anticipated by the HCP participants and the Services. These circumstances result in a substantial and adverse change in the status of a covered species (FWS and NMFS 1996, 2000). Additional mitigation cannot be demanded by the FWS unless the applicant volunteers additional protections.

The Services are held accountable when mitigation is found to be inappropriate subsequent to the issuance of an incidental take permit (Smallwood, 2000). In addition, new “Incidental Take Permit” applicants entering into the HCP process must also bear responsibility for unanticipated changes discovered by existing permit holders (FWS/NMFS 1996, 2000).

Additional mitigation may be expected from the permit holder under “changed circumstances”. “Changed circumstances” are foreseeable changes to include stochastic events that normally occur in the area, i.e.-- fires, flood, drought, and the addition of new species to the ESA’s list. Contingencies are identified in the HCP for natural catastrophes.

Congressional history reveals that the language of the “No Surprises” policy was always a part of the 1982 amendment (H.R. Report No. 97-835, 97<sup>th</sup> Congress, Second Session). To counter attacks against the ESA, the Clinton Administration promoted “No Surprises” as a strategy to entice landowners to prepare and implement HCPs by allowing them to pursue their land development and extraction projects.

The “No Surprises” policy has been criticized for preventing the use of scientific information and management practices in response to unforeseen circumstances (Sheldon, 1998, Smallwood, 2000). The irony of the “No Surprises” Rule is that it fails to reflect ecological reality: influx, uncertain, and dynamic systems. It is unlikely that biological conditions will remain static throughout the life of an HCP that can range from 20-100 years. Subsequently, the spatial and temporal variability inherent in ecosystems should be reflected in the design and implementation of an adaptable HCP.

Whereas earlier approved HCPs addressed single species, covering small geographic areas, more recently approved HCPs address multiple species that take on a regional scale. Subsequently, HCPs have become the vehicle to apply ecosystem management, as opposed to the species specific approach specified in implementing the 1973 ESA. As private landowners continue to seek permits to develop on their land, the number of HCPs has risen to 466 covering ~39 million planning acres of land and safeguarding ~6 million acres of protected land, and 570 listed species (Deblyn Mead, personal communication September 2004).

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### 2.4 Theoretical Underpinnings of the ESA

#### 2.4.1 Ecological Science

Conventional resource management has led to poor management of ecosystems (Berkes and Folke 1998). The notion of ecological systems as closed, regulated and stable has been a long western tradition underpinning past resource management decisions (Scoones 1999, Christensen *et al.*, 1999). The stability of ecological systems has been characterized by concepts of persistence, and constancy. Berkes and Folke (1998) assert “methods of resource development and management have treated the environment as discrete boxes of ‘resources’, the yields from which could be individually maximized”. Persistence can refer to non-extinction of species or the presence of all successional stages or a stable climax in a landscape. Population models have been designed based on the concept of persistence. These models identify carrying capacities of animals and fixed maximum sustainable yields of managing animal populations and natural resources (Berkes and Folke 1998). Constancy may be related to no change, or minimal fluctuation in the numbers and or densities of species or the relative proportion of seral stages on a landscape (Christensen *et al.*, 1999).

The notion of stability assumes the ability to maintain the efficiency of ecological function (Holling 1973). Thus, nature as a commodity is reflected in many concepts and practices of natural resource management (Holling *et al.*, 1998). Subsequently, the utilitarian premise of efficiently producing goods and services from natural resources for short-term gains has occurred without consideration of the risks to species and habitat in the long-term (Christensen *et al.*, 1999). Table 1 represents the various schools of thought and philosophies about human relationships with nature.

The state of ecological science has since evolved to understand ecological systems as nonlinear, naturally dynamic and dominated by high levels of temporal and spatial variability. Ecological systems do not exhibit a constant, predictable, and undisturbed state that can be maintained indefinitely (Scoones 1999, Christensen *et al.*,). Rather, ecosystems exhibit an array of responses on a number of spatial and temporal scales and processes that generate those dynamic must be maintained. For example, multi-species models for fisheries address changes in their competitor, predator, and prey populations and fluctuations in their physical environment (Berkes and Folke 1998). Ecosystems that are human dominated and managed demonstrate diversity and complexity on many spatial and temporal scales.

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**Table 2-1 Natural Resource Movements/Knowledge Domains and the Emergence of Ecosystem Management**

	1850-1890	1890 –1960	1915 –1960	1960s-1970s	1980s - Present	Late 1980s - Present
Movement/ Knowledge Domain	Romantic- Transcend- ental Conservation Ethic	Conservation versus Preservation	Building Momentum	Confrontation and Mainstreaming	Conservation Biology	Ecosystem Management
Philosophy	Nature has intrinsic value independent of human use; celebrate God’s creation.	Utilitarianism Multiple Use Natural resource extraction.  Pure preservation in civil society.	Land Ethic. Land can be used but its essential structure should not be altered.  Human-nature interdependency.	Policy formalized through legislation: endangered species, cumulative effects, pollution abatement and aesthetics.	Sustainable development. Control direct and indirect human effects; minimize stress factors.	Maintain ecological processes, amenities and biodiversity.
Ecosystem assumption	Stability- diversity.	Closed, self regulating & deterministic.	Complex, interconnected system.	Patterns of interactions between organisms and their environment.	Maintain natural disturbances in ecosystems.	Non-linear, dynamic resilience. Natural and human induced fluctuation.
Influences	Emerson, Thoreau, Muir	Mill, Pinchot vs. Muir	Leopold Sierra Club, NWF	Carson, Cousteau, Ehrlich	MacArthur & Wilson Odum, Noss	Tansley, Holling, Walters, Lee
Planning	Pre-Planning Stage	Rational Comprehensive	Rational Comprehensive	Rational/ Incremental	Incremental/ Contingency	Collaborative/ Adaptive

Adapted from Class notes, UAP 5414 Natural Resources Planning, 2002. Virginia Polytechnic and State University.

### 2.4.2 Ecosystem Management

Ecological science is the basis of ecosystem management. An ecosystem is defined as “a spatially explicit unit of the earth that includes all of the organisms, along with all components of the abiotic environment within its boundaries”(Meffee *et al.*, 1997). Ecosystem boundaries are defined operationally with the recognition that ecosystem functioning includes inputs, outputs, and cycling of materials and energy, as well as the interactions of organisms. Boundaries allow for ease in monitoring, studying, manipulating or managing these processes. The arbitrary nature of jurisdictional boundaries relative to key ecological processes requires a broad view of ecosystem management (Christensen *et al.*, 1995).

There are an array of definitions and viewpoints on ecosystem management, some of which are debated. According to Meffee *et al.*, (1997), ecosystem management is an approach to maintaining or restoring the composition, structure and function of natural and modified ecosystems for long-tem sustainability.

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Grumbine (1994) identifies five main goals for ecosystem management: (1) maintain viable populations of all native species, (2) represent, within protected areas, all native ecosystem types across their natural range of variation, (3) maintain evolutionary and ecological processes (i.e., disturbance regimes, hydrological processes, nutrient cycles, etc.), (4) manage over period of time long enough to maintain the evolutionary potential of species and ecosystems, and (5) accommodate human use and occupancy within these constraints.

Christensen *et al.*, (1995) identifies the eight following elements of ecosystem management: (1) sustainability, (2) goals, (3) sound ecological models and understanding, (4) complexity and connectedness, (5) recognition of the dynamic character of ecosystems, (6) context and scale, (7) humans as ecosystem components, and (8) adaptability and accountability. Particular to HCPs, the “humans as ecosystem components” element recognizes the relationship of humans in the environment and how human action influenced by changing social preferences and economic interests can alter ecosystems. In addition, the notion of ecological systems as spatially and temporarily heterogeneous and nonlinear appears to be a running theme throughout the tenets of Christensen *et al.*, (1995). These characteristics make it difficult to foresee the impacts of human activities (Holling 1978, Walters 1986, Noss *et al.*, 1997). Although ecological systems are inherently dynamic, human induced change must be managed within nature’s functional, historical and evolutionary limits (Pickett 1993).

The complexity and uncertainty of social-ecological systems makes precision, control and management of ecosystems a challenge, if not impossible (Scoones, 1999). According to Christensen *et al.*, 1995 uncertainty may fall into three categories: (1) surprises that arise from ecosystems response to unprecedented perturbations, (2) lack of ecological understanding and principles upon which dependable ecological models can be constructed, and (3) poor data quality, sampling bias, and analytical errors.

Uncertainty has also been characterized for wildlife management as environmental variation, partial observability, partial controllability and structural uncertainty (Williams *et al.*, 1996; Williams 2001; Williams and Nichols 2001). Environmental variation is ubiquitous, uncontrollable and sometimes unrecognized. Examples of such uncertainties include climate, human impacts and landscape heterogeneity (Williams *et al.*, 1996; Williams 2001; Williams and Nichols 2001). Partial observability refers to uncertainty about resource status, as reflected in sampling variation in wildlife monitoring. Partial controllability is the difference between conservation that is targeted in decisions and conservation actions that are actually implemented. This leads to possible misrepresentation of conservation efforts and thus to an inadequate accounting of the influence of conservation on population dynamics (Williams *et al.*, 1996; Williams 2001; Williams and Nichols 2001). Structural uncertainty concerns a lack of understanding (or lack of agreement) about the structure of biological relationships that drive population dynamics.

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Adaptive management is a problem-solving tool designed to increase understanding and thereby reduce uncertainty. The inherent complexity of ecosystems, incomplete science, unpredictable interactions between people and ecosystems, coupled with human error, provides an opportunity for adaptive management implementation.

### 2.5 Understanding the History and Applications of Adaptive Management

#### 2.5.1 Adaptive Management History

##### *Environmental Assessment Management Model (AEAM) and Systems Analysis*

Led by C.S. Holling, adaptive management was conceptualized in the mid 1970s by an interdisciplinary team of biologists and system analysts working at the International Institute of Applied Systems Analysis, a think tank (Lee 1993). Among the first to apply adaptive management to natural resources, these scientists designed an Adaptive Environmental Assessment Management Model (AEAM) to incrementally influence construction development designs with the use of environmental impact studies (MacDonald, *et al.*, 1998, Halbert 1993). Information from environmental assessment studies was used to enhance biological understanding of species and ecological systems affected by environmental change. Simulation models and databases were also used to predict future biological conditions. Specifically, key components and processes were modeled with the intention of understanding impacts on the system as a whole. This approach included workshops involving decision makers and managers along with scientists from various disciplines (Taylor *et al.*, 1997).

##### *Quantitative techniques for designing adaptive policies*

Building on the AEAM approach of constructing simulation models of the “managed system”, Walters (1986) described a quantitative method for analyzing and designing adaptive policies. This method involved the development of techniques for quantifying the value of reducing uncertainty about model parameters. These quantitative methods led to a distinction between “active” and “passive” adaptive management (Walters and Hilborn 1978; Walters and Holling 1990). These approaches are explored in Section 2.5.3.

#### 2.5.2 Adaptive Management Defined

The positivist traditions underlying science are based on the idea that an objective, knowable reality exists and that reality can be discerned through systematic methods of scientific inquiry. This tradition has influenced natural resource management. However, unlike conventional management practices, which attempt to make more precise predictions and presume certainty, adaptive management accepts as given the reality of provisional knowledge (Irvine and Kaplan 2001).

Adaptive management is an inductive approach that involves a rigorous process of learning from the outcomes of management actions, accommodating change and improving management. It “relies on comparative studies that combine ecological theories with observation and with active human intervention in nature based on an understanding of human response processes” (Gunderson *et al.*, 1995).

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Monitoring is a key element in the adaptive management cycle. It can provide reliable feedback about whole system response in addition to testing alternative hypotheses about ecosystem function (Taylor *et al.*, 1997). Learning is achieved through an accumulation of knowledge from monitoring and research.

This new knowledge is useful in decision-making about the appropriate management policy or human intervention. Subsequently, new policies are shaped through this iterative process (Walters and Hilborn 1978). Learning how to better manage the ecosystem by continuous hypothesis testing through experimentation, monitoring, evaluating and feeding new knowledge into decision-making can reduce uncertainty (Bisbal 2000, Halbert 1993, MacDonald *et al.*, 1998, Lee 1993, Walters and Holling 1990).

Theorists and practitioners alike use some of the same words such as experimentation, learning, decision-making, policy design and implementation when describing their perception of adaptive management. Grumbine (1996) views adaptive management as the “learning process of experimentation”. He further sees adaptive management as a means to accomplish ecosystem management.

Yaffee’s (1994) concept of adaptive management focuses on the need for resource managers to make decisions despite incomplete information and uncertainty. He offers the following guiding principles of adaptive management: (1) make choices that are seen as experiments, (2) monitor the implementation of the choices, and gather information to evaluate the long-term appropriateness of the choices, (3) reevaluate the choices at appropriate, guaranteed intervals, and (4) maintain the ability and commitment to change direction should implementation be ineffective or new information obviate old choices. Finally, a NSF 2003 report cites adaptive management as having to depend on improved decision-making, flexibility and resilience in the face of changing conditions and taking advantage of new knowledge and technologies.

Others emphasize the need for adaptive management to be built into the design and implementation of policies (Walters and Holling 1990; Holling 1978; Walters 1986). Resource management policies are thus treated as ‘experiments’ from which managers can learn (Holling 1978; Walters 1986). This leads to a greater understanding about the effect of management activities on the system being managed. According to Taylor *et al.*, (1997) increased understanding about how systems respond can lead to more effective and efficient management. Viewing adaptive management as social and institutional learning, Lee (1993), further supports the idea of policies as experiments. Subsequently, individuals, organizations and institutions all learn from experimental policies. Furthermore, adaptive management allows managers to accommodate changes in social values and goals (Taylor *et al.*, 1997).

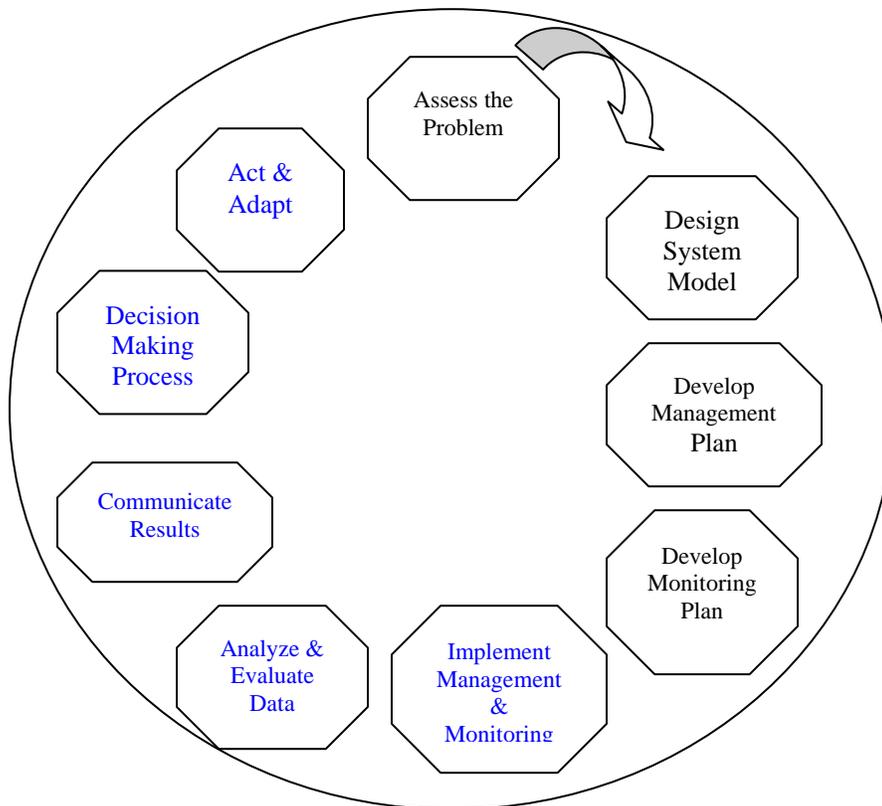
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Adaptive management is also analogous to Friedmann's (1997) social learning theory where existing understanding (theory) is enriched with lessons drawn from experience, creating new understanding. New understanding is then applied in the continuing process of action and change. In dealing with problems that are complex, uncertain, unique, and value laden Schon, (1983) recommends that planning practitioners use "reflection in action" which involves setting up experiments that test ones understanding of the situation.

Modern perspectives on adaptive management are rooted in parallel concepts in business (total quality management and learning organizations), experimental science (hypothesis testing) systems theory (feedback control), industrial ecology, engineering, multi-criterion decision- making and medicine (Borman *et al.*, 1999, Peterman 2002) and have been effective in the following ways:

- ❖ Increasing understanding and producing goods and services
- ❖ Studying large areas or whole systems
- ❖ Measuring a small set of key management indicators.

The key characteristics of an adaptive management process involves iteratively: (1) testing the assumptions by employing different actions to achieve a desired outcome, (2) changing the assumptions and interventions to respond to new information obtained though monitoring and (3) documenting the process and the results achieved to facilitate learning from past mistakes (Margoluis and Salafsky 1998 and MacDonald *et al.*, 1998). See the nine steps for adaptive management in Figure 2.



**Figure 2-2** Adapted from Margoluis and Salafsky, 1998 and MacDonald *et al.*, 1998

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Based upon a synthesis of the literature (Peterman 2002; McDonald *et al.*, 1998, Gunderson *et al.*, 1995; Lee 1993, Walters and Holling 1990), successful implementation of adaptive management requires:

- ❖ Scientifically based adaptive management as an important element of policy development, implementation and evaluation.
- ❖ Mandates to take action in face of uncertainty.
- ❖ Decision makers aware that they are experimenting.
- ❖ Resources sufficient to measure ecosystem scale behavior, conduct long-term monitoring, and research.
- ❖ Iterative hypotheses testing, and theory model and field methods to estimate and infer ecosystem scale behavior and response.
- ❖ A monitoring protocol with goals, objectives and performance criteria to measure outcomes.
- ❖ Decision makers who care about improving outcomes over biological time scales and who encourage learning from experiments.
- ❖ A working environment designed to encourage development and application of quality science in support of policy.

### 2.5.3 Approaches to Adaptive Management

#### *Active adaptive management*

Active adaptive management involves the deliberate perturbing of the system to discriminate between alternative models (hypotheses) (Taylor *et al.*, 1997). Referred to as deliberate experimentation (Walters 1986), management interventions are designed as experiments to test alternative hypotheses about ecosystem function and reveal the best management option.

The features of good experimental design for active adaptive management are: (1) clear testable hypotheses, (2) contrasting treatments (or treatments and controls), (3) replicates, (4) randomized allocation of treatments among experimental units, (5) appropriate response variables, and (6) a process to ensure well designed experiment and monitoring program (Peterman 2002). Active adaptive management yields more reliable information and leads to more rapid learning (Borman *et al.*, 1999, Walters 1990, Walters and Hilborn 1978) than passive, non-experimental approaches.

However, formal experimentation is not always possible given political and social constraints, cost, and duration (Peterman 2002, Doremus 2001). Subsequently, the degree of rigor is adjusted to the circumstance.

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### ***Passive adaptive management***

Under a passive adaptive management approach, a policy is implemented based on a single “best” model that is assumed to be correct. Resource managers presume that this model will produce a desired outcome followed by the monitoring and evaluation of the actual outcome. Monitoring is represented by surveys, whether descriptive, observational or analytical, of existing ecological populations (Taylor *et al.*, 1997). Surveys are often used in place of controlled experiments considered to be impractical or too expensive. Information from various sources, including retrospective studies of past events, descriptive studies and local knowledge can be used to increase the chance of selecting the best policy to aid in interpreting the results.

When using passive adaptive management, only weak inferences can be made about the relationships between management intervention and system response. Passive adaptive management thus becomes a tool for generating hypotheses that can be tested by careful and more efficient experimentation (Taylor *et al.*, 1997).

### ***Trial and Error***

Trial and error that involves a reactive, ad hoc and haphazard decision-making is another approach used by resource managers. Thus, adaptive management forms a continuum from active, passive, (Walters and Hilborn 1978, Taylor *et al.*, 1997) hybrid and trial and error approaches. Table 2 provides a more detailed description of the various definitions and emphasis of, and approaches to adaptive management as noted by practitioners and theorists in the literature.

### **2.5.4 Adaptive Management and Conservation Biology**

Conservation biology, “the science of case studies” (Shrader-Frechette and McCoy, 1993), applies solutions for preserving, restoring, maintaining and managing natural resources. Drawing on the natural sciences to include ecology, biogeography, population genetics and the social sciences to include political science, economics and sociology (Meffee and Carroll 1997), the aim of conservation biology is to protect biological diversity and natural ecosystems. Biological diversity encompasses genetic, species and ecosystem levels. Management is promoted through the creation, design and protection of conservation areas (Yaffee 1994). While founded on the notion of stable relationships between species diversity and area (Scoones 1999), conservation biology has evolved to understand natural systems as dynamic, nonlinear, variable and heterogeneous across multiple spatial-temporal scales (Grumbine 1996, Pickett 1994, Meffee and Carroll 1997).

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**Table 2-2 Distinctions of Adaptive Management**

<b>Approach</b>	<b>Characteristics</b>	<b>Authors</b>
<i>Active</i>	Learning by doing; Simultaneous, rapid learning; Management activities conducted as deliberate experiments	Walters and Holling 1990; Stankey <i>et al.</i> , 2003; Lee 1993; Wilhere 2002; Borman <i>et al.</i> , 1999
	Embraces risk and uncertainty as opportunity for building understanding	Walters and Holling 1990; Stankey <i>et al.</i> , 2003; Lee 1993
	Large-scale application	Walters and Holling 1990; Irwin and Wigley 1993; Haney and Power 1996; Lee 1993
	Integrated, multidisciplinary approach	Holling 1978; Walters 1986; Gunderson 1995; Lee 1993
	Systematic acquisition and application of reliable information to improve management over time.	Walters and Holling 1990; Wilhere 2002; Murphy and Noon 1991
	Test multiple strategies or policies simultaneously and identify trigger points Alternative policies viewed as treatments and implemented through statistically valid experimental design.	Borman, <i>et al.</i> , 1999; Holling 1973; Walters 1986; Wilhere 2002; Irwin and Wigley 1993
	Response to treatments point toward optimal decisions over time	Roe and Eeten 2001; Wilhere 2002; Williams <i>et al.</i> , 1996; Walters and Hilborn 1978
	Data used to structure a range of alternative response models.	Walters and Holling 1990; Borman, <i>et al.</i> , 1999; Stankey <i>et al.</i> , 2003; McLain and Lee 1996; Roe and Eeten 2001
	Systematic comparisons in space and time through controls and treatments or contrasting levels of treatments	Walters and Holling 1990; Walters 1986; Peterman 2002

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**Table 2-2 Distinctions of Adaptive Management  
(continued)**

<b>Approach</b>	<b>Characteristic</b>	<b>Authors</b>
<i>Active</i>	Vehicles for feedback: Long term monitoring to test biological assumptions underlying management plans and evaluation	Borman, <i>et al.</i> , 1999; Walters and Holling 1990; Murphy and Noon 1991; Bisbal, 2001
	Establish cause and effect relationships between management activities and changes in ecological conditions	Wilhere 2002; Lessard 1998
	Decisions based upon result of model performance and continuous testing of alternative models	Holling 1978
	Statistical tools (replication, random allocation of treatments) to test hypothesis or evaluate response	Borman, <i>et al.</i> , 1999; Murphy and Noon 1991; Lee 1993
	Rapid learning Utilization of knowledge: theory, models and field methods to estimate and infer ecosystem scale behavior, modify policy practice.	Borman, <i>et al.</i> , 1999; Walters 1990; Walters and Hilborn 1978, Bisbal 2001; Wilhere 2002; Murphy and Noon 1991
	Feedback control, essential aspect of AM—sequence of activities that allow for the execution of mgmt decisions in spite of scientific uncertainty	Walters and Holling 1990, Lee 1993; Bisbal, 2001
	Complex and expensive	Wilhere 2002; Lee 1993
	<i>Passive</i>	Sequential learning Best guess at mgmt decisions Learn from experience
Formulate predictive models, making policy decisions based on those models and revising models as monitoring data become available		Walters and Hilborn 1978; Wilhere 2002
Model used to predict ecosystem response to management activities		Walters and Hilborn 1978; Wilhere 2002
Fails to use controls, replication and randomization to determine if observed responses are caused by management actions		Wilhere 2002
Assumes best information available is correct and marginal adjustments overtime.		Halbert 1993

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**Table 2-2 Distinctions of Adaptive Management  
(continued)**

Approach	Characteristic	Authors
<i>Passive</i>	Comparisons made with historical data. Anticipated outcomes recorded	Borman, <i>et al.</i> , 1999; Walters and Holling 1990; Roe and Eeten 2001
	Historical data used to construct single best estimate or model for response; decision choice based on assumption model is correct.	Borman, <i>et al.</i> , 1999; Walters and Holling 1990
	Interpretations limited to analyses of trends through monitoring and ecological adjustments with little understanding of causal factors	Borman, <i>et al.</i> , 1999 Roe and Eeten 2001
	Decisions are based upon the assumption of the model being correct; ignores uncertainty	Walters and Holling 1990
	simple and economical to implement	
<i>Trial and Error</i>	Evolutionary Small incremental changes overtime	Walters and Holling 1990; Walters and Hilborn 1978; Wilhere 2002
	Choices are haphazard, later choices made from a subset giving better results	Walters and Holling 1990; Roe and Eeten 2001; Wilhere 2002
	Implement single policy assumed satisfactory until prove otherwise	Borman <i>et al.</i> , 1999; Walters and Holling 1990; Wilhere 2002
	Focuses on trial: resource utilization and revenue but neglects error detection	Wilhere 2002; Roe and Eeten 2002
	Relies on casual observations, anecdotal reports and unreplicated case studies without statistical validity	Wilhere 2002
	Reactive learning that is slow	Borman, <i>et al.</i> , 1999; Lee 1993 ; Wilhere 2002

Conservation biology principles can be used to develop and test a number of hypotheses taking on a passive approach to adaptive management. Principles for reserve design (Murphy and Noon 1991) frequently used as a HCP mitigation measure include:

- a. Species well distributed across their historical geographic ranges tend to be relatively less prone to extinction,
- b. Population persistence increases with population size and habitat patch size,
- c. Habitat patches that are less internally fragmented tend to support species for longer periods than patches that are fragmented,
- d. Habitat patches that are sufficiently close together to allow dispersal tend to promote population persistence, and

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- e. Habitat patches that are connected by habitat corridors or that are set in a landscape similar to the habitat patches will allow target species to disperse freely among patches. Connected patches tend to support a species for longer periods than habitat not so situated.

However, since all wildlife species and habitats may not be best managed exclusively by habitat preservation, direct manipulation of habitat features or intervention in response to demographic trends may be required to meet conservation or other management goals (Murphy and Noon 1991). Manipulation involving controls and replication sites for the purpose of learning from management decisions and practices is characteristic of active adaptive management. See Table 3 for conservation biology criteria for monitoring.

**Table 2-3 Conservation Biology Criteria**

Presence of biota in terms of:	Rare and endangered
	Unique species and communities
	Intolerant species
	Overall species diversity and richness
Presence of habitat in terms of:	Diversity of types
	Connectedness/fragmentation—presence of contiguous habitat and distance to nearest system (wetland or upland), i.e., animal and plant dispersal, animal migration route or corridor.
	Presence of conservation or natural areas, such as nature reserves and wilderness areas.
Urban setting	Percent of land in residential, commercial, industrial use, road density, population density, rate of population growth, percent of impervious surface, presence of trail.
	Significance: likelihood of trampling, trash, pollutant, road runoff, index of urban intensity and likelihood of changing impact in future.

**Source:** Adapted from Roux *et al.*, 1999 and Ehrenfeld 2000.

### 2.5.5 Adaptive Management and Ecosystem Characteristics

Active adaptive management implementation has been increasingly encouraged for urban and agricultural ecosystems, with high population densities and/or extractive uses. But in reality adaptive management becomes a tool to address conflicts between population growth, resource utilization and environmental amenities (Roe and Eeten 2001). Thus, the implementation of adaptive management takes on a trial and error or passive form rather than an active approach, where learning through experimentation is necessary.

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Roe and Eeten (2001: 197) believe “problems with adaptive management have arisen not so much from its approach as from its application to inappropriate ecosystems.” They further argue that different resource management regimes are contingent upon ecosystem characteristics and that adaptive management approaches are limited based upon these characteristics.

They propose the following five factors that define the continuum of ecosystems: (1) human population size; (2) level of resource extraction from ecosystem; (3) degree to which the ecosystem is expected to reliably provide resources (single or multiple) for consumptive uses, i.e., recreation, agriculture, urban; (4) availability of causal models to explain and predict relationships for management purposes; and (5) the mix of ecosystems and organizational health. These criteria also determine thresholds between management regimes (Roe and Eeten 2001). Thus, ecosystem characteristics create thresholds for the application and implementation of adaptive management.

Roe and Eeten (2001: 202) place ecosystems into four categories of use and control: 1) those that are self sustaining with minimum domination by people, i.e., wilderness, mountain peaks, ice caps, 2) others that are colonized but not intensely dominated for consumptive use, i.e., National parks, 3) those that are zones of conflict, experiencing increasingly competitive extractive uses and human domination, i.e., large scale ecosystem restoration and the provisions of reliable ecosystem services-- resource utilization and demand for environmental amenities, and 4) ecosystems where human domination and regular extractive use for high reliability purposes are their preeminent features (pastoral ecosystems and urban ecosystems of cities and towns).

Roe and Eeten (2001: 202) believe that active adaptive management is most appropriate for “human colonized, but not dominated ecosystems.” In this instance, a series of experiments can simultaneously occur in “multiple localities while minimizing human disruption and restoring ecological functions and processes, in whole or significant part, to what existed prior to human settlement” (Roe and Eeten 2001: 202). They further state that a case-by-case management or in other words a trial and error approach to adaptive management is more appropriate for ecosystems characterized as zones of conflict.

### **2.5.6 Adaptive Management in Practice: Case Examples**

The implementation of active adaptive management remains elusive (Walters, 1997). The application of experimentation has been primarily used in agriculture (field tests, rotation policies), waterfowl management (Williams and Johnson 1995; Williams *et al.*, 1996; Williams and Nichols 2001) and fisheries (varying harvest rates, hatchery system) (Walters and Holling 1990). Applications have also been used for forestry management (Stankey and Shindler 1997).

Discussed below are adaptive management case examples. Specifically, ecosystem initiatives such as the Florida Everglades, Columbia River Basin, Northwest Forest Plan and Grand Canyon have identified adaptive management as a key component to addressing the ecological effects of agriculture and urbanization.

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### *Florida Everglades*

According to Gunderson 1999, “if there is no resilience in the ecological system, nor flexibility among stakeholders in the coupled social system, then one simply cannot manage adaptively”. Adaptive management was applied to the Florida Everglades Watershed “to develop policies that would reverse the degradation of a variety of resource issues: declines in wading bird nesting populations, changes in vegetation patterns due to nutrients and water management, changes in aquatic communities, declines in fisheries, and increases in populations of exotic organisms” (Gunderson 1999). First, an Adaptive Environmental Assessment model was developed to simulate spatial and temporal dynamics of key ecosystem components. Subsequent hydrology and ecological sub models were also developed. The credibility and generalizability of the hydrology model led to its use in screening policies to identify a composite of policies devised to meet restoration objectives and to provide alternative uses for water by testing hypotheses of resource declines.

Biologists and hydrologist concluded that enough was known about the Everglades ecosystem to begin restoration and attempt a holistic resolution of chronic issues (Walters *et al.*, 1992, Davis and Ogden 1994, Walters and Gunderson 1994). Most of the competing hypotheses regarding resource degradation (changes in vegetation, wading bird nesting, etc.) were linked to changes in either the quantity or quality of the hydrology (Walters *et al.*, 1992). Therefore, the restoration assessment focused on new arrangements of the hydrology that would recreate historical patterns of flow, depth, and water quality. Those hydrological changes would provide the flexibility to test competing ecological hypotheses. More than one set of integrated composite policies was devised to meet restoration objectives and test hypotheses of resource declines.

The assessment was successful to the extent that it increased understanding by uncovering where ecological resilience had been eroded (nutrients) and where resilience was broad, alternative sources of water for restoration assessment (Gunderson 1999). While many adaptive policies have been recommended, none has been incorporated. Workshops have been held to explicitly design alternative water management experiments that would help to provide information for dealing with resource issues. However, no direct experimentation has been adopted (Gunderson 1999).

Passivity is primarily due to institutional inflexibility and the technical challenges with designing experiments (Gunderson 1999). The Bureau of Management agencies were fearful of risks to endangered species such as the snail kite. Specifically, small changes in nutrient concentrations result in dramatic shifts in vegetation stability domains, a FWS jeopardy opinion on the proposed water management limited the range for experimentation. Thus, compliance with the ESA has been used as justification for the lack of active adaptive management (Gunderson 1999).

### *Columbia River Basin*

The Columbia River Basin has the longest systematic experience with adaptive management (Doremus 2001). An assessment of the Columbia River Basin was chartered by Congress to develop a scientifically sound, ecosystem-based strategy for managing lands administered by the U.S. Forest Service and Bureau of Land Management (Lessard 1998).

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These agencies are responsible for managing 75 million of the 145 million acre Columbia River Basin encompassing portions of Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming. The majority of human settlement is in urban settings of the basin, although the majority of the area is rural (Quigley et al 1999).

Congress chartered the protection of fish and wildlife through the Northwest Power Act in 1984. Specifically, the Northwest Power Planning Council is responsible for mitigating the effects of hydroelectric power development in the Columbia River Basin to ensure the sustainable multiple-use of resources (Lee 1989, 1990; Quigley *et al.*, 1999). Subsequently, States and tribes of the Pacific Northwest and by the Canadian and U.S. governments establish annual harvest regulations for Pacific salmon to conserve and rebuild fish stocks and assure fair apportionment of the catch.

Adaptive management became an explicit policy and guiding premise aimed at rebuilding salmon populations through rehabilitation. Rehabilitation takes into account how salmon production, both artificial and natural would interact with human actions such as passage through the dams and reservoirs, and harvest affecting the fish mortality (Lee 1993).

Some of the components of an adaptive approach to salmon enhancement include:

1. Adaptive management policy. Testing and evaluation of projects “wherever possible, taking into account the need for control or comparison cases for statistical validity.
2. Research, monitoring and evaluation. Continuing responsibility for monitoring linked to adaptive management.
3. Doubling goal. Numerical target for increased abundance, based upon study of losses due to previous exploitation.
4. Genetic risk policy. Recognition of biological properties that are fundamentally important, and affected by management actions but characterized by slow feedback.

Projections of the future were made through existing simulation models, scenarios and environmental impact statement alternatives. Where existing models were not available, new models were constructed and simulations made to project future conditions or interpretations, and inference was made from the information available and model results. Final publications describe assumptions, uncertainty, and variability in data elements and models (Quigley, 1999).

Scenarios ranged from intensive management for commodity production to passive management for a return to more natural processes. Environmental impact statement alternatives included a range in emphasis including continuation for current management, emphasis on commodity production, aggressive restoration and a system of large reserves (Quigley, 1999). However, the risk of harm to already imperiled species aroused opposition to experiments. Thus, robust experimentation with flows, barging, and hatcheries became politically impossible (Doremus 2001).

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Subsequently more passive approaches to adaptive management have been applied and since its implementation, at least twelve salmon runs in the Basin have been listed as threatened or endangered (Doremus 2001). There has been scientific disagreement as to the primary causes of salmon decline and the appropriate remedies (Doremus 2001).

### *Northwest Forest Plan*

The Pacific Northwest Forest Plan was created by the U.S. Forest Service to protect old growth federal forests and associated species such as the Northern Spotted Owl (*Strix occidentalis caurina*). The late successional forests include those across Washington, Oregon, and northern California. The three goals of the plan are to: 1) assure adequate habitat on federal lands to aid the recovery of threatened species of Northern Spotted Owls and marbled murrelets associated with late successional forests, 2) aid the viability of a wide array of associated late successional forest plants and animals through the maintenance and restoration of habitat conditions under each management option in compliance with the ESA and National Forest Management Act and 3) conserve salmon stocks.

President Clinton introduced adaptive management as a guiding principle when he chartered the Federal Ecosystem Management Assessment Team to “identify management alternatives that attain the greatest economic and social contribution from forest while meeting applicable laws and regulations, including the ESA, National Forest Management Act, Federal Land Management Policy Act and National Environmental Policy Act” (Johnson, 1999; Lessard 1998).

Moreover, an Ecosystem Management Assessment working group was charged to explore adaptive management (Lessard 1998). A major component of the adaptive management strategy is the ten adaptive management areas (AMAs) recommended by Federal Ecosystem Management Assessment Team (Johnson 1999). Specifically, management options were developed through an adaptive management framework and simultaneously tested to address ecological concerns and impacts on timber (Stankey and Bruce, 1997).

The scientific approach in designing the experiment involved bringing together existing knowledge and hypotheses to develop an informed judgment regarding the potential outcomes of alternative policy choices. Instead of formal hypothesis testing, ideas were assembled and tested against the views of research and agency scientists with experience in the field to build a working hypothesis about the functioning of late successional forests and the watersheds of the Northwest (Johnson 1999). Mitigation measures included large, interim reserves for marbled murrelets, riparian reserves to protect aquatic systems and buffers established for certain terrestrial species thought not to be adequately protected by other measures.

Although the AMAs have generated a forum for collaboration and an increased level of communication and understanding among agencies, there is limited success in developing tools and processes needed to implement the plan. Hence, progress has been slow. The Clinton administration’s interest in ensuring that AMAs contribute to regional timber harvest goals has presented challenges to innovation.

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While agreement was reached on using AMAs to explore innovative ways to meet the harvest goals, AMAs could not result in harvest goal reductions. In addition, the availability of funding was slow to accumulate information on survey and management support. Technical skills were also in short supply (Johnson 1999).

Thus the full potential for adaptive management under the Northwest Forest Plan has not been realized (Pipkin 1998). Some of the identified weaknesses of the application of adaptive management include the lack of: 1) a well defined baseline or description of starting conditions; 2) new information of sufficient quantity and quality to satisfy the planning standards in applicable planning statutes; and 3) a willingness on the part of participating agencies to invest the resources needed to reassess and modify the direction of their program activities in light of the new information (Pipkin 1998). The need for more permissive management strategies and planning regulations that provide the incentives to adjust, refine, or modify agency land use plans to reflect new or changed circumstances is also suggested (Pipkin 1998).

There has also been uncertainty about which modifications might trigger the National Environmental Policy Act documentation, biological assessments, biological opinions and other ESA administrative burdens. Differences of opinion over when and to what extent, adaptive changes would trigger these requirements led to extensive negotiations as to what is required, and dampened the enthusiasm of field personnel in adaptive management (Pipkin 1998). Finally, there is no regularly scheduled, structured, interagency review of information to determine the appropriate planning response to new information other than those processes associated with requirements of the National Forest Management Act and the Federal Land Management Policy Act (Pipkin 1998).

### ***Grand Canyon – Glen Canyon Dam***

The Bureau of Reclamation undertook adaptive management in 1995 based on recommendations in the Environmental Impact Statement on the Glen Canyon Dam operations. Subsequently, an experimental flood was designed to address the high variability of the Grand Canyon caused by the Glen Canyon Dam. Specifically, releases from the Glen Canyon Dam were used to mimic floods that occurred annually before the dam was built. An environmental assessment of the experimental flood predicted that 17% of habitat for Kanab amber snail (*Oxyloma haydeni kanabensis*), an endangered species, might be destroyed. Since this was 7% more than allowed by a 1994 FWS Biological Opinion on operations of Glen Canyon Dam, the FWS developed reasonable and prudent measures to mitigate impacts to Kanab amber snail.

To protect the snail population, the FWS initially required that the Bureau move ninety percent of the snails located below the worst-case line to higher ground before the flood. This proved difficult causing snails to become dormant and making it challenging to locate snails during the early spring when the experimental flood was to be carried out (Meretsky *et al.*, 2000, Doremus 2001).

Moving them would require extensive damage to the riparian vegetation. Thus, an amendment to the FWS reasonable and prudent measures directed 75% of snails to be relocated from 50% of the worst-case inundation zone, allowing much of the vegetation above the predicted flood height to remain undisturbed.

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Following the experiment, the flood impacts on Kanab amber snail habitat were considerable, but they did not jeopardize the population since the Vasey's Paradise population is relatively large for an endangered species (Meretsky *et al.*, 2000). Although an experimental flood was administratively approved, the endangered status of the Kanab amber snail still reduced the range of experimental options under adaptive management. Flood levels that would have removed substantially more Kanab amber snail habitat were not considered. In addition, no areas of vegetation at Vasey's Paradise were dedicated as controls because of the unacceptability of losing snails (Meretsky, *et al.*, 2000).

### *Case Example Summary*

A review of these case examples reveals that the details of the adaptive management process can vary widely depending on management goals, extent of and gaps in the availability of information, funding, etc. Active adaptive management is either not fully implemented, or is awaiting implementation. Also, despite the promise of adaptive management, there are few examples of improved resource conditions when faced with competing demands for resources.

Another common theme among these cases is the fear of failure. Since adaptive management requires practitioners to anticipate the unanticipated (Stankey and Bruce 1997), it contradicts the positivist traditions underlying science. Consequently, failure to anticipate surprise is seen as a failure in competence rather than an inevitable consequence of trying to explain and predict a complex world (Stankey and Bruce 1997). Stankey and Shindler (1997) warn that "avoiding experimentation and its inherent uncertainty by minimizing or eliminating professional risks, can lead to outcomes that might endanger other values society desires to protect".

An additional common theme was the use of the ESA as justification for not implementing active adaptive management. Pipkin (1998) argues that learning often involves experimentation and taking risks, yet it is difficult to justify risk taking when these areas contain a number of species whose survival is in jeopardy. Thus, plan implementers believed they were avoiding adverse consequences to endangered species as a result of experimentation. However, Lee (1989) purports that adaptive management focuses on populations, while the ESA targets protective measures for individual species. He furthermore argues that failures are fatal for individuals, but rarely for populations (Lee 1989). Stankey and Shindler (1997) assert that the effects of experimentation on a population often become visible only when measured over generations.

### **2.6 Existing Habitat Conservation Plan Research**

Little is known about the effectiveness of HCPs (Thomas and Schweik, 2000) for protecting listed and unlisted species and few have evaluated HCP implementation and the extent of adaptive management. Most HCP studies have been descriptive case studies of the planning process (Beatley 1994, Bean, *et al.*, 1991, Hood 1998).

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Other HCP literature includes critiques of the HCP program from a legal perspective (Moser 2000, Sheldon 1998), or analyses of policies associated with the HCP and recommend alternative approaches (Smallwood 2000, Baur 1997, Buchanan 1997, Walley 1996, Kostyack 2000). Scholars have also assessed the scientific adequacy of the HCP or advocated philosophical principles for implementing the plan (Noss *et al.*, 1997; Kareiva *et al.*, 1999).

The first generation of HCP research consisted of descriptive studies of HCPs that were in the process of completion and approval. Beatley (1994) described case histories of HCPs involving urban development. He recommended that HCP process should include: “all affected stakeholders, include complete biological and scientific information, integrate other local and regional long range planning efforts, develop long term funding, include multiple species and dovetail with other community goals”. Bean *et al.*, (1991) conducted four detailed case studies and examined other HCPs in less detail, providing a description of the planning process, the scope of the HCP, long-term compliance and the need to integrate HCPs with other ESA activities.

Noss *et al.*, (1997) represent the second generation of HCP research that promoted planning principles. Specifically, Noss *et al.*, 1997 recommended the use of conservation biology principles as criteria for assessing the biological adequacy and evaluating the success HCP conservation strategies.

Acknowledging that each species, natural community, site and conservation problem is unique, conservation biology principles are advocated as a starting point for evaluation. These principles are suggested for species conservation, reserve design and management. Adaptive management, an approach to “guide scientists and planners dealing with complex ecosystems, insufficient information, and uncertainty”, is one of the key philosophical principles noted (Noss *et al.*, 1997).

Schweik and Thomas (2002) and Pollak (2001) are among the first scholars to evaluate HCP implementation. Schweik and Thomas (2002) used remote sensing to evaluate the Coachella Valley Fringe Toed Lizard HCP design and the extent of implementation. The purpose was to understand how well the HCP is performing and to incorporate findings into an adaptive management framework. The authors recommend remote sensing as a “feasible method for linking land cover to public policies.” They found satellite-based multi-spectral data to be effective for capturing a baseline inventory of the land cover and providing current and retrospective information for adaptive management.

In addition, remote sensing can be used to monitor compliance with the HCP. Pollak (2001) assessed the results of the Natural Communities Conservation Program (NCCP) by evaluating the Orange Central-Coastal County and San Diego Multi-Species Plan planning process. With its emphasis on multiple species and regional planning, the NCCP was initiated in California as a potential model for the HCP program. Pollak (2001) identified compliance, the acquisition of reserve lands, and biological monitoring and adaptive management as the essential components to implementing the NCCP. Feasibility, science basis and the degree of participant satisfaction formed the basis for evaluating implementation.

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Pollak (2001) found the active adaptive management for reserve to be an essential component of the NCCP and that the Permit was premised upon successful implementation of the adaptive management. Protected species and habitat are carefully monitored, and management techniques are continuously tested and refined in response to new information. However, Pollak (2001) admits that adaptive management is more influential as an idea than as a way of implementing conservation for the following reasons: 1) biological monitoring is still in early stages of development and 2) reserve managers are still learning how to monitor the status of key species and habitat.

Pollak (2001) concluded that “a lot more needs to be learned about monitoring and management”. He subsequently identified the aspects of adaptive management that required greater understanding as follows:

1. Choice of indicators—What species should be monitored? Which variables provide good indicators of the well being of the ecosystem being conserved?

For example, in Orange County, the goals of monitoring have changed from monitoring the overall population status to focusing on changes in population over time and in relative abundances from one location to the next (Pollak 2001).

2. Monitoring protocols—What is the best way to measure our indicators? Managers in Orange County are in the process of developing cost-effective, scientifically valid monitoring protocols.

3. Statistical and sampling issues—To detect trends, baseline data must be available and the natural variability of the parameters being measured must be understood. This includes understanding the variability introduced by the imprecision of the measurement techniques.

4. Understanding inter-relationships—Knowing what the trends are may not be useful if the cause and effect being measured in the system and the possible causes of changes is not understood (Pollak 2000).

Finally, the American Institute of Biological Sciences (AIBS) and the National Center for Ecological Analysis and Synthesis (NCEAS), Kareiva, *et al.*, (1999) evaluated the quality of science used in the formulation of HCPs. The researchers analyzed the characteristics of 208 HCPs and conducted a more detailed analysis of 43 HCPs by assessing species status, proposed takes, impacts of take, mitigation and minimization and monitoring. The scientific analysis of HCPs included the extent of adaptive management in the plans, not in implementation.

The investigators concluded that the data upon which HCPs are based were scientifically insufficient to support the prescribed management actions in the plan. Specifically, there was a shortage of data on species status, take, impact, mitigation and the explicit description of monitoring. Investigators also found that plans for which mitigation reliability was judged insufficient were less likely to discuss adaptive management than plans with adequate data.

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### 2.7 Adaptive Management defined by the Services and Its Implementation for Habitat Conservation Plans

By approving a HCP, and granting private landowners development permits, are willing to accept the risks to species and habitat for the sake of economic interests (Thomas 2000). Although the HCP is intended to mitigate impacts of development, critiques of HCPs indicate that the efficacy of prescribed mitigation measures has not been tested (Kareiva 1999). In addition, many HCPs were prepared based upon inadequate scientific information because the data was not available (Kareiva, *et al.*, 1999 and Hood, 1994).

Buchanan (1997) argues that some HCPs were prepared strictly to lock in management prescriptions over the life of the permit. Stankey *et al.*, (2003) would argue that failing to treat the HCP as a working hypothesis could not only threatened the long-term survival of endangered species, but also the lost opportunity for producing understanding that would reduce risk and uncertainty. However, according to Roux (1999), the adequacy of upfront protections will always be uncertain and the effects of changes in nature and the political economy cannot be predicted.

The Services acknowledged incomplete scientific information or limited knowledge about species biology and the uncertain potency and associated effects of proposed long-term mitigation strategies to conserve species. Subsequently, the Services suggested adaptive management, particularly for large scale regional HCPs (FWS and NMFS 1996, 2000). Applying adaptive management at large scales is also supported by many scientists including Walters and Holling 1999, MacDonald, *et al.*, 1998, and Lee 1993. The Services further claim that the provision of adaptive management is essential in the planning for and the long-term interest of species covered in HCPs (FWS/NMFS 2000).

It is assumed that through adaptive management, mitigation strategies are refined, and the effectiveness criteria that “the likelihood of species survival and recovery in the wild will not be reduced” will be achieved (FWS/NMFS 1996). Ironically, the range of adaptive management application and mitigation adjustments to correct HCP shortcomings is limited (Doremus 2001). Under the “No Surprises” policy, corrective actions to any HCP conservation strategy are contingent upon significant “non-achievement” of the HCP’s base mitigation. In instances of unforeseen or extraordinary circumstances, the Services may only seek voluntary increases to the base mitigation strategy (FWS/NMFS 2000).

In addition, the 1996 HCP Handbook provided little guidance on adaptive management. The 2000 HCP Handbook was enhanced to provide more direction for adaptive management. Specifically, the articulation of broad biological goals, specific objectives, measurable targets for success and clear triggers under a range of possible adjustments and circumstances were suggested (FWS/NMFS 2000).

## Chapter 3

### 3.1 Introduction

This chapter is organized into six sections. Sections 3.2 and 3.3 summarize my epistemological and ontological assumptions of my research and an overview of qualitative research and case study, my method of inquiry. Section 3.4, describes my process of selecting cases. Sections 3.5 and 3.6 identify my data collection and analysis process. Section 3.7 is a discussion of my adaptive management conceptual framework. Sections 3.8 and 3.9 summarize my conceptualization of adaptive management implementation and early stage outcomes and conceptualization of ecosystem characteristics, respectively.

### 3.2 Epistemological and Ontological Assumptions

The methodological approach to this research was guided by the epistemological and ontological assumptions that reality is shaped by both the investigator and actors investigated with the context of their social setting each of whom hold normative assumptions of the world. Subsequently, the observations and measurement instruments of an investigator imperfectly captures reality. Thus, theoretical propositions are constantly evolving and improving.

### 3.3 Qualitative Research

Qualitative research captures how and why things happen and can assess, explain or illuminate underlying phenomenon in a particular setting. The strength of qualitative research is the possibility for understanding latent, underlying or non-obvious issues surrounding a bounded phenomenon within its natural setting (Miles and Huberman 1994). I chose to use data triangulation across the multiple perspectives of my subjects to better capture the reality of implementing adaptive management and achieving early stage outcomes. My inquiry was conducted in a natural setting where I was able to collect place based information to solicit the viewpoints of my subjects about and to understand the meanings subscribed to adaptive management implementation.

#### *Case Study*

Case study is widely used by many disciplines providing rigorous procedures to the study of real-life situations, issues and problems. It is one of several approaches to qualitative inquiry, and there are diverse understandings and definitions of the methodology. The lack of a precise and universal definition is compounded by the flexible and adaptive nature of a case study. It can accommodate a variety of research designs, data collection techniques, epistemological orientations, and disciplinary perspectives each with its own standards of scholarship.

The work of Patton (1990) and the Government Accounting Office (1990) who view case study as an evaluation tool has influenced my multiple case study research design. In particular, the General Accounting Office (GAO, 1990) defines a case study as an investigation involving extensive description, analysis, interpretation, and reporting. Stake (1995) has also influenced my methodology. Stake (1995) regards case studies as contributing to the cumulative development of knowledge and stimulating further investigations.

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He believes that the “business of case study is particularization (physical setting, or historical, economic, political or legal context) (pg. 20).” These influences have shaped my definition of case study for my research application. Case study is an in-depth investigation and analysis of a phenomenon as it evolves in a real life context.

### ***Implementation and Progress Evaluation***

My in-depth case study and cross case analysis was conducted within a formative evaluation framework to obtain a detailed understanding of adaptive management implementation from the perspective of landowners from my cases. In addition, progress and process outcomes are also explained. My assessment of two case studies is intended to generate or refine existing theory rather than to generalize to all HCPs.

The case study approach has been applied to implementation and progress evaluation research. An implementation and progress evaluation two of several types of formative evaluations was employed for my research. Evaluation and implementation have an interactive relationship. Evaluation is concerned with the causes of outcomes and implementation is concerned with utilizing this information to alter outcomes (Pressman and Wildavsky 1984). An evaluation is a systematic inquiry to inform decision-making, judgments and learning (Taylor-Powell, *et al.*, 1998). Evaluation also interrogates the implementation experience by providing the intelligence to make sense of what is happening (Pressman and Wildavsky 1973).

Patton (1990) regards evaluation research as a systematic and empirical based inquiry that requires careful data collection and thoughtful analysis. He further views evaluation as the examination and judgment of accomplishments and effectiveness. Evaluation may be used to: 1) generate theory, 2) inform action, 3) enhance decision-making and 4) apply knowledge to solve human and societal problems (Patton, 1990).

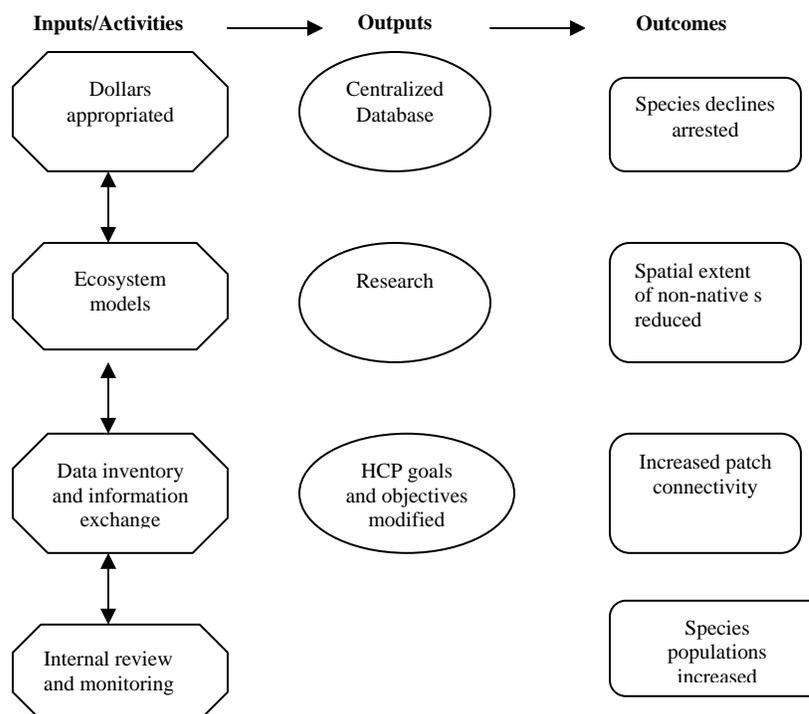
An implementation evaluation assesses whether the project is being conducted as planned and determines compliance with a project, plan or contractual agreement (Patton, 1990). This type of evaluation is necessary for ensuring that the essential elements are in place and operating according to the plan.

A progress evaluation assesses advancement in meeting the goals of a program and a project (Patton, 1990). It involves collecting data and information to learn whether or not performance measures, indicators or benchmarks were met and to identify unexpected developments. Data collection uncovers the impacts of the activities and strategies on participants, and institutions at various stages of the intervention. In addition, a progress evaluation can illuminate ultimate outcomes expected and discover unanticipated or important interim outcomes (Kellogg 1998; Westat 2002). Finally, progress evaluation contributes to, or forms the basis for, a summative evaluation that assesses the quality and impact of a fully implemented project (Patton, 1990).

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Viewing the implementation of adaptive management in terms of activities, outputs and outcomes provides a detailed picture of the adaptive management process as shown in Figure 3-1 below. Conducting an implementation and progress evaluation facilitates the determination of species status and habitat conditions before implementation and following intervention (Patton, 1990).

**Figure 3-1 Adaptive Management Implementation and Outcome Logic Model**



\*Outputs- extent to which program goals have been satisfied. \*\*Outcomes—changes in the larger societal problem that program is intended to rectify.

This framework enabled me to: 1) evaluate the strengths and weaknesses of adaptive management implementation designed to protect endangered species and their habitat and 2) assess the achievement of early stage outcomes. Furthermore, mid-course corrections are recommended.

### 3.4 Purposive Sampling

#### *Cases*

At the time of my case selection in 2003, there were 380 HCPs. My two cases are the Central Cascades HCP and the Orange Central Coastal County NCCP-HCP. These HCPs were selected based upon the following criteria: 1) written adaptive management commitments, 2) multiple species and/ or ecological communities, 3) Implementation Agreements and 4) were approved between 1994 and 1996 were the basis of case selection.

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HCPs that have been in existence for at least 5 years were necessary for a formative evaluation. HCPs approved prior to 1994 are not considered because these plans do not apply adaptive management.

The Central Cascades HCP and Orange Central Coastal County NCCP-HCP are representative cases reflecting the diversity of HCPs implementing adaptive management for forest management and urban uses (i.e., public access, infrastructure, recreation, etc.), respectively. Both case studies are geographically located in the western United States, because most HCP are approved in the west coast where the highest concentration of endangered species and biodiversity are found. In addition, for practical purposes, I needed two cases within reasonable travel distance.

Maximum variation was also employed to determine the extent to which local circumstances affect variation in implementation and short-term outcomes (Patton, 1990). Maximum variation will also facilitate an understanding of the significance of early stage outcomes across cases and how outcomes are qualified by local conditions (Patton, 1990). Since HCPs are place specific there are variations in HCP goals/objectives, and the implementation setting, i.e., politics, and social context, all having an influence on adaptive management implementation and outcomes. Although each case is unique, in some instances similar conclusions may be reached that provide corroborating evidence for reasons that can be explained through theory (Yin, 1994).

Maximum variation is reflected in my HCP selection based on Roe and Eeten's (2001) ecosystem continuum criteria: 1) human population size, 2) level of resource extraction from the ecosystem, 3) ecosystem reliability in providing resources for consumptive uses (single or multiple land uses, i.e., recreation, agriculture, urban), and 4) tension between ecosystem health and high resource reliability. HCPs are also differentiated by HCP applicant type. In particular, my cases are categorized based upon the ecosystem characteristics in which they are implemented as defined below:

- 1) Human dominated (Roe and Eeten 2001) ecosystems represent the built environment - cities and suburbs. The Census 2000 classifies as "urban" all territory, population, and housing units located within an UA or UC. UA and UC boundaries encompass densely settled territory that consists of:
  - ❖ Core census block groups or blocks that have a population density of at least 1,000 people per square mile.
  - ❖ Surrounding census blocks that have an overall density of at least 500 people per square mile. [http://www.census.gov/geo/www/ua/ua\\_2k.html](http://www.census.gov/geo/www/ua/ua_2k.html).

Urban areas and clusters provide a range of goods and services—forests, farmland, wetlands, streams, etc. However, these terrestrial and aquatic systems undergo a high level of extraction. For example, land is extracted for transportation, commercial, industrial, and residential purposes. Amenities include parks, golf courses and cemeteries. See a brief description of my two case studies in Table 3-1 as distinguished by ecosystem characteristics as defined above.

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- 2) Human colonized (Roe and Eeten 2001) ecosystems are defined using the U.S. Census Bureau’s classification of “rural” that consists of all territory, population, and housing units located outside of urban areas (UAs) and urban clusters (UC).
- 3) The rural component contains both place and non-place territory.

[http://www.census.gov/geo/www/ua/ua\\_2k.html](http://www.census.gov/geo/www/ua/ua_2k.html).

These ecosystems are human colonized, but not intensely dominated. They often provide multiple resources that experience low extraction, human consumptive uses. Resources may include: second growth forests, lakes with introduced species, and rivers with regulated water levels.

**Table 3-1 Case Studies**

<b>Ecosystem Characteristic</b>	<b>HCP</b>	<b>Land Use in HCP Planning Area</b>	<b>Species</b>	<b>HCP Project Area</b>	<b>HCP Planning Area</b>	<b>Population</b>
<b>Human Dominated</b>	Orange Central/Coastal County NCCP/HCP, Orange County, CA	Residential, commercial, recreation, water, utilities	7 listed (California gnatcatcher, American peregrine falcon, Riverside fairy shrimp, arroyo toad, least Bell’s vireo, southwestern willow flycatcher, and Pacific pocket mouse); 37 unlisted	38,000 acre Reserve	208,000 acres	3 million residents
<b>Human Colonized</b>	Central Cascades HCP  Kittitas and King Counties in WA	Forest management	4 listed (northern spotted owl, marbled murrelet, grizzly bear, gray wolf) 21 unlisted	125,000 - 148,300 acres	418,000 acres	Kittitas County 31,000 residents  King County 1.7 million residents

### 3.5 Data Collection

Document reviews, interviews and observations were conducted to triangulate data across multiple sources and diverse perspectives to better capture multiple realities. The collection and analysis of secondary data sources consisting of HCPs, Implementation Agreements, Annual Reports, Management Plans, correspondence, minutes of meetings, five year reviews, maps, technical reports and publications took place between February 2003 and July 2005.

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### *Interview Participants*

The review of key documents was supplemented with informant interviews. Initial interviews evolved into additional subjects interviews (snowballing) until the list of potential subjects interviewees was exhausted. A semi-structured interview guide was used to conduct mostly face-to-face interviews and some phone interviews lasting 1.5 – 2 hours each with 20 subjects per case.

Follow up phone calls were placed to clarify issues and events discussed during the face-to-face interview and to request additional documents up until July 2005. Interviews were conducted between January and September 2004. The personal identity and professional affiliation of subjects were not revealed in interview transcripts for the sake of confidentiality. Interviews were recorded and transcribed by a transcriber and myself. My Interview Guide that represents a mix of descriptive, normative and cause and effect evaluation questions is found in Appendix C.

### *Observations*

Interviews were followed by observations of implementation at a Board meeting and site visits. Specifically, a one-hour discussion about implementation was observed at the Nature Reserve of Orange County (NROC) Board meeting for the Orange Central Coastal County NCCP-HCP. A site visit of the NROC Reserve was conducted for approximately 8 hours over two days. In the case of the Central Cascades HCP, I spent one-day observing implementation during a site visit.

### **3.6 Data Analysis**

The iterative process of data analysis involved interpretation and intuition to: 1) make meaningful connections between the research questions, primary and secondary data and findings to create a chain of evidence, and 2) use multiple data collection methods through triangulation to check validity (GAO, 1990). A chain of evidence was established through subject interviews, documents, and observations that were carefully examined to find constructs, themes and patterns. Patterns were identified to assess the consistency or inconsistency of findings and to consider alternative explanations for results. A logic model and conceptual models were integrated into the data analysis process. These models are found in Chapter 3. Table 3-2 summarizes my data collection and analysis methods.

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**Table 3-2 Methods of Data Collection**

<b>Data collection for the case-studies</b>	<b>Analysis</b>
<ol style="list-style-type: none"><li>1. Audio-taped in-depth interviews</li><li>2. Direct observation field notes patterns</li><li>3. Interview transcriptions</li><li>4. Maps, census records</li><li>5. Databases, monitoring plans</li><li>6. Annual reports, audits, newspaper clippings</li><li>7. Agendas, minutes, memos, letters</li><li>8. Budgets</li></ol>	<ol style="list-style-type: none"><li>1. Thematic content analysis latent</li><li>2. Coding, identifying and matching (explanation building) within the data</li><li>3. Organizing information into matrices, graphs and charts to draw conclusions and explain findings</li><li>4. Developing typologies/themes</li><li>5. Establishing chain of evidence through multiple data triangulation</li></ol>
<p style="text-align: center;"><b><u>Instruments</u></b></p> <ol style="list-style-type: none"><li>1. Semi-Structured Interview Protocol</li><li>2. Adaptive Management Implementation &amp; Outcome Logic Model</li><li>3. Conceptual Model of Ecosystem Characteristics</li></ol>	
<p><b><u>Single case analysis</u></b></p> <ol style="list-style-type: none"><li>1. Conduct case studies</li><li>2. Discuss findings in relation to research questions</li><li>3. Write individual case report</li></ol>	<p><b><u>Cross-case analysis</u></b></p> <ol style="list-style-type: none"><li>1. Identify recurring themes</li><li>2. Cross-case discussion</li></ol>

Adapted from Yin (1994) and Appleton (2002).

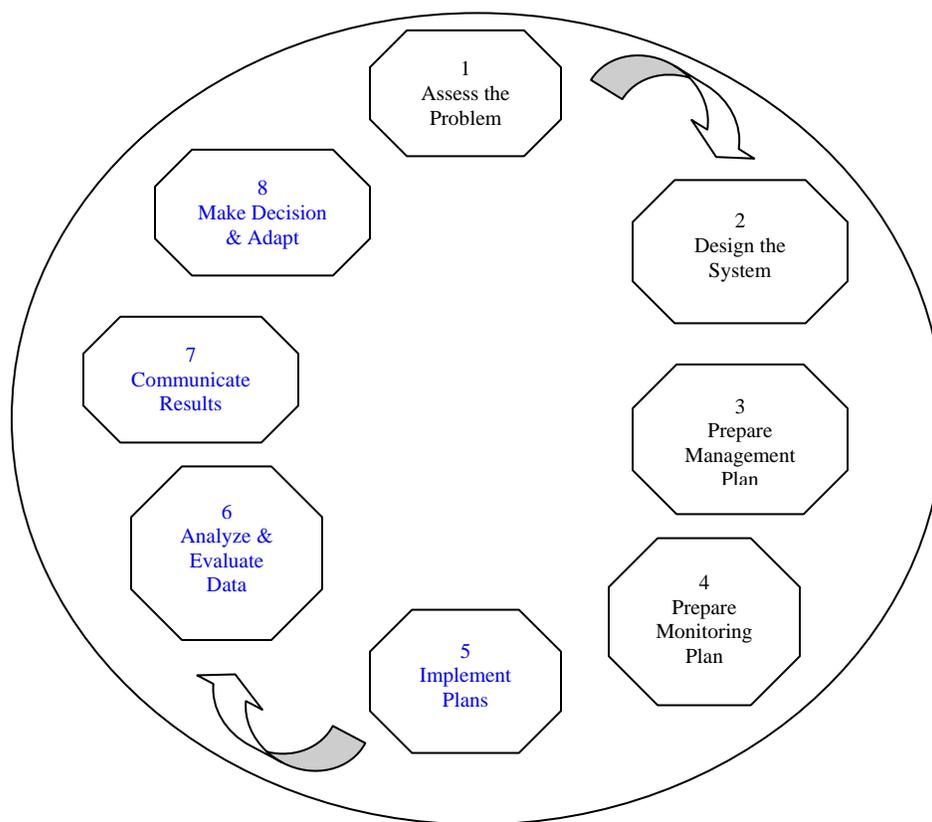
Each case was examined as a single entity in which data were analyzed and triangulated. Systematic patterns with explanations and external oversight and public perception of implementation are also captured for each case. Case conclusions are used as information contributing to the whole study, but each case remains a single case (Yin, 1994).

### **3.7 Adaptive Management Conceptual Framework**

#### **3.7.1 Adaptive Management Process Cycle**

An adaptive management process cycle is derived from the literature. The adaptive management process cycle has five steps that are described below. I use steps 5 through 8 of the adaptive management process cycle to answer research question #1, “What is the extent of adaptive management implementation in the HCP?” and question #2: “How does the approach to the application of adaptive management influence early stage outcomes?” The adaptive management process cycle shown in Figure 3-2 is followed by a description of each step in the cycle.

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**Figure 3-2** Adapted from Margoluis and Salafsky, 1998; MacDonald *et al.*, 1998; Taylor, Brenda *et al.*, 1997.

The first step in the adaptive management cycle is to assess the problem. This involves clearly defining the management problem in terms of ecosystem function. The second step, designing the system, involves the creation of system models that identify key variables of interest and associated indicators. Ranges of models are tested to simulate changes in land use (i.e., forestry, residential/commercial development, recreation use) and land cover and economic forces. Statistical models can be designed based on indicators as well as visualization models that explicitly display spatial changes in key indicators. These models should be continuously refined.

Preparing a management plan is the third step. A management plan is a visionary document that lays out management targets—goals, objectives and activities. The plan identifies assumptions and thresholds that create feedback loops from monitoring results to changes in management. The potential effects of alternative policies on key response indicators are also explored. The use of scenarios is appropriate for exploring alternatives. In addition, the plan identifies key uncertainties about ecosystem function that must be resolved in order to identify the best policy. Finally, the management plan may recommend research as a support to adaptive management to address uncertainties.

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The fourth step is creating the monitoring plan or protocol is a set of procedures that guide the collection of data and information. The monitoring plan identifies the roles and responsibilities, timelines and performance standards. Key response indicators are also identified and prioritized for monitoring (e.g., to predict changes in land use and land cover, water quality). Ideally, monitoring should be designed in a way that provides reliable feedback and tests alternative hypotheses about ecosystem function; the utilization of an experimental design that will facilitate cause and effect or association thinking is preferable.

The fifth step is implementation when key response indicators are monitored over appropriate time frames and spatial scales as identified in the plans. Research may also be conducted to analyze changes in habitat and species conditions. Project outputs, outcomes, and impacts are documented. A centralized database is developed for collecting, analyzing and monitoring data.

The sixth step of the adaptive management process is analysis and evaluation. Analysis involves an assessment of data to resolve alternate hypotheses and uncertainties. Methods of assessment include: qualitative and quantitative data analysis, including cost-benefit analysis. Evaluation involves comparing management outcomes with management objectives, and comparing the system's condition with the predicted outcome. In addition to assessing performance, evaluation may also include tracking process and finances.

Step seven, communication, involves the sharing of monitoring results, milestone achievements and system performance to all stakeholders. Tradeoffs between different alternatives should be collaboratively developed.

The eighth and final step in the process is to incorporate results into future management decisions. The decision to adapt based upon results may involve: 1) adjusting management objectives and strategies, 2) defining further system comparisons, 3) adapting the conceptual model and management and monitoring plans and 4) changing management policies.

### **3.8 Evaluation of Outcomes Defined**

Outcome measures are used to answer my research questions. Early stage outcomes are defined as physical and biological characteristics and processes. These outcomes were compared with short-term objectives that should be identified in each HCP and management plan. Short-term objectives were expected to include both qualitative and quantitative measures for assess the achievement of habitat and species improvements. A more specific explanation of outcomes is discussed below.

#### **3.8.1 Outcomes**

Indicators of physical and biological outcomes were used. Physical outcomes are related to habitat quality such as landscape connectivity and fragmentation, habitat structural diversity, spatial extent, landscape and community diversity and landscape mosaic.

### Chapter 3

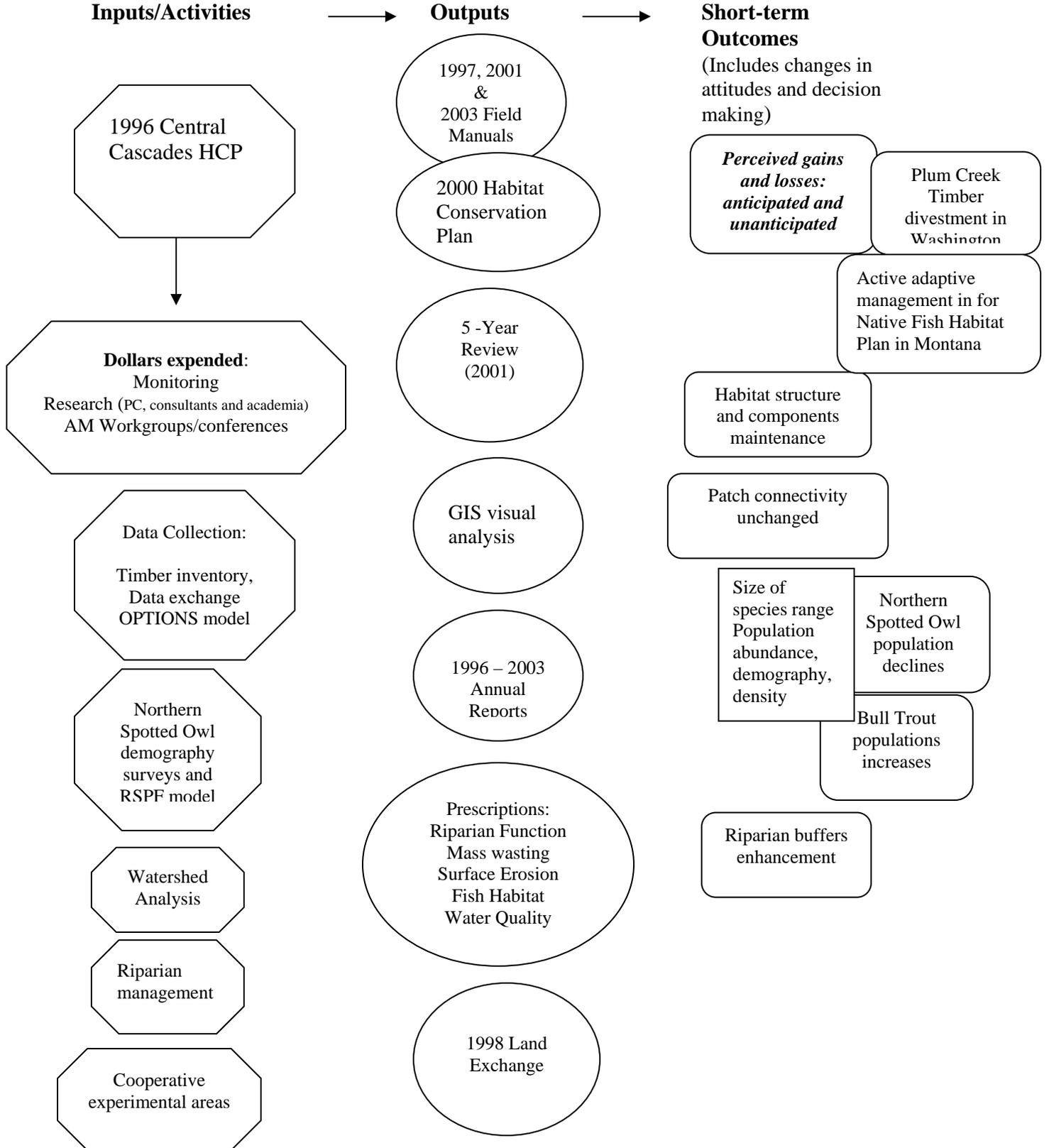
Biologic outcomes include the status of threatened and endangered species, community composition and invasive or introduced species. The criteria for measuring the physical and biological elements within the habitat conservation planning areas included the: 1) aerial extent of different subclasses of the system (e.g., the percentage of cover distinguished by different subclasses of the system), 2) change in species numbers, 3) changes in habitat distribution patterns overtime (e.g., rates of change in aerial extents), or 4) the amount of habitat destroyed (hectares) or converted per year. Process outcomes are defined as enhanced understandings, altered decisions and policy changes based upon learning and new knowledge.

The HCP approval criteria discussed in Chapter 2 are identified as the goals of the HCP Program (USFWS officials in Olympia, WA, personal communication February 2004). I associate the physical and biological outcomes to the criteria “taking will not appreciably reduce the likelihood of species survival and recovery.” Process outcomes are tied to adherence to the Implementation Agreement and the monitoring and reporting requirements. Adequate funding for adaptive management activities is also considered.

Figures 3-3 and 3-4 represent the adaptive management implementation and outcome logic model that were also used to address research questions #1: “What is the extent of adaptive management implementation for the HCP and #2 How do adaptive management approaches influence early stage outcomes?”

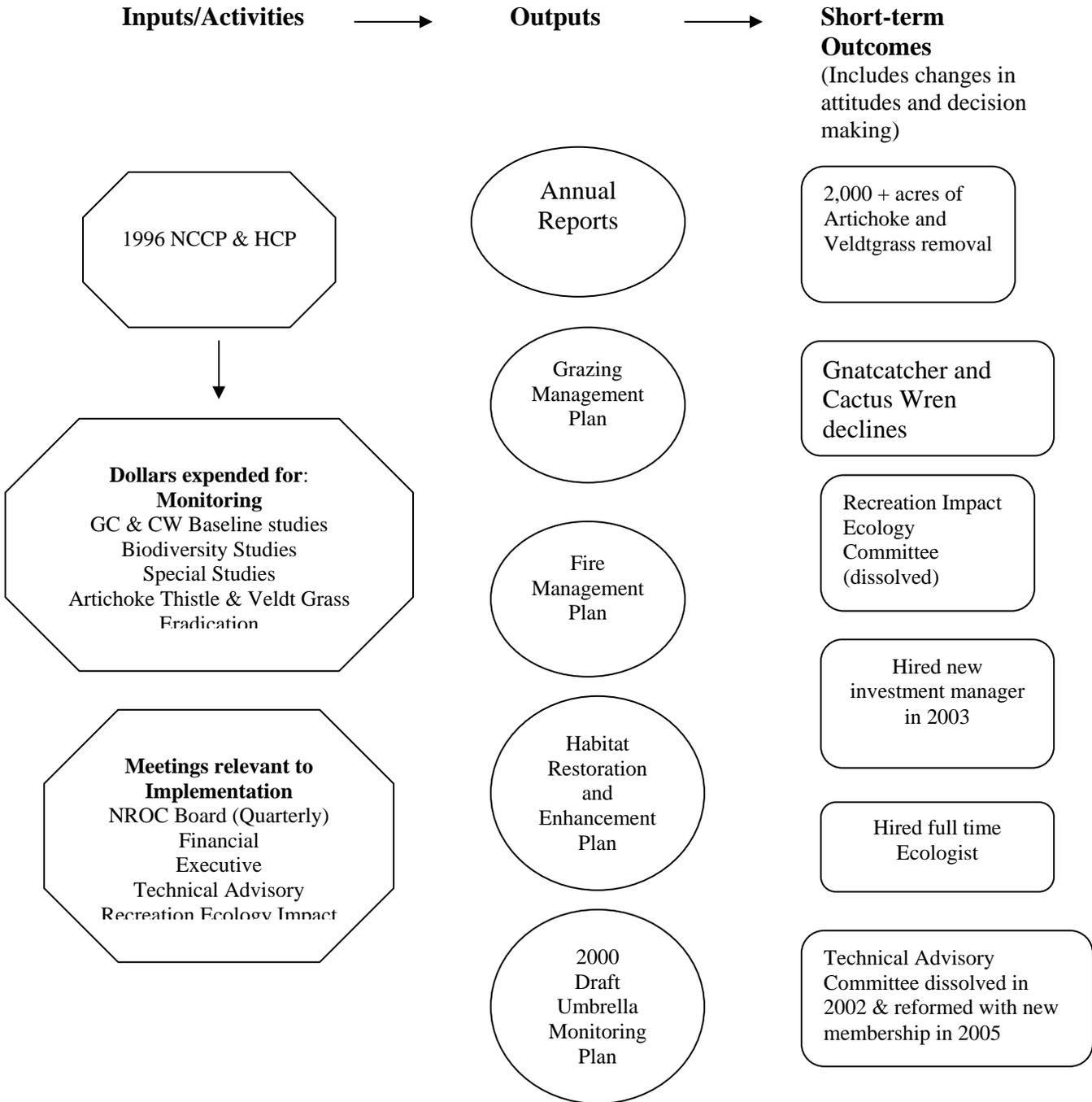
### Chapter 3

**Figure 3-3 Central Cascades Adaptive Management Implementation and Outcome Logic Model**



### Chapter 3

**Figure 3.4 Orange Central Coastal County Adaptive Management Implementation and Outcome Logic Model**



## Chapter 3

### 3.9 Adaptive Management and Ecosystem Characteristics

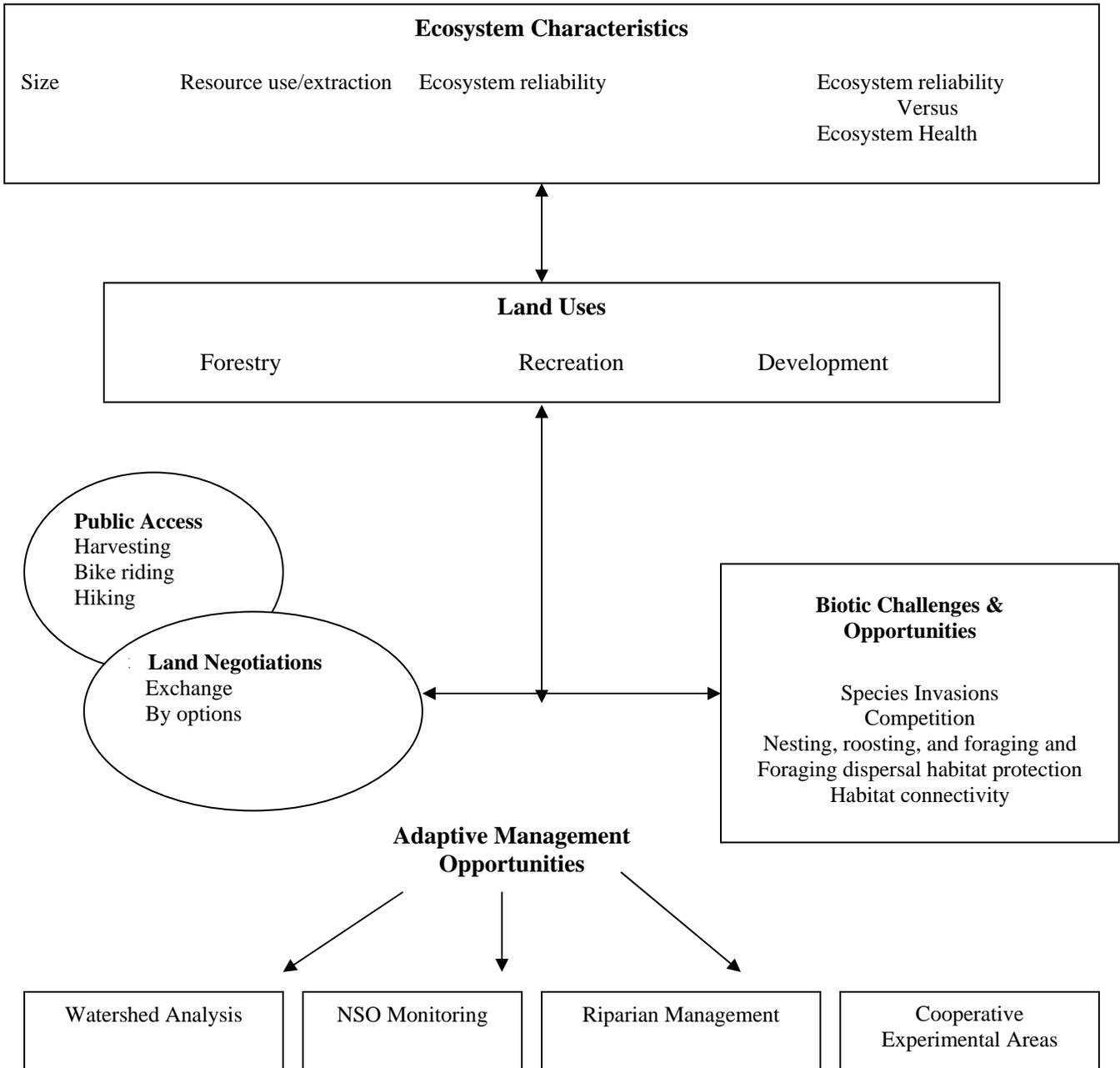
In section 2.4.5 of my literature review, I identify the four categories of ecosystem use and control as defined by Roe and Eeten 2001. Most applicable to my cases are categories 3 and 4, zones of conflict and human dominated ecosystems respectively. Both cases are experiencing increasingly competitive extractive uses and human domination which classifies them as “zones of conflict”. However, for the Central Cascades HCP, the east side of the Cascade crest is “colonized by humans but not intensely dominated for consumptive use”. The HCP ownership is intermingled with US Forest Service land. The Forest Service is not harvesting their land. Populations west of the Cascade crest are significantly higher. The landowner is actively clear cutting forest.

For the Orange Central Coastal HCP, the entire reserve is surrounded by development, population growth and “regular extractive use for high reliability purposes”. Thus, ecosystem characteristics are defined as the socio-economic forces (human induced perturbations, population growth, etc.) or factors within the planning area that influences the physical and biological outcomes of the HCP.

Figures 3-5 and 3-6, shows my conceptualization of ecosystems characteristics for each case study. The Figures provide insight for research question #3: how does the approach to adaptive management vary with ecosystem characteristics?

### Chapter 3

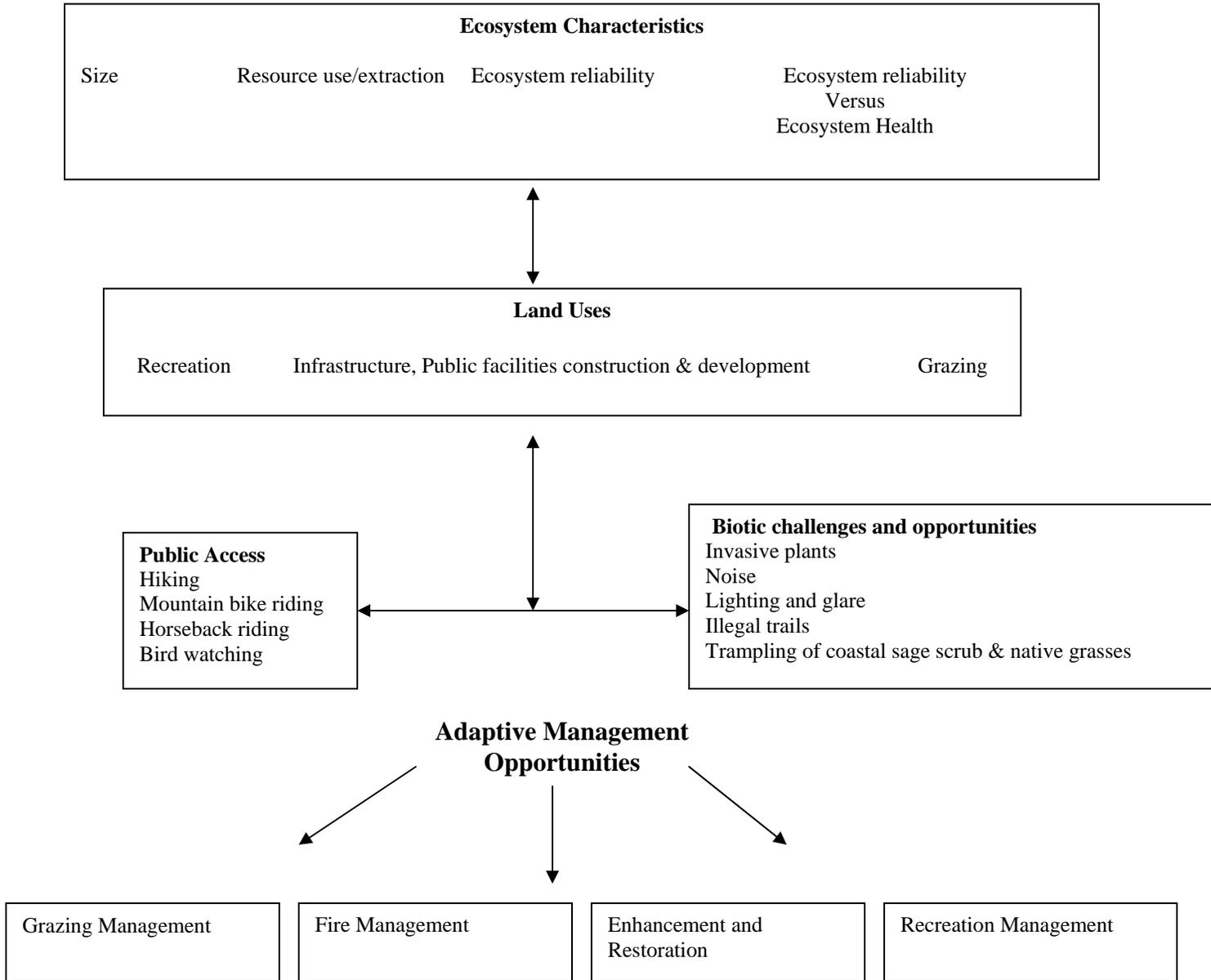
**Figure 3.5 Central Cascades HCP**



Direct and indirect influences of ecosystem characteristics on adaptive management approaches.

### Chapter 3

**Figure 3-6 Orange Central Coastal County NCCP-HCP**



Direct and indirect influences of ecosystem characteristics on adaptive management approaches.

## Chapter 4

### 4.1 Introduction

On June 27, 1996, the U.S. Fish and Wildlife Services (FWS) and National Marine Fisheries Service (NMFS), the “Services”, approved Plum Creek’s Central Cascades Habitat Conservation Plan (HCP) and issued the company an Incidental Take Permit (ITP). The parties also signed an Implementation Agreement. The ITP and Implementation Agreement authorizes Plum Creek to “take” four listed species within its 130,000 – 148,300 acre HCP Project area while conducting timberland production and forest management activities. The four listed species are the threatened: (1) northern spotted owl, (*Strix occidentalis caurina*), (2) grizzly bear (*Ursus arctos*), (3) marbled murrelet (*Brachyramphus marmoratus*) and the endangered gray wolf (*Canis lupus*). Subsequent threatened species listings and issued permits are summarized in Table 4-1. In addition, 311 unlisted vertebrate species of fish and wildlife whose habitat span both east and west of the Cascade Mountain Crest in Central Washington are also covered under the HCP (Central Cascades HCP 2000 and 1996 Incidental Take Permit).

The Central Cascades HCP Implementation Agreement and Incidental Take Permit exist concurrently for 100 years. The first fifty years are identified as Phase I (Central Cascades HCP 1996 Implementation Agreement). An additional fifty years, referred to as a Phase II or the Safe Harbor Agreement authorizes Plum Creek Timber “to improve wildlife and fish habitat to yield benefits beyond those anticipated at the time of the June 1996 agreement” (Implementation Agreement, pg. 3, 1996).

Encompassing King and Kittitas Counties, the HCP project area is bisected by route I-90 and intermingles Federal lands resulting in a checkerboard ownership<sup>1</sup> pattern and a 418,900-acre Planning Area. The primary landowner within the Planning Area is the U.S. Forest Service with 218,700 – 237,000 acres. Other ownerships include the state of Washington, City of Tacoma, Weyerhaeuser Company, and other smaller private landowners all comprising a total of approximately 45,300 acres (Central Cascades HCP 2000).

This chapter is divided into the following two sections:

1. Central Cascades HCP Context (Section 4.1)
2. Central Cascades HCP Design and Ground Rules (Section 4.2)

<sup>1</sup>Checkerboard ownership patterns resulted from various federal land disposal methods (1863 Homestead Act, 1878 Timber and Stone Act, railroad grants and statehood land grants) to transfer land from the public domain to state and private ownership while also retaining large areas of land. The resulting land ownership pattern is a checkerboard of alternating federal, state and private lands with federal lands typically managed by the U.S. Department of Agriculture (Forest Service) or the Department of Interior Bureau of Land Management (Dadswell and Stewart 1999).

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**Table 4-1. Chronology for Northern Spotted Owl Management & HCP Approval**

Date	Activity
October 1984	Final Draft Regional Guide and Draft EIS for the Pacific Northwest for Protection of the Northern Spotted Owl in National Forests
1990	Interagency Scientific Committee
7/23/90	Northern Spotted Owl Federal Listing
1992	Final Draft Northern Spotted Owl Recovery Plan
1993-1994	Northwest Forest Plan
1994-1995	HCP Planning Process
6/27/96	HCP approval & FWS issued ITP 808398
6/10/98	Listing of Bull Trout ( <i>Salvelinus confluentu</i> --Endangered (Columbia River & Puget Sound populations)
7/14/98	Amended ITP 808398 for Bull Trout
3/16/99	Listing of Middle Columbia Steelhead (Trout) <i>Oncorhynchus mykiss</i> –Threatened  Listing of Puget Sound Chinook (salmon) <i>Oncorhynchus tshawytscha</i> Threatened
4/24/00	Listing of Canada Lynx <i>Lynx canadensis</i>
3/29/01	Issued ITP 1220 for Middle Columbia River Steelhead, Puget Sound Chinook, & Canada Lynx

### 4.1.1 History of Management for Northern Spotted Owl

Debates between private industry, conservation groups and governmental agencies over the need to protect the Northern Spotted Owl began in the Pacific Northwest in the mid-1970s' (Central Cascades HCP 2000). Much of the deliberation centered on the amount and location of old growth forests remaining in the region, having implications for both the timber industry and habitat for the owl (Yaffee 1994).

Initial attempts to manage the Northern Spotted Owl in the Pacific Northwest involved the protection of habitat for individual owl pairs on Federal lands. Later proposals focused on the protection of owl habitat areas within National Forests. In 1990, an Interagency Scientific Committee recommended various geographic units termed Habitat Conservation Areas as potentially capable of supporting owl pairs. The Committee also considered dispersal habitat and connectivity as intervening habitat for management between Habitat Conservation Areas.

Listed as threatened on July 23, 1990 (Central Cascades HCP), the Northern Spotted Owl was the most controversial listing for the Pacific Northwest. The FWS cited the loss and fragmentation of old growth and mature forest habitat in Washington, Oregon, and northern California as the primary threat to the Northern Spotted Owl (Yaffee 1994).

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Following the listing of the owl, a FWS Final Draft Recovery Plan (Lujan *et al.*, 1992) reorganized the Habitat Conservation Areas into Designated Conservation Areas. The Designated Conservation Area network remedied deficiencies identified in the old Habitat Conservation Area network. Through remapping of conservation areas, the Designated Conservation Area network provided biological and economic efficiencies to effectively protect habitat for other species. The Final draft Recovery Plan also recommended a broad landscape approach to Northern Spotted Owl protection, covering 7.6 million acres of Federal forestland as primary habitat for the Northern Spotted Owl (Lujan *et al.*, 1992).

The formation of the Forest Ecosystem Management Assessment Team in 1993 was the next phase in the evolution of management options for Northern Spotted Owl. The team created the Northwest Forest Plan that proposed an integrated reserve system based largely on the protection of habitat within multiple purpose watersheds. The Plan also incorporated concepts such as Late-Successional Reserves and Riparian Reserves to assure the viability of threatened and at-risk species. Adaptive Management Areas were designated to test technical and social objectives associated with the overall Federal Ecosystem Management Assessment Team strategy of ecosystem management. Subsequently, the 1994 Northwest Forest Plan superseded the 1992 Final draft Recovery Plan.

Plum Creek Timber Inc. designed the HCP to complement federal Northern Spotted Owl conservation efforts. In preparing the HCP, the company incorporated land designation terms identified in both the Final draft Recovery Plan and the Northwest Forest Plan for the Northern Spotted Owl.

### **4.1.2 Central Cascades HCP Preparation and Approval**

Beginning in 1988 Plum Creek Timber began conducting research and gathering data to protect northern spotted habitats throughout their ownership in the Western and Eastern Cascade Mountains. Activities included: (1) monitoring the movements and habitat use of resident owl pairs, (2) identifying and evaluating owl habitat in various forest types and (3) assessing annual productivity of owl pairs (Central Cascades HCP 2000).

### **4.1.3 Plum Creek Timber Inc.**

Headquartered in Seattle, the primary mission of Plum Creek Timber, Inc is to grow, sell and harvest timber. The company also manufactures finished products primarily for retail, industrial, and other specialty markets. Plum Creek Timber is constantly evolving to diversify its portfolio of services. The company began as a logging department of Burlington Northern Railroad that restructured into a Plum Creek Timber Limited Partnership in 1989. Incorporated in 1999, Plum Creek Timber acquired land holdings in Louisiana, Arkansas, and Maine, establishing itself as a Real Estate Investment Trust. Subsequently, the selling, leasing and management of land for residential, commercial and recreational uses culminated into the formation of a real estate business segment (Erb 2001; [www.plumcreek.com](http://www.plumcreek.com), Plum Creek 2003 Annual Report).

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Hence, service diversification and mergers have established Plum Creek as the second largest private timberland owner in the nation with an estimated holding of 8.1 million timberland acres in 22 states. The company employs 2,040 people in about 20 states (Plum Creek 2003 Annual Report; Plum Creek staff interview, April 2004; [www.plumcreek.com](http://www.plumcreek.com)).

Plum Creek owns and manages approximately 285,000 acres of primarily second growth forestland in the Central Cascade Mountain range where the company harvests and supplies logs to processing facilities and other mills. Plum Creek also operates ten wood products manufacturing facilities. The Company hires contractors to haul timber from Leavenworth, Yakima, Ellensburg, Cle Elum, and North Bend to numerous mills and other timber dependent businesses within the HCP Planning Area (FWS 1999). Company foresters operate from two offices within the HCP Planning Area. These offices are located in Enumclaw and Roslyn and employ 15 and 11 staff, respectively, at the inception of the HCP (FWS 1999). However, staff levels at both locations have been significantly reduced due to company downsizing. Plum Creek Timber also employs two scientists and an operations manager with expertise in wildlife biology, hydrology and forestry sciences.

### 4.1.4 Planning Area Characteristics and Environmental Setting

Plum Creek lands within the checkerboard configuration are recovering from extensive harvest. Subsequently, the landscape is dominated by young even-aged stands with a scattering of older stands to form a mosaic (State official interview, February 2004).

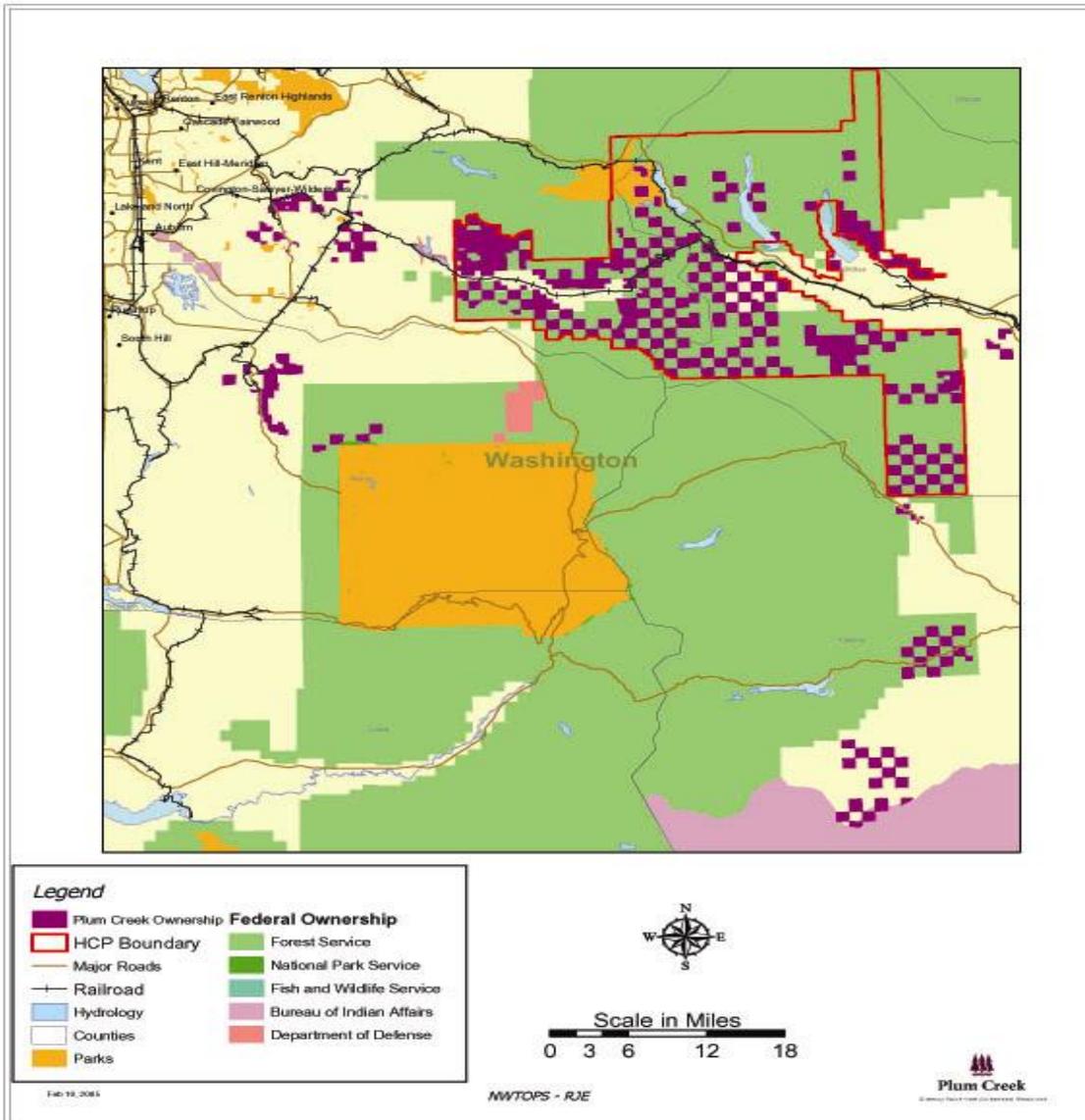
The Eastern Washington and Western Washington Provinces lie in Kittitas and King County, respectively. The Eastern Washington Cascades Province lies east of the Cascade crest from the Columbia River north to the Canadian border, primarily encompassing Federal and Native American owned lands with scattered state and private ownerships.

An extensive area of late successional forest in the region can be found primarily on U.S. Forest Service lands. These lands include the Alpine Lakes Wilderness north of the Planning Area, Norse Peak Wilderness to the south, other late-successional and old growth forests in the U.S. Forest Service Snoqualmie Pass Adaptive Management Area and intermingled private lands. Most of the HCP Planning Area is within the Mt. Baker-Snoqualmie and Wenatchee National Forests outer boundary (FWS 1999). Bisecting the HCP Planning Area, I-90 is of strategic importance because of its north/south and east/west distribution of late successional species. While having cultural significance to several Native American Tribes, the Planning Area is not contiguous to any tribal reservations, nor does it include any incorporated cities.

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The central portion of the Eastern Cascades Province is among three important sub areas for Northern Spotted Owls. This area stretches north of the Wenatchee Forest to the town of Yakima to encompass the Wenatchee National Forest, the checkerboard (Plum Creek and U.S. Forest Service) ownership, and state and private lands (including the eastern portion of the I-90 corridor) adjacent to the National Forest. See Figure 4-1 to view the HCP Planning area on the map of Washington State.

**Figure 4-1 Map of Central Cascades HCP Planning Area**



Source: Plum Creek Timber

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The Western Washington Cascades Province lies west of the Cascade Crest from the Columbia River north to the Canadian border. This province is represented by nonfederal ownership encompassing major urban, industrial, and agricultural areas. The state of Washington and large industrial timber corporations are the primary owners of this forest (Lujan *et al.*, 1992).

The Green River sub-basin begins on the western slopes of the Cascades. The primary water usage in the River is public supply and irrigation. Over the past 50 years, approximately 49 percent of the sub basin has been harvested through regeneration clear-cut harvest techniques. Plum Creek Timber and the Washington Department of Natural Resources primarily manage lands along the River for timber production. U.S. Forest Service lands are designated for timber harvest, management of late successional forest characteristics, and recreational opportunities (Central Cascades HCP 1996, 2000).

Finally, natural and management induced wildfire has been a significant source of disturbance shaping the forests in both the Eastern and Western Cascades Provinces. Recent fire suppression efforts, especially in the eastern Cascades, and selective timber-harvesting practices have resulted in altered tree species composition and forest structures. Late successional forests have become increasingly susceptible to catastrophic fires and epidemic attacks of insects and disease (Central Cascades HCP 1996, 2000).

### **4.1.5 Institutional Context and Relevant State and Federal Programs Affecting the Central Cascades Habitat Conservation Plan**

Landowner coordination is essential because of the checkerboard pattern of ownership and because species inhabiting the forests and streams in the Planning Area are not restricted to habitat on Plum Creek's land. Cooperation with the U.S. Forest Service is particularly critical given the intermingled pattern of ownership. This section describes the state and federal regulations that influence Plum Creek's forestry operations in the Planning Area.

#### ***The Washington Forest Practices Rules***

The Forest Practices Act and the implementing Forest Practices Rules and Regulations govern all state and private forestry practices in Washington. The statute was adopted in 1974 to regulate activities such as timber harvesting, road construction, and replanting and chemical application.

The Act's purposes are to: 1) meet water quality standards under the Clean Water Act, (2) protect other public resources (fish, wildlife, and public capital improvements such as county roads), and (3) maintain a viable forest products industry (Toth 1995; Central Cascades HCP 2000; Washington Department of Ecology 1999).

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The Washington Department of Natural Resources administers and enforces the Forest Practices Rules. All harvest activities on private forestlands require a Forest Practices notification and Washington Department of Natural Resources approval. Forest practices are classified based upon the degree to which operations have the potential to damage public owned natural resources. There are rules for aquatic resources, (e.g., riparian areas, wetlands, and sediments from roads) as well as provisions for wildlife reserve trees and critical habitat to address terrestrial wildlife. Specifically, forest practice standards are established to address issues such as: watershed analysis procedures, wetland protection, harvest size based upon silviculture techniques, timber salvage, culvert sizing, road design, and aerial application of herbicides (Title 222 WAC). Procedures for watershed analysis were established in 1992 to require watershed level consideration of all cumulative impacts of timber harvests across all ownerships (Toth 1995; Washington Department of Natural Resources official interview, January 2004).

### ***Final Draft Recovery Plan for the Northern Spotted Owl***

The 1992 Recovery Plan for the Northern Spotted Owl is a FWS strategy for owl recovery and its removal from the threatened species list. While relying primarily on Federal lands for recovery of the Northern Spotted Owl the Plan also recognized the role of non-federal lands in recovery. The plan contained suggestions for non-federal forestlands to support Northern Spotted Owl populations by protecting nesting, roosting and foraging habitat and foraging and dispersal habitat. Since the I-90 corridor contains designated conservation areas for the Northern Spotted Owl, the HCP provides for foraging dispersal habitat in all riparian corridors within the Planning Area for Northern Spotted Owl dispersal. Plum Creek Timber's foraging dispersal habitat is intended to complement federal habitat management goals for Northern Spotted Owls. In addition, nesting roosting and foraging habitat supplements owl sites on Federal lands (Lujan *et al.*, 1992; Central Cascades HCP 2000). The final draft Recovery Plan for the Northern Spotted Owl was not formally adopted. The subsequent development of a Northwest Forest Plan superseded the Recovery Plan. Both plans aim to: (1) maintain and protect suitable habitat for Northern Spotted Owls and other wildlife species, and (2) supplement nesting, roosting, and foraging habitat and dispersal habitat to ensure the unimpeded movement of Northern Spotted Owls throughout the I-90 corridor (Central Cascades HCP 2000).

### **Northwest Forest Plan**

The U.S Department of Agriculture, U.S. Forest Service, and U.S. Department of the Interior, Bureau of Land Management, adopted the 1994 Northwest Forest Plan that proposed an Integrated Reserve System defined by the range of the Northern Spotted Owl. The reserve encompasses 24 million acres of land on 19 national forests and seven Bureau of Land Management Districts in western Washington, Oregon, and Northern California. Lands are allocated into one of the following management categories: congressionally reserved areas, late successional reserves, administratively withdrawn areas, adaptive management areas and riparian reserves.

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These categories include Federal lands within Designated Conservation Areas established in the Final Draft Recovery Plan (Central Cascades HCP 2000). Table 4-2 defines the management categories relevant for the HCP.

**Table 4-2 Northwest Forest Plan Categories Adopted by the Central Cascades HCP**

<b>Category</b>	<b>Definition/Purpose</b>	<b>Permitted activity</b>
Late Successional Reserves (LSR)	Old growth forests and extensive areas of younger forests: Habitat for late successional and old growth related species.  Managed, protected and enhanced to create late successional conditions.	Thinning of young stands and other silvicultural operations in stands of certain ages to accelerate the development of late successional habitat characteristics.  Forest management to control risk of fire and insect infestation.
Adaptive Management Area (AMA)	Opportunity to implement & learn from management experiments on federal lands and areas of mixed ownership to achieve ecological, economic and other social objectives.  **Snoqualmie Pass Adaptive Management Area (SPAMA) is apart of the HCP Planning Area (The AMA is represented in the checkerboard ownership).	Innovative forest management.  Development and demonstration of monitoring protocols and new land management approaches. (USDA 1994a).
Riparian Reserves	Lands along streams and unstable and potentially unstable areas where special standards and guidelines direct land use. The reserves:  Maintain and restore riparian structures and functions of intermittent streams,  Confer benefits to riparian dependent and non-fish species,  Enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas,  Improve travel and dispersal corridors for terrestrial animals and plants, and  Provide greater watershed connectivity.	Silvicultural practices to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics.  Fuel woodcutting is prohibited.
<b>Sources:</b> Central Cascades HCP 1996 & 2000, USDA 1994a.		

The Northwest Forest Plan was envisioned to: 1) “maintain a healthy forest ecosystem with habitat (including riparian areas and waters) to support native species populations associated with late-successional and old growth forests), and 2) maintain a sustainable supply of timber and other forest products for local and regional economic stability on a predictable and long term basis” (USDA 1994a). Another goal was to improve coordination and collaboration with state, tribal, and local governments interested in implementing management approaches complementary to the goals of the Northwest Forest Plan ([www.reo.gov.library.agreements/mou\\_revised.htm](http://www.reo.gov/library/agreements/mou_revised.htm)).

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As Plum Creek prepared its HCP, the company patterned its management of late successional reserves, adaptive management areas and riparian reserves after the Northwest Forest Plan. Coordination is necessary given the intermingled ownership pattern and the sensitivity of habitat surrounding the I-90 Corridor for Northern Spotted Owls (Lujan *et al.*, 1992; Central Cascades HCP 2000).

### 4.2 The Central Cascades Habitat Conservation Plan: “Provisional Knowing”

Plum Creek’s intent in creating a multi-species conservation plan was to acquire a permit enabling the company to harvest timber. Habitat modification and the displacement of Northern Spotted Owls is a consequence of forest management. The primary goals of the Central Cascades HCP are to: (1) provide Plum Creek the predictability and flexibility to manage its timberlands economically while contributing to the conservation of the four listed species, (2) comply with the requirements of the HCP, Implementation Agreement and Incidental Take Permit, and (3) prevent future additional species listings by providing adequate habitat conditions in the Planning Area (Central Cascades HCP 2000).

#### 4.2.1 Overview

This section represents Plum Creek’s strategy for protecting species. Policies that inform implementation, the company’s classification of multiple species and the forest inventory, harvest methods and forestry management guiding principles are discussed. Also described are mitigation strategies and ground rules for HCP modification. This section concludes with a description of the HCP reporting requirements and HCP termination stipulations. A primer for chapter five, this section reveals the narrow parameters within which HCP modification may occur, limiting the capacity for active adaptive management during plan implementation.

#### *Species and Forest Classification*

The 315 species covered in the HCP are prioritized into the following groups based upon habitat preferences in the Planning Area: (1) 4 Permit species; (2) 21 Special Emphasis Species; (3) 11 Species of Concern, and (4) 280 Associated Species. Special Emphasis Species are protected under the Section 4(d) ESA Special Rule.

The Special Rule provides a Safe Harbor from “take” prohibition as long as forest management within route I-90 does not reduce habitat below thresholds contained within 1.8-mile circles around owl site centers. In addition, the feeding and breeding habitat preferences of 311 species were divided into 16 aquatic and terrestrial life form groups ranging from very specialized groups to habitat generalists.

A stand structure classification system is established for the following purposes, to: (1) link forest inventory and wildlife habitat databases; (2) establish a basis to predict habitat use for multiple species; and (3) provide a viable classification system for ecosystem management across the intermingled ownership. These eight forest stand structures represent forest structural attributes across the eastern and western physiographic provinces of the Planning Area.

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They are classified as: (1) stand initiation, (2) shrub/sapling, (3) young forest, (4) pole timber, (5) dispersal forest, (6) mature forest, (7) managed old growth and (8) old growth. Forest stands throughout the landscape are classified to associate the biological needs of forest wildlife to the physical and vegetative characteristics of the forest. Primary, secondary, or non-habitat life form preferences are established based upon forest inventory parameters and the wildlife components of the various stand stages. The percentage of primary and suitable habitat is projected per decade for each life form in the Planning area. The presumption is that all species dependent on these habitat types will be adequately protected for the life of the HCP (Central Cascades HCP 2000).

### ***Nesting, Roosting and Foraging Habitat and Foraging and Dispersal Habitat***

One of the most controversial aspects of the Northern Spotted Owl natural history concerns its habitat requirements. Northern Spotted Owls are known to nest, roost and feed in a wide array of habitat types and forest stand conditions throughout their distribution. Habitat types used are Douglas fir (*Pseudotsuga menziesii*), Douglas-fir/hardwood, ponderosa pine (*Pinus ponderosa*), western hemlock (*Tsuga heterophylla*), mixed evergreen, mixed conifer, and other forest types in different parts of their range. Most observations of habitat use have been made in areas having a component of old growth and mature forests. However, observations of Northern Spotted Owl use in managed timberlands are commonplace (Lujan, 1992). There are fewer studies of habitat selection and no studies of habitat preference.

Plum Creek classified nesting roosting and foraging and foraging dispersal owl habitat in the Planning Area by partially adopting State Forest Practices Rules and Regulations where “A” is optimal habitat, “B” is suitable habitat and “C” is marginal habitat. The company combined the “A” and “B” classifications so that A/B represents suitable habitat. Parameters such as tree species, quadratic mean diameter, relative density and fire management analysis zone were also considered in classifying Northern Spotted Owl nesting, roosting and foraging and foraging dispersal habitat. The following assumptions influenced establishment of habitat classifications:

- 1) A/B “suitable” is nesting, roosting and foraging habitat,
- 2) High quality Type C (marginal) habitat may serve as nesting, roosting and foraging habitat in the Eastern Cascades; whereas, mid to low quality Type C habitat generally provides at most, foraging dispersal habitat at the stand level;
- 3) Dispersal habitat provides the minimum stand conditions for foraging and cover for thermal and predator protection.
- 4) Some forest stands previously classified as “non-habitat” can be considered to be at least FD habitat, if radio telemetry and site center locations prove documented use; and
- 5) Vegetative plots of stand level conditions surrounding Northern Spotted Owl locations provide reliable data from which to describe owl habitat.

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Plum Creek Timber then mapped the HCP Planning Areas using these habitat classifications. Subsequently, the company projected the percentage of Northern Spotted Owl habitat based upon the eight forest structural stages. Northern Spotted Owl habitat classifications, nesting roosting and foraging and foraging dispersal habitat are defined below.

Nesting habitat consists of functional territory occupied by a pair of reproductively active birds during courting and breeding. Both males and females defend this territory through vocalization and visual displays. Roosting habitat consist of areas of relatively dense vegetation, with high canopy closure dominated by large diameter trees. Foraging habitat is more extensive and variable than either nesting or roosting habitat. Foraging habitat, characterized by high canopy closure and complex structure is used to locate and capture prey (Lujan *et al.*, 1992).

Finally, dispersal habitat facilitates the movement of juvenile and adult Northern Spotted Owls to leave one area to establish a new home range in another area (Lujan *et al.*, 1992). Plum Creek defines dispersal habitat as forested areas that provide at least roosting and foraging conditions for juvenile Northern Spotted Owls while they move from the natal nest site to unoccupied habitat. Breeding territories may eventually be established in unoccupied habitat (Central Cascades HCP 2000).

### 4.2.2 Harvest Methods

Plum Creek's foresters are responsible for protecting and enhancing environmental values of the forests while providing economic timber growth and harvest. Foresters craft a harvest plan for each timber sale and monitor harvest plan implementation by contractors who harvest the forest. Contractors are generally required to: (1) avoid yarding downed logs through streams; (2) refrain from causing soil erosion or degradation of side slopes; (3) mitigate impacts to natural resources; (4) comply with special conditions (i.e., trail protection or visual sensitivity); and (5) maintain a cost effective production level while meeting State and Federal safety guidelines.

In addition, "contractors must maintain riparian buffers along all fish-bearing streams and along 20 to 30 percent of smaller, non fish-bearing streams that are not under State regulation (Plum Creek staff interview, April 2004)." The Washington Department of Natural Resources requires all landowners to submit a Forest Practices Application prior to harvesting. When submitting an Application, Plum Creek foresters include their harvest plan for Washington Department of Natural Resources approval. Table 4-3 describes the harvest planning, review and approval process. It also explains the ad hoc self-audits conducted by Plum Creek foresters.

Plum Creek Timber manages its forests by applying even-aged and uneven aged harvesting techniques. Table 9 describes these two silvicultural techniques and leave tree requirements. Implemented on the east and west of the Cascades, these practices are defined and required by state Forest Practices Rules.

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**Table 4-3 Plum Creek Forester Harvest Plan and Approval Process**

<b>Timeframe for planning</b>	<b>Harvest Plan (Check list Guideline)</b>	<b>Forest Practices Application</b>	<b>Public review</b>	<b>Post audit</b>
7-12 months in advance	Stream surveys Fish presence Seeps and spring buffers Green trees and wildlife trees Harvest activity Harvest method Acreage Location Sales within a unit	Application includes harvest maps of its timber sales/stands to the Washington Department of Natural Resources.	The Washington Department of Natural Resources, the Department of Fish and Wildlife, and Timber Fish and Wildlife representative reviews the timber sale before stands are harvested.	Plum Creek foresters compare pre and post harvest information.  Sites for review are strategically selected based on the complexity of the sale, i.e., regulatory issues raised when seeking harvest permit, the number of conservation requirements, etc.
<b>Sources:</b> Plum Creek staff interviews, April 2004, FWS interview, March 2004)				

### 4.2.3 Environmental Principles

Plum Creek periodically employs eleven environmental principles to address aesthetic and environmental issues in the Planning Area. This typically involves implementing practices in excess of State Forest Practices Rules and Regulations (Central Cascades HCP 2000). The eleven principles include sustainable forest management, ecological and structural diversity, water quality and fish and wildlife resources.

#### *Sustainable Forestry Initiative*

In 1999, Plum Creek endorsed the Sustainable Forestry Initiative, a third party verification program. The program sets forth measures by which interested parties – customers, conservation interests, members of the public – can monitor and evaluate the commitment of the Company to practice sustainable forestry.

An independent Sustainable Forestry Board comprised of representatives from government agencies, the environmental community, forest product companies and others lead the program. The Sustainable Forestry Initiative is based on six principles relating to sustainable forestry, responsible practices, forest health and productivity, protection of special sites, legal compliance and continual improvement.

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**Table 4-4 Regulated Harvesting Methods in the Central Cascades**

Geographic Location	Silvicultural Technique	Silvicultural Technique	Leave Tree Requirements	Leave Tree Requirements
	<b>Even Aged</b>	<b>Uneven Aged</b>	<b>Wildlife Reserve Tree Retention (WRTs)</b>	<b>Green Recruitment Tree (GRT) Requirements</b>
<b>Definition</b>	<p>Clear cuts</p> <p>Seed tree harvests (20 or fewer trees per acre remain after harvest)</p> <p>Over story removal (more than 5,000 board feet per acre are removed and fewer than 50 trees per acre at least 10 feet in height remain after harvest)</p> <p>Shelterwood regeneration harvest in Washington is an even-aged harvest method when 20 or fewer dominant, vigorous trees per acre remain after harvest.</p>	<p>Leaves more than 20 trees per acres when using the shelterwood method</p> <p>This technique is defined by the states as an uneven aged harvest.</p>	<p>Defective, dead, damaged, or dying trees which provide or have the potential to provide habitat and corridors for wildlife species dependent upon standing trees.</p>	<p>Trees left standing in designated upland management areas to become future wildlife reserve trees. These trees also serve as visual buffers and green-up strips.</p>
<b>East of Cascades</b>			Two WRTs	Two GRTs, plus two downed logs for each acre harvested.
<b>West of Cascades</b>			Three WRTs	Two GRTs, plus two downed logs for each acre harvested
<ul style="list-style-type: none"> <li>• Plum Creek alters its shelterwood methods to achieve site-specific objectives such as the maintenance of structural diversity by leaving trees with a variety of species, diameters and vigor classes (i.e., dead and dying trees).</li> <li>• Trees counted by Plum Creek as remaining after harvest are those trees at least 10 inches in diameter at breast height (DBH) with at least the top one-third of the stem supporting green, live crowns (Central Cascades HCP 2000).</li> <li>• Plum Creek claims to have exceeded WRT and GRT standards in the eastern Cascades (Plum Creek staff interview, April 2004).</li> </ul> <p><b>Sources:</b> Central Cascades HCP 2000; Plum Creek staff interviews, April 2004)</p>				

Plum Creek Timber foresters use pre-harvest checklists to ensure implementation of Sustainable Forestry Initiative requirements at each site. The checklists help foresters evaluate opportunities based on conditions at each location and to make recommendations for a variety of factors.

For wildlife management, for example foresters may recommend maintaining “cavity trees” to provide nests or dens for birds or mammals. In 1999, Price Waterhouse Coopers found Plum Creek’s ownership in Arkansas, Idaho, Louisiana, Maine, Montana and Washington to be in compliance with the Sustainable Forestry Initiative standards (Plum Creek Timber, 2003).

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### 4.2.4 Mitigation Strategies and Adaptive Management

Plum Creek Timber asserts that the “HCP analyzes and provides for ongoing, active adaptive management that will yield site-specific prescriptions that may vary over time (pg. 10 HCP Implementation Agreement 1996)”. Four opportunities for adaptive management are identified in the HCP to address the capacity of mitigation strategies to adequately protect species and their associated habitat. Although Northern Spotted Owl management, riparian management, watershed analysis, and cooperative experimental areas are the identified adaptive management opportunities, an analysis of implementation reveals that Northern Spotted Owl management and watershed analysis are the primary activities targeted for adaptive management.

Riparian management goals are achieved through watershed analysis. Specifically, HCP riparian prescriptions serve as minimum and interim guidelines that are refined through watershed analysis. Both watershed analysis and riparian management are encompassed in an Aquatic Resource Monitoring Program intended to evaluate the effectiveness of the HCP as a “management experiment” (Central Cascades HCP 2000). However, according to a Services’ official “watershed analysis and riparian habitat management are more hard wired in the HCP, without active adaptive management (Services interview, January 2004)”.

#### 4.2.4.1 Northern Spotted Owl Management Strategy

Past timber harvest operations on both private and Federal lands in the I-90 corridor reduced mature and late successional forests. The aim of the Northern Spotted Owl management strategy is to avoid a significant reduction of nesting, roosting and foraging habitat for owl population recovery and protect foraging dispersal habitat. Results from a forest inventory model and a resource selection probability function model that predicts owl sites also drives Northern Spotted Owl management.

##### *Nesting, Roosting and Foraging Habitat and Foraging/Dispersal Habitat.*

While some harvesting of Northern Spotted Owl nesting, foraging, roosting and dispersal habitat is permitted, the HCP does not anticipate a significant net loss of habitat. Plum Creek believes a portion of the habitat will be replaced by growth of younger forest stands on Plum Creek and U.S. Forest Service lands (Central Cascades HCP 2000).

In addition, future land sales, and the movement of owl pairs is assumed to reduce the likelihood of forestry impact on habitat (Central Cascades HCP 1996, 2000; Plum Creek staff interview April 2004). To supplement the Northwest Forest Plan objective, Plum Creek targets nesting, roosting and foraging habitat and foraging/dispersal habitat for protection.

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### OPTIONS: An Inventory Database

Inventory data is used to profile current forest landscapes in the Planning Area and to establish a basis for predicting the characteristic of future stands (Central Cascades HCP 2000). Defined by tree species, tree size and stocking information, forest inventory polygons are used to better manage and model existing conditions in Plum Creek's land base. Each forest polygon is updated annually for growth, silvicultural treatments, insect infestations, disease, and other forest related factors.

The company estimates annual or decadal owl impacts over 50 years (phase I of the Plan) in the 418,900 - acre Planning Area. Specifically, GIS integrates Northern Spotted Owl habitat with proposed timber harvest schedules for specified harvest units. The OPTIONS database tracks all activities occurring on each individual forest inventory polygon. These activities are integrated into a GIS database for an evaluation of changes in habitat quantity, rate of change, distribution, type and the capacity of the habitat to support owls. Plum Creek Timber began evaluating habitat changes in 1996, and will its evaluations every 10 years until 2045 (end of Phase I) (Central Cascades HCP 2000). The company applies OPTIONS to forecast the regrowth of nesting roosting and foraging habitat from foraging dispersal habitat.

### Resource Selection Probability Function Model

A Resource Selection Prediction Function (RSPF) model was developed as a way to assess the impacts of management alternatives to Northern Spotted Owls. The RSPF: (1) provides the probability that Northern Spotted Owls will use a resource unit as a nest site over a certain time period, (2) evaluates the effects of forest growth and timber harvest on the amount and juxtaposition of owl habitat at decadal intervals during the 50-year HCP permit period and (3) estimates potential carrying capacity for Northern Spotted Owl nest sites in the HCP planning area through the permit period under different management alternatives. The most effective unit of analysis was determined to be a 0.7-mile radius circle. Habitat variables within the circle initially considered to have the most predictive influence included acres of nesting, roosting and foraging habitat, the standard deviation of elevation (surrogate for topographic relief), and the amount of circle in the fire management analysis zone (surrogate for elevation and precipitation subunits in HCP area) (Hicks, Herter and Early 2002).

The average rate of occupancy was negotiated at 78% based upon observations of Northern Spotted Owl sites in the HCP Planning Area that were active during HCP planning. The occupancy rate is multiplied against the maximum potential RSPF probability to yield a more accurate estimate of Northern Spotted Owl occupancy in the planning area and in the future (Plum Creek Timber, 2001; Central Cascades HCP 2000, Manly 2002).

At HCP inception, there were 107 known Northern Spotted Owl site centers of which sixty-seven site centers contained significant amounts of habitat within a 0.7- mile radius on Plum Creek's lands. Owl pairs or singles were found to occupy these sites.

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By applying the model, the company assumed 17 of the 67 sites would not be affected by forest management activities due to either the presence of isolated habitat at the outer edges of 0.7 - mile management circles or site centers were located on U.S. Forest Service land containing sufficient habitat (Central Cascades HCP 1996, 2000).

Table 4-5 summarizes the purpose, objectives and approach of the Northern Spotted Owl management strategy. Table 4-5 is followed by a list of mitigation measures and criteria for assessing mitigation effectiveness.

**Table 4-5 Northern Spotted Owl Management**

Approach	Points	Purpose
Harvest deferrals	<p>Represents 1.5% of HCP Project Area.</p> <p>Core nesting areas on 26 sites deferred for harvest for 20 years.</p> <p>Selective harvesting in foraging areas at 11 of the 26 sites.</p> <p>Strategically placed near U.S. Forest Service land.</p> <p>Deferrals available for yr. 21 – 50 and Phase II of permit.</p>	Minimize harvest impacts on owl habitat by allowing natural successional processes to continue in currently suitable owl habitat.
Protect Nesting, Roosting and Foraging and dispersal habitat	Maintain targeted percentages of Northern Spotted Owl habitat, and stand structures annually.	Minimize harvest impacts on owl habitat by allowing natural successional processes to continue in currently suitable owl habitat.
<p><u>OPTIONS</u></p> <p>Forest estate planning model (inventory database)</p>	Simulates growth, silvicultural activities, ecological constraints and harvesting for HCP Project Area.	To evaluate long term availability of habitat for listed and unlisted species across ownerships in the Planning Area.
Resource Selection Probability Function Model	<p>Estimates probability that the Northern Spotted Owl will use a resource unit (0.7 mi circle) with certain characteristics in a certain time period.</p> <p>1. Identifies habitat (mature, old growth, etc.) most highly correlated and predictive in Northern Spotted Owl nest site selection.</p> <p>2. Evaluates forest growth and timber harvest effects on the amount and juxtaposition of Northern Spotted Owl habitat at decadal intervals over 50 yr. Incidental Take Permit.</p> <p>3. Estimates potential carrying capacity for Northern Spotted Owl nest sites in HCP Planning Area for the permit period.</p>	<p>To verify Northern Spotted Owl deferral effectiveness at selected owl sites.</p> <p>Assumptions of the model are verified through Northern Spotted Owl monitoring.</p>

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### Northern Spotted Owl Mitigation Measures and Criteria

Mitigation measures are actions taken by Plum Creek to minimize and avoid impacts to species addressed in the HCP. To assess the effectiveness of mitigation strategies in meeting the biological needs of the Northern Spotted Owl, Plum Creek identified the following criteria.

1. Habitat Mapping—Development of a habitat classification system to identify and map nesting/roosting/foraging, foraging/dispersal habitat, and non-habitat in the 418,900- acre Planning Area; and continued mapping of habitat conditions throughout the permit period.
2. Nesting, Roosting and Foraging Habitat Maintenance—Plum Creek will maintain target percentages for nesting, roosting and foraging habitat identified for each decade in Table 5-4 of Chapter 5, at a minimum, 6-8 percent of its ownership in the Planning Area as Northern Spotted Owl nesting, roosting and foraging habitat.
3. Nesting Roosting and Foraging Deferrals – 1,100 – 1,900 acres of current nesting roosting and foraging habitat will be deferred from harvest for at least 20 years near key Northern Spotted Owl sites in the Planning Area. Habitat deferrals only represent 1.5% of the landscape and allow for minimal disturbance (Services interview, January 2004; Central Cascades HCP 2000).
4. Foraging Dispersal Corridors –1,300 – 2,300 acres of current nesting, roosting and foraging and foraging dispersal habitat will be retained as foraging dispersal corridors to facilitate dispersal and linkage to additional habitat on PC and Federal lands.
5. Riparian Habitat Areas – 3,100 –3,700 acres forestland adjacent to perennial streams will be maintained as Northern Spotted Owl habitat (nesting, roosting and foraging or foraging/dispersal) during the permit period.
6. Model and Deferral Validation Surveys –Plum Creek will conduct surveys in portions of the Planning Area to validate the RSPF model predictions of Northern Spotted Owl habitat suitability during the permit period and the effectiveness of deferral at selected owl sites. Survey methodology will be determined with the FWS.
7. Prey Surveys—Plum Creek will conduct surveys for Northern Spotted Owl prey species in the dispersal forest and managed old growth structural stages that are designed to function as owl habitat.
8. Harvest Timing—When entering Northern Spotted Owl sites to conduct harvesting operations, Plum Creek will consider prioritizing owl sites by first entering those stands with less biological value (i.e., unoccupied sites), and second, those stands furthest from an owl site center.

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9. Seasonal Protection—Known sites with active Northern Spotted Owl nests in the Planning Area will receive protection within a 0.25-mile radius from March 1 through August 31.

### 4.2.4.2 Watershed Analysis

Plum Creek believes adaptive management to be implicit in the watershed analysis process (Plum Creek staff interview, February 5, 2004). Governed by the Washington Forest Practices Rule, watershed analysis is a voluntary initiative to protect the biological requirements of anadromous salmonids and other fish (Washington Department of Ecology 1999). The watershed analysis process involves identifying important physical processes that affect streams and understanding how forest management may influence these processes.

In 1992, the Washington Department of Natural Resources began providing administrative oversight for the watershed analysis process to ensure aquatic habitat protection and restoration and the practice of compatible commercial forestry. According to a Department of Natural Resources official, “watershed analysis provides certainty to landowners that once this process is complete, they will not be further regulated (Washington Department of Natural Resources personal communication, January 27, 2004).” Plum Creek began conducting watershed analysis throughout their ownership in 1993 prior to HCP approval. Private landowners with at least a 10% ownership in a basin were encouraged to initiate a watershed analysis. At that time, Plum Creek made a commitment to the Department of Natural Resources to complete watershed analysis in 20 Watershed Administrative Units within the planning area. Subsequent changes in land ownership within the Planning Area reduced Plum Creek’s watershed analysis responsibility from 20 to 17 Watershed Administrative Units (Central Cascades HCP 2000). See Figure 4-2, map of watershed analysis.

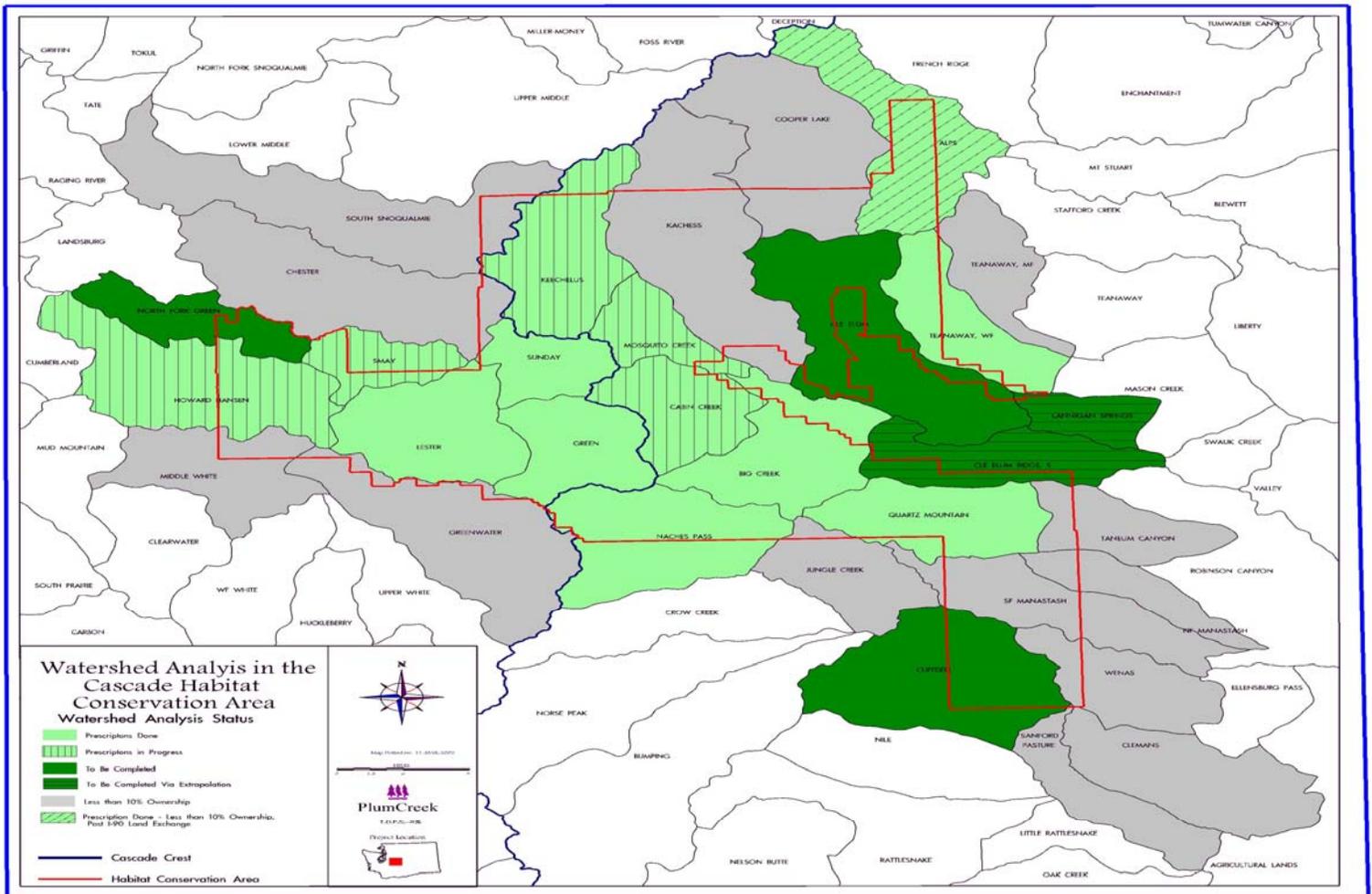
During the HCP planning process, Plum Creek negotiated the incorporation of watershed analysis into the HCP Implementation Agreement. The process of watershed analysis for Plum Creek involves the following:

- Resource assessment— A team of scientist (state, company staff, consultants) established a baseline of information on the ecological structure, function, processes, and interactions affecting the aquatic resources within the watershed. They also described how historical management practices may have caused watershed conditions.

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- Prescriptions— Representatives from the FWS, NMFS, Washington Department of Fish and Wildlife and local tribes participated on a prescription writing team. Prescriptions are designed to address any deficiencies in practices used at the time of the assessment. They included options for operating in and adjacent to sensitive areas and prescriptions to avoid, prevent, or minimize potential adverse impacts in the watershed (Central Cascades HCP 2000).

**Figure 4-2 Watershed Analysis Map**



Source: Plum Creek Timber

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- **Public Review and Comment**— A team leader must complete an environmental checklist required under the State Environmental Policy Act. The full report and checklist is forwarded to the Washington Department of Natural Resources for threshold determination. The Department then coordinated a public review.
- **Monitoring**— Prescriptions are continuously revised as monitoring activities provide feedback about changes in system conditions due to new practices. Changes in watershed conditions and the effectiveness of remedial prescriptions are assessed every five years to incorporate new learning and correct causative factors for watershed deterioration and/or damage (Plum Creek Timber, 2001; Central Cascades HCP 2000; <http://www.dnr.wa.gov/forestpractices/watershedanalysis/manual>).

The Washington Department of Natural Resources identified seven modules that assess various watershed elements important to fish habitat and water quality. Table 4-6 provides a list of watershed analysis modules.

In 2000, the new Forest and Fish Rules (WAC 222-22-070 (3) e) withdrew the need for landowners with a HCP and incidental take permit to develop riparian function prescriptions from the watershed analysis process. This exemption is based upon state determination that HCP prescriptions are more restrictive than riparian prescriptions derived from watershed analysis (Keechelus Lake-Mosquito Creek Watershed Analysis, August 2002).

**Table 4-6 Watershed Analysis Modules**

Water Analysis Module	Watershed Processes and Resources Addressed
<b>Mass Wasting</b>	Debris Torrents Landslides Earth flows
<b>Surface Erosion</b>	Hill slope surface erosion Dry ravel Sheet wash Road Erosion
<b>Hydrology</b>	Peak Stream flows Summer Low Flows
<b>Riparian Function</b>	Large Woody Debris Recruitment Shade/Water Temperature Bank Stability
<b>Channel Condition</b>	Historic Channel Disturbance Current Channel Condition Spatial Distribution of Channel Response Types Dominant habitat forming/Geomorphic Processes
<b>Fish Habitat</b>	Distribution and Relative Abundance of Salmonoid Fish Existing Habitat Condition Fish habitat Utilization and Preferences
<b>Water Supply/Public Works</b>	Location and Sensitivity of Water Supplies/ Public Works Public State Roads and Bridges Reservoir, Irrigation Surfaces Municipal, Domestic, hatchery water supplies

Extracted from 1996 Central Cascades HCP

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As an example of HCP prescription stringency, Table 4-7 shows a comparison of the HCP riparian prescriptions with the Lester Watershed Administrative Unit analysis prescription. The first row of the table shows the HCP riparian prescription requiring a 200-foot RHA while the Lester prescriptions requires a 50-foot riparian management zone.

A comparison of prescriptions in the second row of the table reveals specificity in Lester prescriptions that provide more explicit and measurable requirements. HCP and Lester prescriptions identified in the third row are not as clear. A review of other completed Watershed Administrative Unit analysis indicates that the level of stringency is channel specific.

A Watershed Administrative Unit may have 15 channel segments for which prescriptions are derived. However, many of the watershed analysis prescriptions are presented as options for implementation. Moreover, when comparing watershed analysis riparian module prescriptions with HCP riparian prescriptions, the HCP is generally more restrictive. The 200-foot RHAs and the mandatory implementation of all interim HCP riparian prescriptions provide support for this assessment.

The 2000 Forest and Fish Rules placed greater emphasis on road management, elevating the importance of Road Maintenance and Abandonment Plans that were already apart of watershed analysis recommendations. Specifically, landowners are expected to review all roads within their ownership by 2005 and to provide the DNR with a maintenance plan to bring all roads up to forest practice standards.

**Table 4-7      HCP and Lester Watershed Administrative Unit Riparian Prescription Comparisons**

<i>HCP Riparian Prescriptions (Fish Bearing Stream) (pg. 24)</i>	<i>Lester Watershed Analysis Prescriptions (3/ 96 rev. 2/98) (Fish Bearing Stream)</i>
200 foot RHAs as determined by the normal high water mark...	50 – foot Riparian management zone with a 30-foot no cut zone.
No commercial harvest area of a 30 ft. horizontal distance...	Leave 70 of the largest conifer trees per acre, 12 inches dbh or larger well distributed within the riparian management zone. Leave 100 of the largest conifer trees per acre well distributed, if there area no 70 conifer trees per acre more than 12 inches dbh.
Limited silvicultural prescriptions for conifers and harvest of deciduous trees...	Silvicultural manipulations may be warranted to meet rehabilitation goals. Aimed at promoting restoration of historical stand conditions. (E.g. manipulation of hardwood stands to speed their transition to conifer, manipulation of conifer through thinning to accelerate growth on residual stems.

Landowners then have until 2015 to comply with the new road standards. Consequently, landowners are no longer required to develop mass wasting and surface erosion prescriptions associated with roads ordinarily developed through watershed analysis. According to a Services official, “Plum Creek systematically inventories roads that need culverts and bridges.” He went on to say, “there is no need for adaptive management with this blanket commitment (Services interview, January 2004)”.

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In late 2000, the Washington Department of Natural Resources discontinued its oversight of watershed analysis, making the initiation and continuance of watershed analysis voluntary. Nevertheless, Plum Creek continued to implement watershed analysis for a year following Washington Department of Natural Resources divestment.

### ***Riparian Management Strategy***

Watershed analysis is the driver for the riparian management strategy. Riparian management involves deferrals for section 303 (d) stream segments and wetland management zones, and aquatic resources monitoring discussed in Table 4-8. Implemented at a minimum and on an interim basis, riparian habitat protection prescriptions are replaced by site-specific watershed analysis.

### ***Riparian Habitat Protection.***

Plum Creek Timber used its experience and experimentation with New Forestry techniques and early watershed analysis to establish riparian habitat area prescriptions along streams. Riparian habitat areas are identified, designed and maintained to protect watersheds and wildlife. Riparian habitat areas and wetlands total more than 12,000 acres of Plum Creek's ownership in the HCP Planning Area (Central Cascades HCP 2000). Northern Spotted Owls that concentrate their home range in proximity to streams prefer riparian habitat areas.

Riparian habitat area interim and minimum guidelines are established for fish and non-fish bearing streams, yarding corridors and road management. See Appendix A-Table 1 for fish bearing and road management interim guidelines. Table 4-8 summarizes the purpose, objectives and approach of aquatic resource protection. Next, Table 4-9 describes the Plum Creek HCP Mitigation Summary submitted by Plum Creek foresters to the Washington Department of Natural Resources as part of their Forest Practices Application Checklist.

### **4.2.4.3 Cooperative Experimental Areas**

A component of the Northwest Forest Plan, the objective of the Snoqualmie Pass Adaptive Management Area is to develop and implement a scientifically credible, comprehensive plan for providing late successional forests on the checkerboard lands in the I-90 corridor (Northwest Forest Plan Standards and Guidelines 1994).

This "cooperative experimental area" was intended for the application of landscape-wide experiments through joint private and federal funding and adaptive management implementation (Plum Creek Timber staff interview April 2004). Plum Creek believed that by incorporating ecosystem management in the HCP, biological relationships of forest inhabiting species and streams across multiple scales would be effectively addressed throughout the Planning Area. Moreover, through cooperation, implementation cost would decrease (Central Cascades HCP 1996 & 2000).

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Potential learning opportunities include: 1) stand thinning to accelerate development of late successional habitat, 2) riparian improvement projects to meet aquatic conservation strategy objectives, and 3) road system improvements associated with watershed restoration ([www.reo.gov/ama/research/snoqualmie.htm](http://www.reo.gov/ama/research/snoqualmie.htm)). Plum Creek’s ownership in the Snoqualmie Pass Adaptive Management Area has since been transferred to the U.S. Forest Service (See Chapter 5).

**Table 4-8 Aquatic Resource Protection & Mitigation Strategies**

Species/Habitat Strategy	Approach	Purpose
<u>Watershed analysis</u>	Identify important physical processes that affect streams and understanding how forest management may influence these processes.	Protect biological requirements of anadromous salmonids and other aquatic species.
<u>Riparian management</u>  Designed to identify and maintain riparian forests as priority areas for fish and wildlife habitat protection.	<p>Maintain distribution, diversity and complexity of various component of watershed.</p> <p>Maintain connectivity within and between watersheds.</p> <p>Maintain the physical and biological integrity of the aquatic and riparian zone.</p> <p>Manage road densities to minimize disturbance to fish and wildlife species.</p> <p>Maintain a natural sediment regime to protect the aquatic system.</p>	To minimize impacts to and maintain in stream habitat for resident and anadromous fish and wildlife species, respectively.
<u>Harvest deferrals</u>	<p>Defer harvest within 667 acres in riparian habitat areas adjacent to 303(d) listed stream segments until watershed analysis is completed in each watershed administrative unit.</p> <p>Harvest will also be deferred within 1,320 acres in wetland management zones surrounding wetlands.</p> <p>Currently listed 303 (d) streams are being provided with a 100-foot riparian habitat area on non-fish bearing, perennial streams.</p> <p>*Watershed analysis will address the water quality parameters such as stream temperature, turbidity, and sediment input.</p>	<p>To comply with water quality standards under section 303(d) of the Clean Water Act.</p> <p>The Washington State Department of Ecology identified fish-bearing streams and adjacent habitat areas of poor water quality. The streams are: Big Creek, West Fork Teanaway, Lookout Creek and Gold Creek.</p>
<u>Aquatic monitoring</u>	<p>Provide landscape wide monitoring of habitat conditions;</p> <p>Analyze the effects of the various riparian habitat area management strategies on stream temperatures; and</p> <p>Assess fish populations and insect communities to assess biological integrity of streams.</p> <p>*Results from watershed analyses contribute to the accomplishment of aquatic resource monitoring objectives.</p>	To conduct habitat monitoring baseline monitoring, and trend to address concerns identified in riparian management strategy.

**Source:** Central Cascades HCP 2000.

**\*\*Note:** The methodology, location, and frequency of aquatic resource monitoring for each objective are discussed in the **Appendix A Table 2**.

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**Table 4.9 Plum Creek HCP Mitigation Summary**

Northern Spotted Owl Deferral Area	Northern Spotted Owl Presence within 0.25 mile	Watershed Analysis Prescriptions Complete	Riparian Habitat Areas	Wetlands	Snags & Snag Recruitment Trees	Talus Slopes &/or Caves	Goshawk Deferral Area & Presence within 0.25 mile	Marbled Murrelet Presence Within 0.25 mile	Grizzly Bear Recovery Zone
No harvest of nesting roosting and foraging habitat  No harvest of foraging dispersal habitat	No harvest between March 1 – August 31	Identify the name of Watershed Administrative Unit	Fish bearing 200' buffers on each side of stream No harvest next to stream Removal of trees as marked. Total buffer meets Foraging Dispersal habitat requirements	Forested Type A and B greater than 5 acres  Wetland Management Zone minimum of 100' & average of 200'	Average of 6 leave trees per acre (3 snags and 3 recruitment)	Up to 100' buffer per consultation with FWS & Washington Department of Fish and Wildlife	No harvest between March 1 – August 31	No harvest between March 1 – August 31	Open road visual screening to obscure up to 90% of a grizzly at 100 foot.  Gated and closed to year round public traffic.

### 4.2.5 HCP Ground Rules for Modifications: Minor Amendments and Unforeseen and Extraordinary Circumstances

Plum Creek expects to learn over time while implementing the HCP through experience and experimentation resulting in Plan improvement. New information concerning the efficacy of the mitigation program may warrant changes in the HCP. However, the company anticipates that most changes will occur through minor amendments. For example, new information may reveal that the dispersal habitat definitions require less or greater canopy cover than previously allotted. In this instance, minor modification to the HCP is allowable to incorporate new canopy cover objectives. Second, the modification or alteration of stand structure/life form habitat projections could occur based upon trend monitoring results or new information from the scientific literature. Moreover, the net effect on the species resulting from minor HCP amendments are not expected to significantly differ from that anticipated under the original Incidental Take Permit. In addition, the level of incidental take authorized will remain within the level authorized under the permit. Therefore, the relationship between “take” impacts and the associated minimization/mitigation measures will remain equivocal (Implementation Agreement 1996, Central Cascades HCP 2000).

Changes in operations are more or less operational restrictions than provided for in the HCP (Central Cascades HCP 2000). Changes in harvest timing, harvest location, and the application of silvicultural techniques such as commercial thinning, pruning, or fertilizing may occur on an incremental basis and extended over time. However, these changes do not require an amendment to the HCP or permit (Implementation Agreement 1996; Central Cascades HCP 2000).

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### *Field Manual*

The HCP Field Manual provides operational guidance to the foresters and is a living document that supplements the HCP. Proposals between Plum Creek and the Services reflecting changes in operations and new prescriptions are documented in the manual in the form of letters. Proposals generally address the current and modified provision, the rationale for the change, the effect on the species, and the conclusion regarding whether the modification is minor. Approved HCP modifications result in a revision of the applicable sections of the document, not a revision to the document in its entirety (Central Cascades HCP 2000).

### *Unforeseen Circumstances*

An “unforeseen circumstance” involves a change in circumstance or information precipitating the need to revise the HCP. Under unforeseen circumstances, the Services will not require additional land or financial compensation beyond the level of mitigation approved in the HCP as long as Plum Creek is in compliance with the terms and conditions of the implementation agreement, permit and HCP (USDI 1994).

Plum Creek and the Services established parameters within the HCP to remedy a potentially unforeseen or changed circumstance in the Planning Area (See Chapter 5). Subsequently, modifications to the HCP or an amendment to the permit is not necessary (Central Cascades HCP 2000).

In addition, should a species be listed as threatened or endangered after the effective date of the Incidental Take Permit, Plum Creek may amend the permit to add any species dependent on the various habitat types analyzed in the HCP. The amended permit will extend through the implementation of Phase II or Safe Harbor.

### *Extraordinary Circumstances*

“Extraordinary Circumstance” is invoked when a substantial and material adverse change has occurred in the status of a species. If a material adverse change is proven, the Services may seek additional mitigation from Plum Creek.

The substantial and material adverse change finding must be clearly documented and the status and habitat requirements of the affected species must be based upon reliable, peer reviewed scientific and technical information (Central Cascades HCP Implementation Agreement 1996). The Services must consider the following factors:

- Size of the current range of affected species.
- Percentage of range adversely affected by the HCP.
- Percentage of range conserved by the HCP.
- Ecological significance of that portion of the range affected by the HCP.
- The level of knowledge about the affected species and the degree of specificity of the species conservation program under the HCP.
- Whether the HCP was originally designed to provide an overall net benefit to the affected species and contained measurable criteria for assessing the biological success of the HCP.

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If required, additional mitigation from Plum Creek shall be limited to the original terms of the HCP, if the company is operating in compliance. Mitigation will first be provided on public lands. Only when existing Federal lands are insufficient may the Services seek additional mitigation from Plum Creek. Finally, changes in riparian management prescriptions resulting from watershed analysis and aquatic monitoring are neither unforeseen nor extraordinary circumstances (Central Cascades HCP Implementation Agreement 1996).

### 4.2.6 Monitoring & Reporting

Plum Creek agreed to monitor terrestrial and aquatic wildlife identified in Table 4-9A on an annual basis until permit expiration. The dates shown under the calendar reporting-year for Northern Spotted Owl monitoring represent two seasons of demographic data collected prior to USFW reporting.

Subsequently, the dates under Decision Reviews represent the years in which management decisions based upon data collection are made. Decisions about the results of Northern Spotted Owl carrying capacity projections are made every five years within the first 20 years of the HCP and every ten years thereafter.

Watershed analysis is identified under the Aquatic Resources section. Management prescriptions are modified as necessary to meet objectives. Five-year reviews of completed watershed analysis are conducted every five years within the first 20 years of the HCP and every ten years thereafter.

### 4.2.7 Termination

The Services or Plum Creek may terminate the HCP Incidental Take Permit. The company agrees to provide the Services with a 90-day advance notice of the proposed termination before the end of Phase I. Prior to an early termination, Plum Creek is required to sufficiently mitigate past incidental take through conservation measures under the HCP. Plum Creek may invoke the dispute resolution procedures articulated in the Implementation Agreement to resolve any technical disagreement about the necessity or amount of additional mitigation (Central Cascades HCP Implementation Agreement 1996). Termination of the permit with respect to any listed species would also automatically terminate the Implementation Agreement and the HCP. Either party may terminate the Implementation Agreement and HCP for material breach of unlisted species, not covered by the permit (Central Cascades HCP Implementation Agreement 1996).

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**Table 4-9A Central Cascades HCP Monitoring and Reporting Schedule**

	<b>CALENDAR YEAR REPORTING</b>	<b>DECISION REVIEWS</b>
Habitat Verification Stand Structure Life form Northern Spotted Owl habitat	Annually through Incidental Take Permit duration	1998, 2001, 2006, 2011, 2016, 2026, 2036, 2046
<b>Northern Spotted Owl Carrying Capacity</b>	-	2001, 2006, 20011, 2016, 2026, 2036, 2046
<b>Northern Spotted Owl monitoring</b>	1997, 1998, 2005, 2006, 2010, 2011, 2015, 2016, 2035, 2036	1998, 2006, 2011, 2016, 2036
<b>Life forms (species categorized and assigned by a number for management based upon similar characteristics, i.e., range, occurrence, &amp; habitat requirements) (Except Lifeform 5: grouse, deer, elk, lynx)</b>	2001, 2006, 2011, 2016, 2026, 2036, 2046	
Marbled Murrelet		
Grizzly habitat and roads		
Gray Wolf habitat		
Breeding Bird Surveys		
Amphibian surveys		
Small Mammal/prey Surveys		
<b>AQUATICS</b>		
<b>Watershed Analysis</b>	2001-2010; 2016-2020; 2026-2030, 2036-2040	2001, 2006, 20011, 2016, 2026, 2036, 2046
Monitor Permanent Stream Monitoring sites	2000, 2002, 2004, 2006, 2008, 2011, 2016, 2021, 2026, 2031, 2036, 2041, 2046	
4 riparian scenarios	2000-2004	
303(d) listed and Bull Trout	1997 & 1998; 2001 & 2006	
Aquatic insect collection	2000, 2002, 2004, 2006, 2008, 2011, 2016, 2021, 2026, 2031, 2036, 2041, 2046	
Fish Population 75 meter survey reaches	2000, 2001, 2002, 2004, 2006, 2011, 2016, 2021, 2026, 2031, 2036, 2041, 2046	

### 4.2.8 Summary

This chapter described the history of the Northern Spotted Owl and the external influences that shaped the HCP design laying the foundation for HCP implementation. Habitat protections identified in the HCP do not span very far from state regulations already required of Plum Creek. The Washington Department of Natural Resources, under the authority of the Forest Practices Board governs the conduct of watershed analysis and harvesting of timber on state and private lands. Nesting, roosting and foraging habitat and foraging/dispersal habitat classifications along with owl circle protection around nests are also state Forest Practices adopted in the HCP.

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The HCP Ground Rules weaken the notion of adaptive management implementation. Under the HCP Agreement, most changes will occur through minor amendments (Central Cascades Implementation Agreement, 1996). Moreover, the company's anticipation of changes in harvest location and timing are a prelude to the next section. Chapter five will reveal the process through which new information is acquired and how modifications are made to management practices.

## Chapter 5

### 5.1 Introduction

The first eight years of Central Cascades HCP implementation are represented in two ways.

1. Refinements and enhancements were made to the components of the HCP that were unresolved during the planning phase.
2. Minor adjustments were made to management practices based upon stakeholder suggestions during plan implementation.

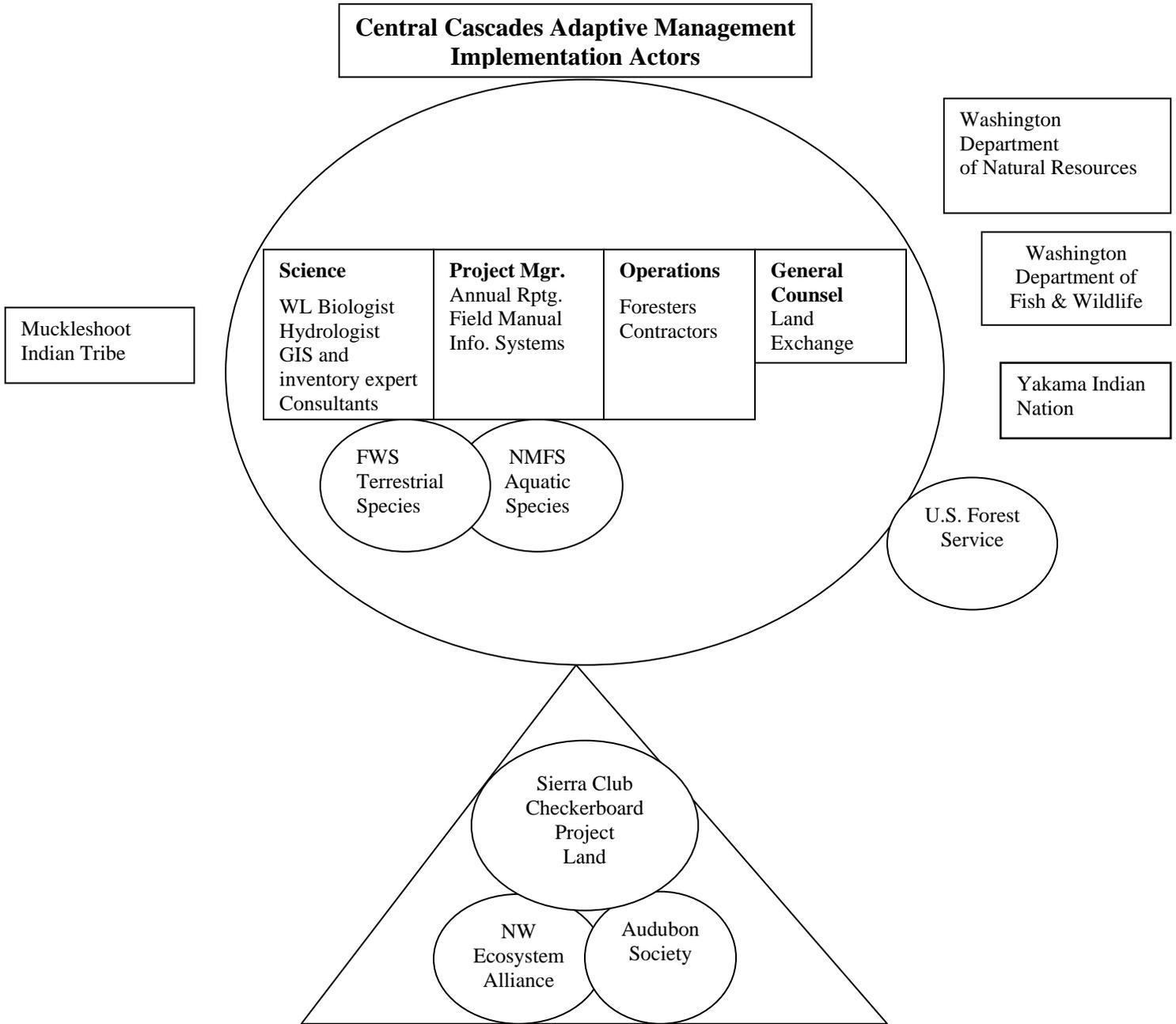
Plum Creek Timber has been successful in establishing a cooperative relationship with the Services. In fact, the company and the Services authored the HCP (Services interview, January 2004; Plum Creek Timber staff interview, April 2004). Plum Creek Timber views the HCP from a biological as well as a legal and business perspective (Plum Creek Timber staff interview, April 2004; Services interview January 2004). The Services supported Plum Creek Timber's position during the HCP planning phase and have maintained this support during HCP implementation. Approvals granted to Plum Creek Timber for modifications to HCP implementation proving beneficial for the company provides such evidence. Moreover, ongoing dialogue between Plum Creek Timber and the Services, site visits by the Services and company audits, has proven successful for the company in establishing a cooperative and trusting relationship. Thus, the outcomes discussed in this chapter are a reflection of negotiation and a strong partnership between Plum Creek Timber and the Services.

This chapter begins with an implementation timeline of activities since HCP approval and a conception of implementation actors. The main HCP implementation actors are represented in the large circle shown in Figure 5-1. Specifically, the squares shown in the circle reflect Plum Creek Timber employees and the smaller circles represent the two federal agencies responsible for HCP implementation oversight. The U.S. Forest Service, another federal agency overlaps the large circle to the extent that federal land is adjacent to Plum Creek Timber land and that both entities aim to protect Northern Spotted Owl habitat. In addition, Plum Creek Timber and the U.S. Forest Service coordinate Northern Spotted Owl monitoring activities east of the Cascades. However the U.S. Forest Service has no involvement in HCP implementation.

The rectangles left and right of the large circle represents state and tribal experts that have peripheral influence over HCP implementation. The Washington Department of Natural Resources had an indirect involvement in HCP implementation given their review of Plum Creek Timber's harvest plans and the Department's former oversight of the watershed analysis program. The Washington Department of Fish and Wildlife also has an indirect relationship with the HCP through its cooperative timber fish and wildlife enhancement program designed to conserve, enhance, and ensure the proper utilization of the state's natural resources, including lands, waters, timber, fish and game. In this capacity, the DFW has reviewed Plum Creek Timber's harvest plans. As participants of the state timber fish and wildlife program, the tribes also review Plum Creek Timber's harvest plans and serve on Plum Creek Timber's watershed analysis prescription team.

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Figure 5-1



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Finally, the triangle represents the environmental interests that commented on the HCP during its planning phase but have not been directly involved in HCP implementation. Plum Creek Timber occasionally implements state and tribal recommendations for habitat protection and enhancement above the HCP prescriptions.

Regardless, these groups have a continued interest in HCP species outcomes and have worked alone and collaboratively, recommending habitat improvements and protections for the Northern Spotted Owl and other life forms. For example, the Sierra Club facilitated a land exchange between Plum Creek Timber and the U.S. Forest Service to make sure late successional forests would not be harvested.

The following aspects of adaptive management implementation are also covered:

1. Plum Creek Timber's assumptions on harvesting activity
2. Land Exchange
3. Watershed Analysis Extrapolation
4. The Adaptive Management Process
5. Process Evaluation
6. Progress Evaluation
7. Summary

Implementation of the HCP followed a timeline shown in Table 5-1. The long time horizon for Northern Spotted Owl response to HCP management strategies is acknowledged, thus it is premature to assess HCP impact on species survival and recovery. Thus, outcomes at this stage have more socio-economic and policy (HCP Program) oriented rather than biologically oriented

**Table 5-1 Implementation Timeline**

<b>Date</b>	<b>Activity</b>
1996 1997 2001 2003	Field Manual (Creation and updates)
November 1999	Land Exchange
December 2000	Revised HCP
May 2001	Plum Creek Timber Plum Creek Timber

### **5.1.1 Plum Creek Timber Assumptions on Harvesting Activity**

The Northwest Forest Plan guidelines that prescribe Federal harvesting activities (within late successional reserves and adaptive management areas, see Section 4.1.5) informed Plum Creek Timber's Northern Spotted Owl habitat management strategy. Their assumption about federal harvest plans convinced Plum Creek Timber that there would be a moderate reduction of available owl habitat for the first 20 years of their permit. The company also anticipated that land exchanges, the regrowth of harvest on both their land and Federal lands, and the movement of owl pairs would reduce the likelihood of forestry impact on habitat (Central Cascades HCP 1996 & 2000).

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Furthermore, the company assumed that: (1) seasonal species owl site protection from disturbance, (2) maintenance of habitat at 30 selected nest sites, and (3) their dispersal strategy to reduce the likelihood of isolating owls across the I-90 corridor would minimally impact local and regional populations of Northern Spotted Owls over the permit period (Central Cascades HCP 1996 & 2000).

In regards to aquatic species, Plum Creek Timber assumed that watershed conditions would be protected through management prescriptions, watershed analysis, and best management practices (Central Cascades 1996). Finally, the company asserted that by targeting the biological needs of the most sensitive fish species (i.e., salmonids), the environmental requirements for successful spawning and rearing of all other fish species in the Planning Areas would also be adequately protected (Central Cascades 1996).

### 5.1.2 Land Exchange

In 1998, the Checkerboard Project, a Committee of the Sierra Club, facilitated the negotiation of a land exchange between Plum Creek Timber and the Forest Service. In this capacity, the organization represented conservation and environmental groups interested in promoting connective corridors that link late successional forest in the Snoqualmie Pass Adaptive Management Area for a wide range of species. Concerned that Plum Creek Timber was deficient in managing their ecological significant (old growth, streams, trails, roadless areas) land, these stakeholders believed corridors could compensate for the impacts of: (1) past forest practices, (2) the existing checkerboard ownership patterns and (3) industry management objectives (personal communication with environmental organizations, February and March 2004).

In November 1999, an I-90 Land Exchange authorized by Congress was signed into law by the President. The land exchange comprised 31,600 acres and 11,600 acres of Plum Creek Timber and National Forests System lands, respectively, presented in Table 5-2.

**Table 5-2 Land Exchange**

Gaining entities			
Acreage	U.S. Forest Service	Plum Creek Timber	Gifford Pinchot National Forest
Exchanged acres	30,800*	8,600*	
Donated acres	800		
U.S. Forest Service Acres remaining			3,000
<b>TOTAL</b>	31,600	8,600	3,000

\*Acres in the HCP Planning Area. (Central Cascades HCP 2000)

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As a result of the Land Exchange, Plum Creek Timber modified its 1996 HCP to provide incidental take authorization for activities on the newly acquired 8,600 acres within the Planning Area. The permit no longer covers the 30,800 acres transferred to the U.S. Forest Service. Modifications resulting from the land exchange, as well as other minor adjustments induced the company to replace the 1996 HCP with a 2000 HCP.

Table 5-3 reflects the change in Plum Creek Timber and Forest Service land ownership. It shows that as of 2000, 148,300 acres were covered in the HCP. The 130,000 acres of Plum Creek Timber land identified under options-to-buy will remain in the HCP until they are purchased. Since the Land Exchange, Plum Creek Timber came to realize the multiple interests in their land. Subsequently, land sales have become apart of Plum Creek Timber's strategy for HCP divestment.

**Table 5-3 Land Ownership Pre and Post Land Exchange**

Ownership	Pre-Land Exchange	Post-Land Exchange (2000)	Escrow and Option to Buy Sections Not Owned by Plum Creek Timber
Plum Creek Timber*	170,500	148,300	130,000
Forest Service	196,500	218,700	237,000**
Other (State & Private)	45,300	45,300	45,300
Water (Lakes)	6,600	6,600	6,600
Total	418,900	418,900	418,900

\*Includes lands owned and lands on which Plum Creek Timber has timber harvest rights

\*\*The Forest Service is not expected to necessarily own all of the land, however the lands shall be managed comparably. (Central Cascades HCP 2000, pg. ES-2, December 2000)

### ***Land Sales***

Several thousands of acres are in negotiation for sale. The conservation community e.g., Trust for Public Lands, Cascade Partnership, etc., was granted the Option-to-Buy land depending upon how much and how soon they were willing to pay. The Forest Service also has the option to buy land. Additional Land Sales are described below:

#### 2001 Transactions

3,400 acres Sold to the U.S. Forest Service

2,900 acres Sold to Mountains to Sound Greenway\*

1,300 acres Sold to Northwest Ecosystem Alliance\*

\*These environmental organizations donated the purchased acres to the Forest Service.

22,200 acres Net from U.S. Forest Service in I-90 Exchange

13,400 acres for U.S. Forest Service Option to Buy

*Plum Creek Timber Ownership as of 12-31-01 is 140,700.*

#### 2002 Transactions

5,300 acres Sold to the U.S. Forest Service

500 acres Sold to Mountains to Sound Greenway\*

\*This environmental organization donated the purchased acres to the Forest Service.

*Plum Creek Timber Ownership as of 12-31-02 is 134,900.*

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### 2003 Transactions

644 acres Sold to NW Ecosystem Alliance

4,729 acres Sold to Pacific Crest

4,988 acres Sold to the U.S. Forest Service

*Plum Creek Timber Ownership as of 12-31-03 is 125,976.*

### **5.2 The Adaptive Management Process**

Plum Creek Timber claims the application of adaptive management to evaluate the success of their HCP in achieving stated ecological objectives. However, the process for adaptive management is not clearly articulated in the HCP, particularly for watershed analysis and riparian management for which further clarity was sought (personal communication, Plum Creek Timber staff March 2005). Furthermore, Plum Creek Timber chose not to establish testable hypotheses for their adaptive management objectives. With the exception of the resource selection probability function model estimate, quantitative thresholds for triggering corrective action are not identified for objectives listed in each adaptive management strategy. Additionally, the discussion on analysis of causative action is vague for each strategy.

#### **5.2.1. Research and Monitoring**

Plum Creek Timber's research and monitoring program and reporting schedule for plan evaluation are the drivers for implementing adaptive management. The research and monitoring program is intended to address HCP gaps in empirical data or experience for which assumptions were made and modeling designed (Central Cascades 2000). Research is intended to provide alternatives for management if necessary, such as alternative management practices for water quality or revised criteria for Northern Spotted Owl habitat types and location in the Planning Area.

Monitoring is conducted to detect trends in watershed health and Northern Spotted Owl demography. If monitoring reveals deviations in biological conditions, corrective action is to be triggered (Central Cascades 2000).

Since monitoring is the primary emphasis of HCP implementation, modifications to management practices as a result of new information gained through research did not occur. The HCP identified potential research questions that could become the basis for hypotheses testing within the Planning Area. However these questions were not used for hypothesis testing (Plum Creek Timber staff interview, February 2005).

#### **5.2.2 Action: Triggers, Analysis and Management Modification**

Corrective action is initiated when deviations in biological conditions fall below a certain threshold--that is conditions that fall below a predicted or estimated level. Deviations are discussed with the FWS and NMFS officials who would require an analysis of causative action.

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Deviations from predicted habitat conditions may result from management actions taken in the HCP or external factors, such as activities on Federal land, or naturally occurring events such as catastrophic fires (Central Cascades HCP 2000). Corrective action to modify mitigation and management under the HCP are based on “non-achievement” of specific HCP objectives rather than on conditions created by external causes. If deviations in desired levels of biological condition are due to HCP implementation, “mid-course corrections” are to be taken to affect desired outcomes.

For example, Plum Creek Timber determines the achievement of prescribed stand target percentages containing stand structure and Northern Spotted Owl habitat classifications. If targets are not met, harvest deferrals to maintain nesting, roosting and foraging habitat around selected sites may be moved, extended or increased if predicted levels of use are not achieved (Central Cascades HCP 2000).

Plum Creek Timber’s process of determining deviations in biological conditions is not transparent. The HCP states that deviations must demonstrate statistical significance and biological relevance and changes in management and mitigation will be determined by monitoring data. However, there was no monitoring protocol designed to ensure the proper data collection of indicator variables of habitat or species and data analysis during HCP implementation.

In addition, thresholds levels for every terrestrial and aquatic resource identified in the monitoring and reporting schedule were not clearly defined in the HCP or other documentation. Measurable criteria for HCP physical and biological objectives were not found. The establishment of measurable criteria guides the type of monitoring including the number of samples, distribution of samples and use of controls. Furthermore, it was unclear how data are used to determine desired physical and biological conditions or whether conditions were within or outside prescribed thresholds. While the types of modifications to mitigation are defined, the process of decision-making in determining the need to modify mitigation strategies was not transparent. Finally, follow up questions posed to Plum Creek Timber about these issues yielded vague answers.

Sections 5.2.3 through 5.2.6 describe the process for incorporating adaptive management for Northern Spotted Owl management, watershed analysis and riparian management as defined by research and monitoring, thresholds for and analysis of corrective action and management/ mitigation modification.

### 5.2.3 Northern Spotted Owl Management Strategy

**Goal:** Estimate the amount and juxtaposition of habitat needed to avoid impacts.

**Research & Monitoring:** Demographic monitoring, refinement and assumption verification of the Resource Selection Probability Function (RSPF) carrying capacity model (Chapter 4). The effectiveness of 20 year Northern Spotted Owl deferrals (1,100 – 1,900 acres of nesting, roosting and foraging habitat and 1,300 – 2,300 acres of foraging dispersal corridors) and monitoring and reporting of stand structure and Northern Spotted Owl habitat target objectives (Central Cascades HCP 1996 & 2000).

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**Threshold for Triggering Corrective Action:** Corrective action is triggered when the revised estimate for the Northern Spotted Owl carrying capacity in the HCP project area falls below 80% of the predicted value by the RSPF model (Central Cascades HCP 1996 & 2000).

**Analysis of Causative Action:** Adaptive management feedback “loops” to evaluate monitoring data and determine corrective actions are synchronized with the HCP monitoring and reporting schedule for the RSPF Carrying Capacity model projections. The Services must establish through peer reviewed opinion that a decline in Northern Spotted Owls is due to conditions caused by the HCP or the miscalculation of owl response to habitat provided (Central Cascades HCP 1996 & 2000).

**Modification of Management and Mitigation:** Modification may result in the redesign of nesting, roosting and foraging habitat deferrals and foraging dispersal corridors to change the location, deferral period, or number of stands to be deferred. The total amount of owl habitat to be maintained on Plum Creek Timber’s land will not be increased from levels specified in the HCP, except as provided under Extraordinary Circumstances (Implementation Agreement 1996).

### 5.2.4 Watershed Analysis

**Goal:** To establish timber harvest practices which restore and protect aquatic habitat.

**Research & Monitoring:** The collection of baseline information on the ecological structure, function, processes, and interactions affecting the aquatic resources within a watershed (Central Cascades 2000). Through compliance and effectiveness monitoring the following questions are asked: (1) “are the mass wasting prescriptions preventing or avoiding the triggering of management related landslides”, (2) "Are road maintenance actions reducing sediment inputs to streams", (3) "Are riparian management prescriptions working to keep streams cold, clean, and complex?" (Personal communication, Plum Creek Timber staff, March 2005).

**Threshold for Triggering Corrective Action:** “Thresholds for performance are not strictly defined, but for roads the aim is to keep sediment inputs below 50% of background levels, and for riparian prescriptions to keep streams within water quality standards (Personal communication, Plum Creek Timber staff, March 2005)”.

**Analysis of Causative Action:** “Reviews are periodically conducted to identify gross failures of the Watershed Analysis prescriptions' ability to address major processes that shape aquatic resource structure and function (Personal communication, Plum Creek Timber staff, March 2005)”.

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**Modification of Management and Mitigation:** Corrective action is taken as a result of scheduled watershed analysis reviews conducted every five years. Specifically, “if basic functions are found not to be protected, prescriptions are refined to address the particular situation using new science on watershed processes or management relationships when available (for validation of original analyses) (Personal communication, Plum Creek Timber staff, March 2005)”.

### 5.2.5 Riparian Management Strategy

**Goal:** Design riparian protection zones around fish bearing and non-fish bearing streams to minimize impacts to and maintain in stream habitat for resident and anadromous fish and wildlife species, respectively (Central Cascades HCP 1996 & 2000).

**Research & Monitoring:** Pre- and post-harvest comparisons of structural components in the riparian zone (Central Cascades HCP 1996 & 2000).

**Threshold for Triggering Corrective Action:** “Thresholds are developed from two monitoring projects: 1) maintenance of stream temperatures, and 2) fish and aquatic insect response to the harvest treatments (Personal communication, Plum Creek Timber staff, March 2005)”.

**Analysis of Causative Action:** “An analysis is conducted if the 100-ft or 200-ft RHAs produce significant (e.g., 1 degree c or more) and consistent increases in temperatures after harvest. The decline of fish and aquatic insect populations relative to the controls after harvest would also be cause for investigation and a revision of the riparian strategy (Personal communication, Plum Creek Timber staff, March 2005)”.

**Modification of Management and Mitigation:** “(1) Change the riparian buffer design to include larger or smaller zones, more or less, (2) apply different structural retention guidelines, (3) extending protection to additional stream areas and types. Direct management action may be taken to create or to maintain early successional habitat in RHAs, i.e., through timber harvest, prescribed burning or a combination thereof (Personal communication, Plum Creek Timber staff, March 2005)”.

### 5.2.6 Cooperative Experimental Areas

The HCP does not require the U.S. Forest Service and Plum Creek Timber to cooperate on research and monitoring efforts. However, Plum Creek Timber anticipated the coordination of research and monitoring to support adaptive management objectives in the SPAMA. To accommodate this effort, the HCP allowed for the modification of Plum Creek Timber’s prescriptions and operations upon the consent of the FWS (Central Cascades HCP 1996).

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### 5.3 An Evaluation of the Implementation Process

This section discusses HCP compliance and the extent to which the HCP is being implemented as planned. Changes in the projected amount of Northern Spotted Owl habitat are explained as well as deviations from the HCP regarding the completion of watershed analysis. This section also describes challenges to implementing HCP prescriptions.

#### 5.3.1 Northern Spotted Owl Habitat and Stand Structures

Northern Spotted Owl habitat, stand structure and life forms are monitored annually. Every 5 years the inventory is analyzed to compare existing stands and the projected percentage of stands. The baseline is reestablished and new targets are set for the next 5 years. Plum Creek Timber also tracks the activities of the Forest Service to determine impacts on Plum Creek Timber land (Plum Creek Timber staff interview, April 2004).

Subsequently, in December of 2001, Plum Creek Timber revised their estimates of timber inventory, forest stand structures definitions and owl habitat amounts to account for: 1) the use of inventory polygons that replaced management units, (2) differences in timber measurements of newly acquired Forest Service stands and (3) the sale of 2,400 acres to Mountains to Sound Greenway (2002 Central Cascades HCP Annual Report; Services Interview, January 2004).

While these changes affected the projected amounts of owl habitat when compared to the original HCP, the change did not affect habitat amounts in 2001. Additionally, the changes are not anticipated to affect the amount of timber harvest that will occur (Central Cascades HCP 2002 Annual Report). However, the changes affected the amount of owl habitat reported in various categories. Table 5-4 gives the estimated percentages of Northern Spotted Owl habitat and forest structural stages protected by Plum Creek Timber compared to All Ownerships in the Planning Area (HCP) providing as a result of the Land Exchange. Percentages are Estimated and Displayed by Decade for the 50-Year permit Period. (Central Cascades HCP, pg. 196 December 2000).

Table 5-4 shows decadal fluctuations of Plum Creek habitat in the various structural stages. Plum Creek Timber projects an increase in Northern Spotted Owl habitat and structural stages compared to HCP inception (1996). The company (PCT) anticipates providing more habitat than other landowners in the HCP Planning Area (HCP).

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**Table 5-4 Post Land Exchange: Projected Northern Spotted Owl Habitat and Forest Structure Percentages**

Category	Year											
	2001		2006		2016		2026		2036		2045	
	PCT	HCP										
<b>Northern Spotted Owl Habitat</b>												
NRF	6.8	26	4.7	25	2.8	24	2.1	26	2.3	27	2.4	28
FD	12.2	25	11.4	25	9.9	25	11.9	26	17.4	28	23.2	29
Total (Percent)	19.0	51	16.1	50	12.7	49	14.0	52	19.7	55	25.6	57
<b>Structural Stages</b>												
SI/SS/YF	50.4	22	52.2	22	38.4	15	33.2	13	29.1	11	30.2	13
Pole Timber	13.0	10	14.8	11	31.9	18	36.6	16	33.8	13	28.0	10
Dispersal Forest	19.5	16	18.6	16	16.9	16	18.8	17	24.8	19	28.0	19
MF/MOG/OG	12.0	43	9.3	42	7.7	42	6.3	45	7.2	48	8.7	49
Non-Forested	5.1	9	5.1	9	5.1	9	5.1	9	5.1	9	5.1	9
<b>Total Percent</b>	100	100	100	100	100	100	100	100	100	100	100	100

\*Notes: Goals for Northern Spotted Owl habitat and structural stages will be achieved if measures are within 10 to 20 percent of the values estimated in the table.

NRF – Nesting, roosting and foraging habitat; FD – Foraging-Dispersal habitat; SI – Stand Initiation  
 SS – Shrub/Sapling; YF – Young Forest; MF – Mature Forest; MOG – Managed Old Growth; OG – Old Growth. Source: Plum Creek 2001.

### 5.3.2 Watershed Analysis & Riparian Management Strategy

Adaptive management is implicit in watershed analysis process (Plum Creek Timber Staff, February 2005). Watershed analysis, riparian management and aquatic monitoring work in tandem and have an interdependent relationship. The minimum and interim riparian prescriptions provide a base level of aquatic resource protection. Prescriptions derived from watershed analysis are site specific and replace the minimum and interim guidelines. Aquatic monitoring contributes to the development of site-specific prescriptions. Plum Creek Timber evaluates the performance of prescriptions during its Five Year Review of HCP implementation.

Table 5-5 summarizes progress toward the completion of watershed analysis for 17 Watershed Administrative Units. It shows completed analysis for Watershed Administrative Units identified by sequence numbers 2 through 10 that underwent the state environmental review process. By the time sequence numbers 11-13 were ready for environmental review, the Washington Department of Natural Resources divested from the watershed analysis process. Sequence numbers 14 – 19 will be completed through extrapolation.

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**Table 5.5 Status of Watershed Analysis for Watershed Administrative Units in The Plum Creek Timber Central Cascades HCP**

Sequence Number	Watershed Name	Public		Reports Completed	Technical Review		Prescriptions		SEPA	
		Kickoff	Synthesis		Initiated	Completed	Initiated	Completed	Initiated	Completed
1*	Alps	11/93								
2	Quartz Mountain	11/93								
3	Lester	4/94								
4	Naches Pass	6/94								
5	Big Creek	9/94								
6	W.F. Teanaway	7/95								
7&8	Green River & Sunday Creek	7/95								
9&10	Keechelus & Mosquito Creek	6/96								
11	Cabin Creek	7/96							N/A	N/A
12 & 13	Howard Hanson & Smay Creek	9/96							N/A	N/A
14	North Fork Green River	2002							N/A	N/A
15	Cle Elum Ridge, South	2003							N/A	N/A
16 & 17	Cle Elum- & Lannigan Springs	2004							N/A	N/A
18	Cliffdell	2005							N/A	N/A
19+	All other lands in the HCP									
*	No longer apart of PC ownership		completed		Completed via extrapolation					

Note: All of these Watershed Administrative Units are available as options to purchase (Central Cascades HCP 1998 Annual Report).

According to a Services official, “there have not been significant changes in the status of aquatic species as a result of watershed analysis.” Services monitoring data revealed that Bull trout populations have remained the same and Chinook and Steel head populations have increased (Services interview, January 2004). Plum Creek Timber suspects that “the Tacoma and Washington Department of Natural Resources HCPs are contributing to the protection of aquatic resources in the Green River watershed (personal communication, Plum Creek Timber staff, March 2005).” Examples of watershed analysis prescriptions that have replaced minimum and interim HCP prescriptions are described below:

### *Road Management and Sediment Inputs to Streams*

Road sediment abatement will continue in response to the Washington Department of Natural Resource’s Road Maintenance and Abandonment Plan Program (See Chapter 4). Although Plum Creek Timber has not conducted as many Road Management Block inventories for their forest roads as planned.

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The company intends to implement all inventories by the end of 2005. Best management practices from the process will be implemented by 2015. The company inventoried all road crossings of known or potential fish bearing waters in the HCP in 2003. Of the 102 structures surveyed, 33 were judged to be passable and 69 impassible (Plum Creek Timber 2001). Criteria from the U.S. Forest Service and Washington Department of Fish and Wildlife were used to determine fish passage potential. Passage barriers were prioritized using estimates of the amount of habitat above the blockages and the severity of passage impairment (e.g., partial or full blockage). Blockages, if removed, could open access to nearly ten miles of resident trout habitat. Twelve culverts (6 each for Puget Sound and Yakima Units) were identified as having top restoration priority (2003 Central Cascades HCP Annual Report).

According to Plum Creek, “localized “hot spots” of erosion contribute the majority of sediment to streams. Certain classes of roads, such as mainlines adjacent to streams, are large contributors (Plum Creek Timber 2001)”. Subsequently, ninety-six miles of road have been upgraded to current Road Maintenance and Abandonment Plan standards, (See Chapter 4) twenty-two miles have been abandoned, and 139 new miles have been built (see Table 5-6). Specific practices used to reduce sediment delivery and to divert runoff onto the forest floor include additional cross drains, slash filter windrows, grass seeding of cut slopes, installation of rock weirs in ditch lines, and “final approach” sediment traps between the last cross drain and a channel (Plum Creek 2001).

**Table 5-6 Summary of Road Work (miles) on Plum Creek Timber Lands in the HCP Area, 1996-2001.**

Area	Constructed	Abandoned	Upgraded	Total Miles in Watershed Administrative Units as of 1/1/2002
Westside	82	12	57	1,155
Eastside	57	10	39	742
Total	139	22	96	1,897

(Source: Plum Creek Timber 2001)

### 5.3.2.1 Watershed Analysis Extrapolation

Plum Creek Timber’s experience with the Watershed Analyses process led the company to conclude that they were “past the point of diminishing returns with regard to the incremental management of each successive analysis (Plum Creek Timber 2001)”. Thus, Plum Creek Timber will extrapolate best management practices from completed watershed analysis to nearby watersheds rather than complete watershed analysis for remaining watershed analysis units.

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Acknowledging their limited scientific understanding of the linkages between management activities and aquatic resources, Plum Creek Timber decided to take another course of action. Specifically, the company chose to identify products that provide “concrete information” from completed analysis to use in their daily decision-making. Information products include: mass wasting hazard maps; road erosion hot spot maps, and hydrologic sensitivity maps (Plum Creek Timber 2001). The ability to profit from their earlier work and quickly implement forest management improvements was the motivation for this decision. While Plum Creek Timber acknowledged the value of information to be gained from channel, riparian, and habitat condition monitoring and restoration, the company believed the existing aquatic monitoring program to be sufficient (Plum Creek Timber 2001). In addition, the company viewed restoration opportunities as limited for the HCP (Plum Creek Timber staff interview February 5, 2004; Plum Creek Timber 2001).

Plum Creek Timber convinced the Services that by extending findings from completed watersheds to neighboring drainages that aquatic resources would be adequately protected (Services interview, February and March 2004; Plum Creek Timber 2001). A reconnaissance-level survey of the characteristics and conditions in the unstudied watershed analysis units to test the hypothesis of extrapolation was completed in 2003. Completion of the watershed analysis extrapolation process is expected in 2006 (Plum Creek Timber). Details of the extrapolation process were not disclosed. According to Plum Creek Timber, preliminary results indicate that the extrapolation approach will successfully lead to the implementation of “HCP wide best management practices for aquatic resource protections (2003 Central Cascades HCP Annual Report)”.

Plum Creek Timber asserts that Mass Wasting assessments will continue in all watersheds, and that hydrology assessments may also be needed in some areas. While riparian assessments may be conducted, the company will restrict efforts to identifying situations where HCP prescriptions need augmentation (Plum Creek Timber 2001).

### **5.3.2.2 Aquatic Habitat and Resource Monitoring**

Aquatic habitat resource monitoring is conducted to ensure that appropriate prescriptions are implemented to protect fish and water quality. Baseline monitoring is conducted to characterize existing conditions and establish a database for future comparisons. Trend monitoring involves the evaluation of long-term changes in a particular parameter. Water quality parameters such as water temperature and turbidity are the focus of trend monitoring. The three main objectives of aquatic resource monitoring are to:

- (1) Provide landscape wide monitoring of habitat conditions over the Permit period;
- (2) Analyze the effects of the various riparian habitat area management strategies on stream temperatures; and
- (3) Assess fish populations and insect communities to assess biological integrity of streams in the Planning Area over the life of the Permit.

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Monitoring activities that support watershed analysis and riparian habitat management such as stream temperature monitoring, landscape wide monitoring of aquatic habitat trends and biotic integrity stream assessments are described in Appendix A Tables A-1, A-2 and A-3, respectively.

Table A-1 is an overview of stream temperature monitoring and the effectiveness of HCP riparian prescriptions. The Table reveals small differences in upstream and downstream temperatures after harvest. The average difference in temperature cooling was 0.1 C, statistically insignificant.

Table A-2 summarizes landscape wide fish habitat and fish abundance response to a 200 ft RHA buffer prescription. Based upon before/after, control/ impact (BACI) design, pre harvest sampling revealed minimal difference (0.10) between the treatment and control groups of variable mean values describing channel, habitat, and large woody debris characteristics.

Finally, Table A-3 summarizes biotic integrity assessments. Stream benthic invertebrate community structure trend measurements indicate that the biotic integrity of sampled streams is good to excellent condition.

### 5.3.3 Modifications, Enhancements and Challenges to HCP Implementation

There have been many adjustments and refinements to the process of HCP implementation. In addition, Plum Creek Timber faced a few challenges. According to the 2000 HCP, results from (1) amphibian surveys linked to riparian habitat area monitoring and (2) breeding bird surveys were to be used to determine thresholds for triggering corrective action. In an effort not to duplicate state research, Plum Creek has delayed amphibian monitoring for the HCP. The Washington Department of Fish and Wildlife is addressing basic research questions about the biology of species such as Tailed Frogs (*Ascaphus truei*). Plum Creek Timber planned to conduct similar research, but decided to wait for outcomes produced from the state study. Plum Creek will also incorporate planned state research in conjunction with other regulations for streamside protection. The research is intended to answer questions about buffer effectiveness along streams (Personal communication, Plum Creek Timber staff, March 2005).

Thus, riparian management triggers for corrective action are now developed from stream temperature monitoring and fish and aquatic insect response to the harvest treatments (Personal communication, Plum Creek Timber staff, March 2005). See Table A1 of the Appendix for Plum Creek Timber's approach to stream temperature monitoring.

#### *Channel Migration Zones*

Members of the Muckleshoot Indian tribe recommended the protection of areas within and outside of channel migration zones, (Services interview, January 2004). Specifically, prescriptions were written for geomorphic settings where active stream channels rapidly shift positions within an active floodplain.

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Plum Creek Timber voluntarily extrapolated the channel migration zone prescription to all of its lands in the HCP upon the discovery of several watersheds with these conditions (Plum Creek 2001). The outer margin of the channel migration zone now replaces the ordinary high water mark as the place to begin riparian habitat areas and other riparian prescription. Areas along channel migration zones are no longer harvested throughout the HCP project area (Plum Creek 2001).

### *Intermittent Stream Protection*

A prescription was written for portions of intermittent streams where bank full widths are 2-ft or wider during watershed analyses for the Quartz Mountain, Naches Pass, and Big Creek watersheds. This prescription calls for the three following management options: (1) leaving a 33-ft wide Riparian Management Zone and retaining 33% of the representative timber, (2) leaving a 66-ft wide riparian management zone and retaining 66% of the representative timber, or (3) developing a site-specific plan. The purpose of the riparian management zone buffer is to provide a source of large woody debris for channel roughness and associated storage capacity for coarse and fine sediment (Plum Creek Timber 2001).

### *Perennial Seeps and Springs*

Perennial seeps/spring definitions and prescriptions that had not been addressed in the HCP were developed cooperatively with the Services and other stakeholders. Perennial seeps/springs are linear flowing water bodies that typically have no mineral bed or bank and that often occur outside of mass wasting areas. The prescriptions were independent of Watershed Analysis, but augment riparian protection (Central Cascades HCP Field Manual, 2001).

### *Yarding Corridors*

Adherence to the 15% yarding corridor riparian prescription (20% in special circumstances) was found to be a daunting task. Plum Creek Timber foresters experienced difficulty in finding local conditions that permit the harvest of opposite hillsides from one side of the stream. The Westside of the crest was found to have more suitable conditions comparable to the eastside due to steep topography however, the 15% threshold was difficult to achieve. Plum Creek Timber is considering building more roads to access timber from the opposite ridge, or using helicopter logging techniques to fulfill the yarding prescription. The company agreed to collect additional information on the nature and extent of the operational difficulties imposed by the 15% yarding corridor prescription. Subsequently, modifications to the prescriptions may be proposed (Plum Creek 2001)

### *Streamflow Monitoring in South Fork Taneum Creek*

Two stream gauges were installed along South Fork Taneum Creek in 1995 to provide data on baseline conditions and to monitor trends as timber harvest occurred in the basin. Equipment problems and other data collection difficulties limited the available period of record to November 1997 through June 2002. Stream flow monitoring at the two gauges were discontinued after July 2002.

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The lower station will be dismantled if the landowner chooses to have it removed. The upper facility will remain in place but will not be maintained. Stream flow monitoring is discontinued for the following reasons:

- Inadequate pre-harvest monitoring period to establish baseline conditions. The gages were only operating a few months before timber harvesting began in 1998 in the study basin.
- Insufficient number of flow peaks in the record to support statistical comparisons of pre- and post-harvest flows. Only a few peak flow events are recorded each year in the Taneum Creek and other eastside streams. The spring snowmelt period consistently produces the largest peak of most years. Summer and fall rainstorms produce a few other peaks, and occasional rain-on-snow events produce very large peaks. The duration of the study would have to be fairly large to generate enough samples to test for differences before and after harvest.
- Insufficient amount of projected timber harvest in the study basin to generate a detectable difference between upstream and downstream gages with statistical reliability.
- Research shows that peak flow differences are generally not detectable unless at least 20% of a basin is clearcut. Ownership changes in the South Fork Taneum sub-basin since streamflow monitoring began make it likely that timber harvest will occur in less than 10% of the sub-basin.
- High cost and effort of maintaining stations and ensuring data quality. Annual equipment maintenance and streamflow rating work is expensive (Plum Creek 2001)

Since 1996 stream type verification surveys have been conducted on 172 miles of stream in the HCP project area (Plum Creek Timber 2001). Plum Creek Timber found evidence of channel and habitat changes from flooding. A recent streamside harvest using a 200 ft. riparian habitat area was discounted as a contributing factor to channel and habitat changes (2003 Central Cascades HCP Annual Report).

Stream type surveys are expected to decline in next few years for following reasons: (1) Changes in land base; (2) anticipated declines in timber harvest; (3) Use of Service protocols for water type downgrades that streamline HCP implementation and (4) previously gathered information (Plum Creek Timber 2001).

Table A-4 in Appendix A provides an overview of stream type monitoring. The Table shows the company's approach to detecting fish distributions and inspecting perennial flow to ensure proper riparian prescription implementation. It indicates that federally listed fish species have not been encountered during those surveys.

### 5.4 Summary

This evaluation uncovered the evolving nature of the HCP and its implementation. Plum Creek Timber has enhanced some of its aquatic resources protections amidst delays and adjustments to original commitments, i.e.—watershed analysis.

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The company anticipates that despite changes in the timber inventory that initially reduced the percentages of stand structures, the amount of owl habitat will exceed amounts projected in the original HCP. However, Plum Creek has primarily focused on fulfilling state prescriptions and implementing best management practice, rather than learning through active adaptive management.

Moreover, there were mixed messages about the role of adaptive management for aquatic resources. Plum Creek view adaptive management as integral to watershed analysis. A Services official opined watershed analysis, riparian management and new road requirements as strictly regulatory and static. The same official initially claimed that there was not much adaptive management in the HCP for aquatic resources and then later stated that it may be too soon for adaptive management implementation (Services interview, January 2004).

### 5.5 Evaluation of Progress

This section is a progress evaluation to assess: 1) advancement in meeting the goals of the HCP, 2) whether or not performance measures and criteria were met, and 3) to identify what unexpected developments occurred. Early examples of active adaptive management are described. Results from Northern Spotted Owl monitoring are discussed at length followed by results from the Quartz Mountain watershed analysis review. Modifications to the HCP related to and mitigation implementation challenges for aquatic resources are also discussed. In addition, divergent opinions about why cooperative experiments did not occur with the U.S. Forest Service are shared. This assessment reveals the unexpected and significant decline of Northern Spotted Owl populations and the role of the Barred Owl in Northern Spotted Owl declines. Since there are no performance measures or benchmarks, the impacts of mitigation activities for terrestrial and aquatic resources are unclear. However, short-term outcomes of political and policy relevance are disclosed.

#### 5.5.1 Active Adaptive Management

Early examples of active adaptive management employed flexible silvicultural practices to achieve HCP habitat targets and to meet operational and forest regeneration needs (Plum Creek Timber 2001). However, review of these experiments reveal very small-scale study areas replete of controls and replication sites.

Although forest stands and inventory polygons are convenient for administrative purposes and may be cost effective operationally, the impacts of a large scale harvest operation cannot be deduced from small area studies within timber sales (stands). The effects of fragmentation, water quality, and changes in vegetation are not easily detected at this scale (Taylor *et al.*, 1997).

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### ***Mole Mountain***

The prey density study conducted in the Mole Mountain timber sale (stand) described in the Table A-5 of the Appendix A was conducted between 1994 and 1995, prior to the HCP. This study was designed as an experiment to ascertain the effects of timber harvest on Northern Spotted Owl prey density. Implemented within a 180-acre stand, the experiment revealed that population responses to timber harvest was species specific, but that northern flying squirrels, prey of the Northern Spotted Owl was less affected by timber harvest than other species. While the biological objective for was achieved, silvicultural implications of the experiment were severe. Specifically, the ability of stand regeneration was reduced, predisposing the unit to catastrophic fire due to slash accumulations and the high density of defective trees. The unit was later exchanged with the U.S. Forest Service.

Despite the land exchange, the objective of the prey density study could have been achieved in other areas of Plum Creek Timber's ownership. Instead of focusing this study in one timber sale, ideally, the entire HCP project area could be tested. For example, a study of the HCP project area could be conducted to determine the best method of partial cutting to minimize harvest impacts on wildlife.

Specifically, the study design could consist of timber sales (stands) within the Puget Sound Harvest unit (west of the cascades) and the Yakima Harvest Unit (east of the Cascades) established as experimental units. These units could receive several treatments (cable logging with skyline motor carriage, helicopter logging, mechanized logging involving a tractor, etc.) to determine which treatment minimizes impacts on Northern Spotted Owl habitat.

Another approach might be to vary the harvesting activity within the timber sales/stands (e.g., clear cut, partial cutting, or not cutting) to monitor and detect trends in wildlife density over a period of years. Differences in wildlife responses could be observed between experimental units within the same geographical area. Of course, these units must be comparable in stand type and size to allow for the validation of scientific findings. Results from experiments contribute to a stronger knowledge base that helps reduce uncertainties in managing for timber and wildlife under changing conditions (Taylor *et al.*, 1997).

### ***Big Frosty***

Lessons from the first project led to an experiment that was conducted within the Big Frosty stand following HCP approval. The objective of the experiment was to explore the effectiveness of foraging dispersal corridors (approach described in Table A-6, Appendix A). In particular, harvest corridors within a 145-acre forest stand were designed to facilitate movement and dispersal of owls to other areas within the landscape.

Unlike the Mole Mountain unit, the silvicultural goals of active reforestation and regeneration of desired forest types was achievable. Trees were planted in the spring 1998 and inspection of seedlings two years later revealed stand regeneration.

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The approach to establishing foraging dispersal corridors an objective of the Northern Spotted Owl strategy was rather limited. An alternative approach could have involved an experiment to test whether foraging dispersal is functioning as nesting roosting foraging habitat for Northern Spotted Owls. This experiment could be used to justify the company's emphasis on foraging dispersal habitat protection.

Although, it appears that in practice, HCP implementation focuses on protecting and maintaining riparian habitat areas as corridors rather than establishing foraging dispersal habitat as corridors. Another experiment could compare linkages of foraging dispersal habitat and nesting roosting and foraging habitat to riparian buffers to test the effectiveness of habitats for Northern Spotted Owl dispersal.

Other terrestrial research and monitoring activities include: goshawk protections, breeding bird surveys and wildlife reserve tree and green retention tree monitoring. Two goshawk studies were launched in the Cooper Lake and Peaches Ridge stands in 1994 and 1999, respectively. The 1994 study involved harvest avoidance of five-acres surrounding the goshawk nest site. The nest produced young during the harvesting activity in 1994. In 1996 and 1997, the pair nested and produced young each year.

The 1999 study involved establishing a 150 ft no cut buffer and a corridor to connect the nest area to a riparian strip adjacent to U.S. Forest Service land. Goshawk fledged 2 young in 1999, but no goshawk activity has been observed since 2000.

A breeding bird survey was conducted as part of a thesis project (Manuwal and Gergen 2001) to evaluate breeding bird associations with HCP forest stand structures. The study recommended more standing and forest floor deadwood that provide structural components. Deciduous tree and understory shrub development was also encouraged.

Wildlife reserve tree and green retention tree monitoring described in Table A-7 of Appendix A involved comparing post harvest results with HCP guidelines and State Forest Practice Rules. Results revealed that Plum Creek Timber met the State tree size and volume criteria on the east and west of the Cascades.

### **5.5.2 Nesting, Roosting, and Foraging Habitat Deferrals and Foraging Dispersal Corridors**

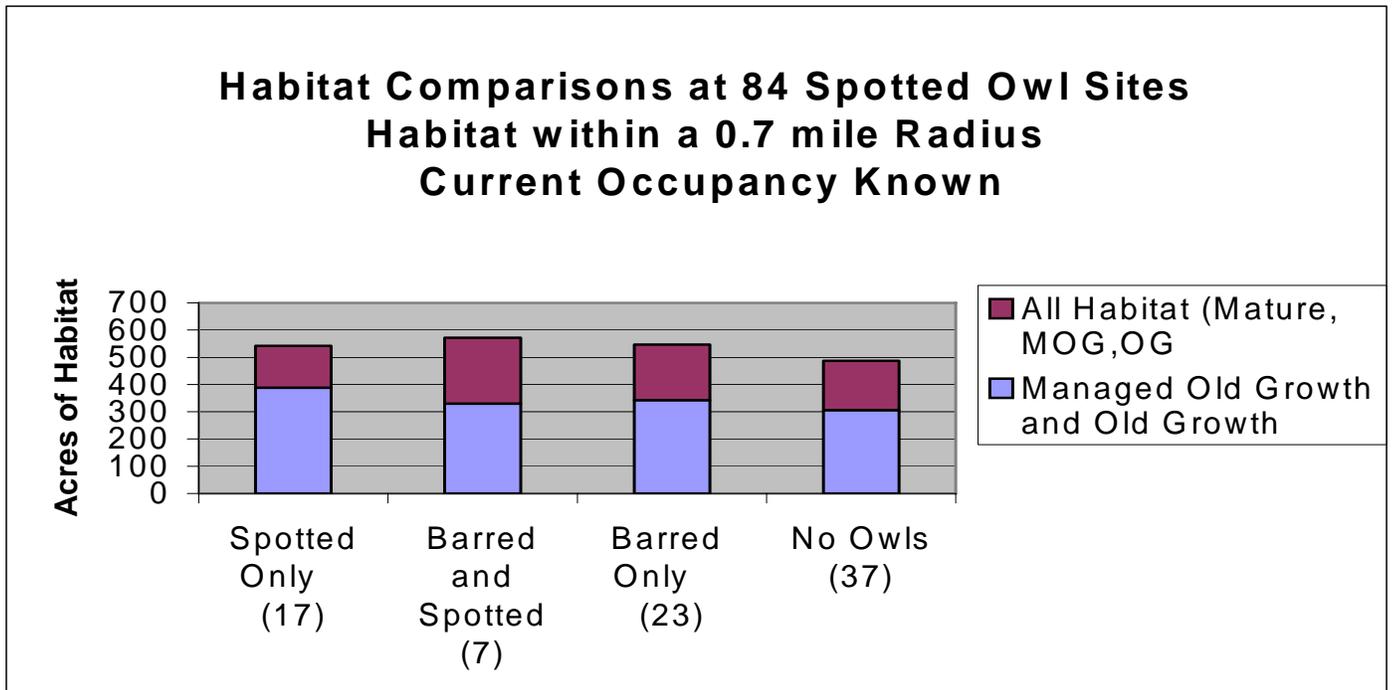
Barred Owls have been observed sharing Northern Spotted Owl nesting sites for multiple years. This indicates that their territories are well established and stable. Subsequently, Barred Owls now outnumber Northern Spotted Owls in sights originally occupied by Northern Spotted Owls at HCP inception.

Plum Creek Timber assessed the effectiveness of nesting, roosting and foraging deferrals and foraging dispersal corridors relative to current occupancy status of Northern Spotted Owls and Barred Owls. The company evaluated 84 sites with habitat data and verified occupancy status.

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Figure 5-2 indicates that the amount of total habitat (mature, managed old growth and old growth structure types) did not vary significantly between sites that remained Northern Spotted Owl sites where Barred Owls are now dominant or co-existent (Plum Creek Timber 2001). Results suggest that the turnover of Northern Spotted Owl sites to Barred Owls is not singularly related to the amounts of habitat around the nest site.

**Figure 5-2 Habitat Comparisons at Northern Spotted Owl Sites**



(Source: Plum Creek Timber 2001)

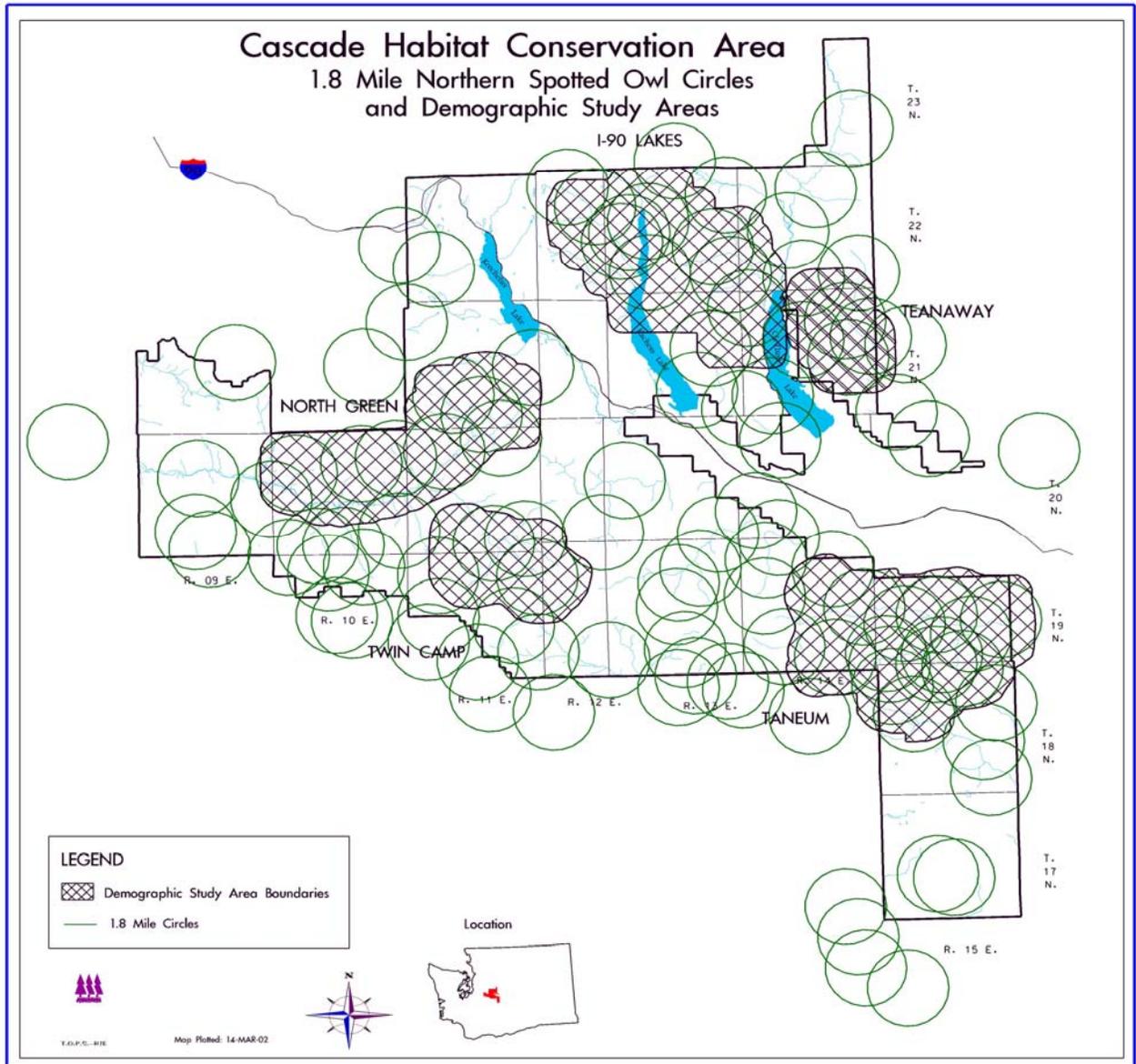
### 5.5.3 Northern Spotted Owl Demographic Monitoring

Plum Creek Timber and the Forest Service exchange information and data on Northern Spotted Owl movement and collaborate on Northern Spotted Owl monitoring (Forest Service and Plum Creek Timber Interviews, February through May 2004; Plum Creek Timber 2001). Specifically, demographic monitoring consists of three surveys to verify owl occupancy and productivity throughout the year by Plum Creek Timber, and its contractors exclusively on the west side of the Cascades. Monitoring on the east side of the Cascades is conducted in cooperation with U.S. Forest Service scientists from the Cle Elum Ranger District.

First, protocol surveys are conducted in demographic study areas in late successional reserves, adaptive management areas and matrix landscapes described in the Northwest Forest Plan. 1997 and 1998 surveys were conducted in the following Eastern Cascade subunits: North Green River, I-90 Lakes, Teanaway, Twin Camp and Taneum subunits. These subunits represent 39% of the HCP Planning Area as shown in Figure 5-3 (Hicks, Herter and Early 2002).

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Figure 5-3 Northern Spotted Owl Demographic Monitoring Areas



(Source: Plum Creek Timber 2001)

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Figure 5-3 shows the characteristics of the demographic study areas that also considered sites with foraging dispersal habitat corridors and nesting roosting and foraging habitat deferrals. The survey detected a new, previously unknown owl site, Rachel Lake that is more than two miles from Plum Creek ownership. All recently active, known owl sites within the demographic study areas were detected during the surveys (Central Cascades HCP 2000 Annual Report).

The I-90 Land Exchange between Plum Creek and the U.S. Forest Service decreased Plum Creek ownership within the I-90 Lakes Demographic Study Area to approximately 18%. The “Option-to-Buy” within the exchange agreement will further decrease company ownership. Subsequently, monitoring within the I-90 Lakes will not continue in the future, although voluntary monitoring will continue for the short term. The remaining study areas representing 28% of the Planning Area will retain Plum Creek ownership and surveys will continue according to the HCP Monitoring and Reporting schedule (Table 4-5, Chapter 4) (Central Cascades HCP 2000 Annual Report).

A further analysis of the demographic study areas indicates the small number of foraging dispersal corridors relative to the total acreage for each study area. The nesting, roosting foraging deferral sites represent only 1.5% of the HCP Project Area as agreed during HCP negotiations. This presents an opportunity to link foraging dispersal and nesting roosting foraging habitat in these demographic study areas providing an added value to for the Northern Spotted Owl. According to a state official, linkages have not been made (State official interview, February 2004). In addition, given the significance of the I-90 Corridor, Plum Creek Timber should continue monitoring within the I-90 Lakes demographic study area at least until the land is purchased by the U.S. Forest Service.

**Table 5-7 Characteristics of Demographic Study Areas**

DSA Name	Acres	Regulatory Owl Sites	Sites with FD Corridors	Sites with NRF Deferral
I-90 Lakes	45,300	11	2	5
Teanaway	37,600	5	0	0
North Green	46,200	8	4	4
Twin Camp	15,100	6	1	1
Taneum	19,400	14	5	3
Total	163,600	44	12	13

Source: Plum Creek 2001.

Second, surveys of recently active known sites outside the demographic study areas were also conducted in 1997 and 1998. Surveys were conducted in the entire HCP Planning area in 1996 and 1999. All surveys on the east of the Cascades were conducted in cooperation with the U.S. Forest Service researchers at the Cle Elum Ranger District Lab (Hicks, Herter and Early 2002). According to a 2000 Annual Report, survey results provide information on owl site density, owl productivity, population dynamics, owl site movements, individual owl movement, survival and habitat use. However, no further information is provided about how the survey results changed or enhanced the company’s knowledge of spotted owl life history. Furthermore, there is no information about how this new knowledge might influence Plum Creek Timber’s management practices.

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Third, project level surveys were conducted within harvest units (Puget Sound and Yakima) to verify that no active nests existed prior to the initiation of timber harvest operations. Each project level survey area was comprised of three to six calling stations from which calls are made three times over the season. Approximately 302 project level surveys were conducted within the HCP project area between 1996 and 2001.

Occupancy and productivity surveys of 107 known sites in and adjacent to, 0.7-miles of the HCP Planning Area were conducted from 1995 to 2001. Plum Creek evaluated nesting, roosting, and foraging habitat and foraging dispersal habitat within the 0.7-mile radius of owl sites to test the hypothesis that the high spotted owl site vacancy rate is related to timber harvest in late successional habitat (Hicks, Herter and Early 2002).

Over the five years of HCP implementation, timber harvest patterns and changes in timber inventory (i.e.--polygons replacing management units) contributed to the decline of nesting, roosting, and foraging and foraging dispersal habitat declines. A detailed analysis of a subset of 93 sites revealed the following:

- 45 sites that were vacant in 1997 remained vacant in 2001;
- 5 sites that were vacant in 1997 were occupied in 2000 by spotted owls;
- 21 sites were occupied in 1997, but these sites were vacant in 2001. The habitat amounts within 1997 and 2001 did not significantly vary between occupancy categories, based on paired t-tests (Hicks, Herter and Early 2002).
- Spotted owls continued to occupy 22 sites from 1996- 2001 (Hicks, Herter and Early 2002).
- The 22 sites maintaining spotted owls throughout the 5 yr. period had the lowest amount of total habitat in both 1997 and 2001. These sites when combined experienced a 16% reduction in habitat over the five-year reporting period (Hicks, Herter and Early 2002).

### *Relationship between Northern Spotted Owls and Barred Owls*

Barred Owls have been observed at the same sites over multiple years, indicating that their territories have become established and are stable. Of the 107 sites in or adjacent to the HCP Planning area, 31 are known or suspected to support a Barred Owl territory. Barred Owls now outnumber spotted owls in sites originally occupied by spotted owls at the inception of the HCP. Subsequently, the overall spotted owl population in the HCP project area appears to have declined substantially from 120 owls in 1992 to 69 at the inception of the HCP to 48 in 2001 (Hicks, Herter and Early 2002). Northern Spotted Owl researchers from the U.S. Forest Service and the National Council for Air and Stream Improvement confirm a similar trend in other Washington populations (Plum Creek Timber 2001).

The FWS commissioned a Northern Spotted Owl population study as part of the 2004 Northern Spotted Owl Listing Status Review. Data from 14 demographic study areas within Washington, Oregon, and California were analyzed to estimate trends from the period of 1985 through 2003. Data was provided from the Northwest Forest Plan monitoring program, Tribes, other agencies and private organizations.

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Plum Creek provided information to the FWS and made a presentation at the FWS Status and Trends (1985 – 2003) of the Northern Spotted Owl Review workshop. Preliminary results indicate that the greatest declines in population across the range of Northern Spotted Owl occurred in Washington (7.5% per year). Oregon declined by 2.8% per year and California by 2.2% per year ([www.reo.gov/monitoring/trends](http://www.reo.gov/monitoring/trends)).

### 5.5.4 Resource Selection Prediction Function Model

The Resource Selection Probability Function (RSPF) model (page 15, Chapter 4) was refined in November 2001 and February 2002 based upon new owl habitat information obtained from updated timber inventory data, demographic surveys on Northern Spotted Owl occupancy and productivity. The RSPF was further enhanced through the evaluation of multiple models using Akaike's Information Criterion (AIC). Specifically, data were compiled on 92 resource units (0.7 mile circles) used by spotted owls and 51 random units that were not used. The most biologically relevant variables selected on the basis of AIC and professional judgment were the: (1) number of mature forest acres, (2) number of managed old growth acres, (3) number of acres in old growth, (4) number of acres in riparian zones, (5) range in elevation (meters), and (6) minimum 50-year site index for Douglas fir (feet). These variables were used in the 2002 RSPF equation (Plum Creek Timber 2001). Table 5-8 compares the 1995 RSPF carrying capacity projections with results from the 2002 RSPF equation (Hicks, Herter and Early 2002).

**Table 5-8 Comparison of projected spotted owl carrying capacity in the Cascades HCP Area using 1995 RSPF equation and 2002 revised RSPF equation**

<u>Year</u>	<u>1995 Equation</u>	<u>1995 Equation (w/o Rate)</u>	<u>2002 Equation</u>
2006	83	106	104
2016	84	108	105
2026	86	110	108
2036	88	113	114
2045	89	114	118

(Extracted from Manley 2002.)

The most significant reason for the changes in the outputs of the two equations is that the 78% occupancy rate (discussed on pg. 15, Chapter 4) is no longer included in the equation to estimate the expected number of owl sites occupied. This occupancy rate was dropped from the equation because the rate has not remained stable, probably due to weather and Barred Owl competition. The output now estimates the actual number of "available" owl sites (maximum carrying capacity) estimated to be present in the planning area (Hicks, Herter and Early 2002).

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Other changes are due to the fact that more mature and old growth habitat is present on the U.S. Forest Service land due to improved inventory data. According to Plum Creek Timber, late successional forest types make up 3 of the 6 variables in the new RSPF, so that an increase in the availability of these types in the HCP area increases the probability of more resource units supporting Northern Spotted Owls. Of the 107 known owl sites at HCP initiation, as of 2001:

- 20 occupied by Northern Spotted Owls,
- 31 occupied by Barred Owls,
- 7 occupied by both species, and
- 49 were vacant (Hicks, Herter and Early 2002).

Plum Creek's decision with the approval of the Services to remove the occupancy rate from the equation absolves the company from trying to understand why spotted owls are not present. Estimating the number of available owl sites does not inform the company about the quality of the habitat on Plum Creek land. The rationale that mature and old growth habitat is present on adjacent U.S. Forest Service further provides the excuse not to learn about Northern Spotted Owl responses to mitigation and management practices. Moreover, investigations could be made to determine how past and current land use has altered habitat, influencing species interactions, i.e. – territorialism or competition between Barred Owls and Northern Spotted Owls.

### *Evaluation of Barred Owl Occupancy*

The revised RSPF equation was used to evaluate the shift of spotted owl sites to Barred Owl sites in the HCP area. The 0.7 -mile resource units of 93 spotted owl sites were calculated for which current occupancy was known in the HCP. Table 5-9 reveals that sites that have remained vacant before and after the HCP was initiated have a reduced probability of predicted occupancy by Northern Spotted Owls. According to Plum Creek this result suggests that sites were marginal in their configuration of physical and habitat features. In addition, consistently vacant owl sites were generally sub optimal in 1996 and remain so at present (Hicks, Herter and Early 2002).

Interestingly, those sites that have gone vacant with the last 5 years (including sites that now support Barred Owls) increased slightly in their RSPF "score" from 42% average probability of occupancy to 46%. Similarly, the 22 sites that have remained occupied by Northern Spotted Owls had the strongest "score" in 1996 and remain so at present (Hicks, Herter and Early 2002).

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**Table 5-9.** Resource selection probability function results (average percentages) for 0.7-mile radius circles around 93 owl sites with varying occupancy histories (1996-2000).

<b>Status: 1996-2000</b>	<b>Number of sites in Category</b>	<b>RSPF (1996)</b>	<b>RSPF (2000)</b>
<b>Vacant-Vacant</b>	45	41%	35%
<b>Vacant-Occupied</b>	5	52%	40%
<b>Occupied-Vacant</b>	21	42%	46%
<b>Occupied-Occupied</b>	22	58%	60%

Significant differences between average percentages occurred only between the occupied-occupied case and all other categories ( $P < 0.05$ ). Source Plum Creek 2001.

### 5.5.5 Northern Spotted Owl “Take” from 1997-2001

Plum Creek evaluated the change in nesting, roosting and foraging habitat within 1.82 and 0.7 mile radii around 93 Northern Spotted Owl sites between 1997 and 2001. Those sites for which nesting, roosting and foraging reductions crossed 40% (within 1.82 mile radius) and 50% (within 0.7 mile radius) thresholds (determined by FWS biological opinion) were analyzed for the source of reduction. Twenty-eight Northern Spotted Owl sites crossed the threshold of decline with one or both radii. Timber harvest occurred in 18 sites, while the remaining ten sites were not harvested. Habitat definition changes occurred in the 10 sites. In the eighteen sites where timber harvest occurred:

11 occupied by Barred Owl

2 contained Northern Spotted Owls

5 vacant prior to the HCP remain vacant (Hicks, Herter and Early 2002).

Plum Creek Timber asserts that there is no relationship between habitat related trends, Northern Spotted Owls, Barred Owls and vacant sites (Plum Creek Timber 2001). In addition, despite the preponderance of Northern Spotted Owl population declines that have fallen below 80% of the RSPF predicted value, Plum Creek has not volunteered, nor have the Services requested an analysis of causative action or invoked extraordinary circumstances. Moreover, the FWS has not recommended the reallocation of conservation among species and habitat to avoid jeopardy to species. Options for management modifications are identified on page 36, Chapter 5. It should be noted that Plum Creek Timber presented results of Northern Spotted Owl monitoring at the HCP 5-year review in May 2001. The RSPF model was refined in November 2001 and February 2002 resulting in the removal of the spotted owl site occupancy rate. It can be assumed that the removal of the occupancy rate provides the company with further certainty that it will not be expected to provide mitigation under extraordinary circumstances.

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Under extraordinary circumstances, the weather and the Barred Owl would be considered external factors, requiring the Services to bear the cost of habitat protections. However, by removing the threshold for Northern Spotted Owl corrective action, Plum Creek will no longer need to be concerned about the possibility of modifying their management and mitigation as agreed in the HCP. As a Plum Creek stated, “we are in the business to make money and require long-term certainty to make strategic decisions (personal communication, May 2004)”.

While the company has not conducted studies on why the Barred Owl has exponentially invaded Northern Spotted Owl territory, Plum Creek is consistent in stating that the declines are not related to habitat loss. Both the Services and Plum Creek assert that Plum Creek’s adjacency to non harvested U.S. Forest Service lands provide ample Northern Spotted Owl habitat. The Services also speculate the cause of Northern Spotted Owl declines. The follow quotes provide such evidence:

“The spotted owls are declining continuously as well as its reproductive success. The Barred Owl invasion is a principal factor. However, the weather and other invasive species could also be a factor. There have been no catastrophic events. Since the Forest Service has not harvested there is less change in the habitat as originally conceived (Services interview, January 2004)”.

“We planned on the Forest Service harvesting. Since they haven’t, there is more habitat available for the NSO. This counters the argument that the decline in NSO is due to habitat management (Plum Creek staff interview, April 2004)”.

A U.S. Forest Service official spoke of the challenge in teasing out the factors that contribute to Northern Spotted Owl declines. However, the official alluded to habitat loss as a factor for Northern Spotted Owl declines. Provided below is an excerpt of our interview:

“It’s difficult to monitor population trends and find out causes and effects of trends. The problem is it’s impossible to measure population trends and proving barred owl vs. habitat is the cause of Northern Spotted Owl declines (Interview with Forest Service Researcher, February 2004)”.

A Plum Creek official’s response to my question about corrective action and adaptive management included a statement about the complex relationship between Barred Owls and Northern Spotted Owls. Interestingly he referred to the potential consequences of Northern Spotted Owl declines as imposed by the state forest and fish rules rather than the FWS. Deference to state regulations is a consistent theme in my evaluation of HCP implementation.

“The decline has not triggered adaptive management yet, but we will be taking a closer look at these declines. We just haven’t figured out the reason for the Northern Spotted Owl decline. The barred owl is very difficult to locate. They are competitive, aggressive and are generalist in their use of the habitat. This is an interesting issue that you should continue to watch. There will probably be debates on whether more habitat should be left and what role the state forest and fish rules should play (Plum Creek staff interview, February 2004)”.

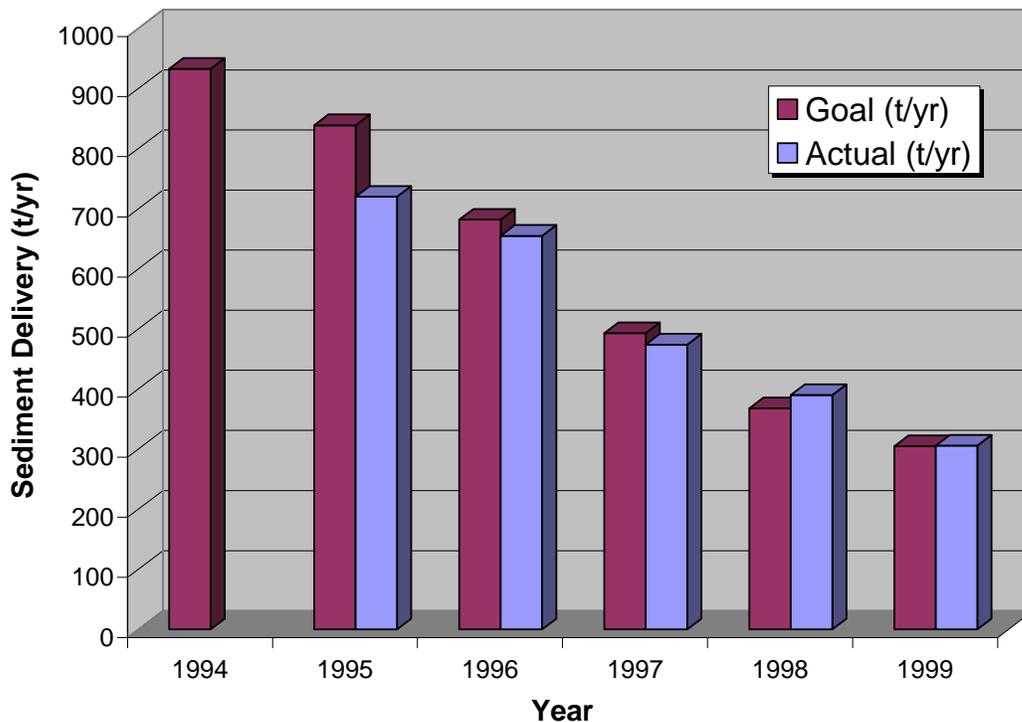
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### 5.5.6 Quartz Mountain Watershed Administrative Unit 5-Year Review

The Quartz Mountain Watershed Administrative Unit is the only watershed in the HCP that has undergone a formal 5-year Review. The Naches Pass WAU analysis was completed in 1994 and should have been presented at the 5-year Review. The Lester Watershed Administrative Unit analysis completed in 1998 had not undergone a 5-year Review as of May 2004. There were three topics addressed in Quartz Mountain review: (1) compliance with prescriptions, (2) effectiveness of prescriptions, and (3) validation update of the science that was used in the original analysis.

Plum Creek Timber determined that compliance was high, noting the effectiveness of road erosion control prescriptions. The company claimed that other prescriptions (e.g. -- large woody debris recruitment) required a longer timeframe for effectiveness testing. The effectiveness of road sediment abatement efforts is illustrated using the upper Taneum Creek watershed within the Quartz Mountain Watershed Administrative Unit as a case study. In this Watershed Analysis, strict annual sediment reduction targets were established with a goal of achieving inputs equal to less than 50% of natural background levels within five years. Figure 5-4 shows the trends in estimated road sediment inputs to the North Fork Taneum Creek watershed revealing that the sediment reduction goal was achieved in 1999.

**Figure 5-4. Trends in estimated road sediment inputs to the North Fork Taneum Creek watershed, Washington.**



Source: Plum Creek 2001.

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Since 1999, few roads have been constructed and road maintenance continues in the basin. The establishment of road best management practices led to the upgrade of 96 miles of roads, road abandonment of 22 miles and 139 miles of roads constructed based upon improved state standards. Subsequently, more water is being dispersed onto the forest floor. Finally, road enhancements have also contributed to fish passage improvements (Central Cascades HCP 2003 Annual Report).

Road management plans that accompany watershed analysis have identified sediment delivered to streams facilitating the mitigation of landslides, and steep and unstable slopes. Based upon observation, Plum Creek Timber asserts to have reduced sediment intakes to streams. Mass wasting hazard areas have been identified throughout the planning area and prescriptions are applied HCP wide (Plum Creek Timber 2001).

Responding to my probe about adaptive management for watershed analysis a Plum Creek Timber official stated, “the best example of modifications related to watershed analysis is the addition of riparian buffers along selected intermittent streams. For instance, the 2001 Keechelus-Mosquito Creek Watershed Analysis recommends buffers on some seasonally-flowing streams crossing erosive materials where delivery of the sediment to downstream fish-bearing waters could be substantial”. “Another example is for the adoption of Watershed Analysis prescriptions for channel migration zones which are now applied as no-harvest protections throughout the HCP” (personal communication with Plum Creek Timber staff, March 2005).

Watershed analysis extrapolation was an outcome of the Quartz Mountain 5-year Review. A proposal due in 2002 describing the extrapolation process, and the time intervals between reviews was not available. Subsequently, the company will consolidate reviews of all eastside watersheds into one group, and all west-side watersheds into another group given the, to provide comparable benefits more quickly and at lower costs.

Plum Creek Timber has provided an anecdotal 5-year assessment of the Quartz Mountain watershed. Beyond road improvements, Plum Creek Timber has not demonstrated measurable improvements in the other modules identified in Table 4-6 in Chapter 4. Despite the divestment in watershed analysis by the state in 2000, it is assumed that the Services would be interested in the effectiveness of all module prescriptions in improving the Quartz Mountain watershed condition.

### **5.5.7 Modifications, Enhancements and Challenges to HCP Implementation**

The 2000 HCP indicates that results from (1) amphibian surveys linked to riparian habitat area monitoring and (2) breeding bird surveys would be used to determine thresholds for triggering corrective action. However, amphibian monitoring for the HCP has been delayed since the Washington Department of Fish and Wildlife is addressing basic research questions about the biology of species such as Tailed Frogs (*Ascaphus truei*) that were intended for exploration by Plum Creek Timber.

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Research in conjunction with other regulations for streamside protection that will answer questions about the effectiveness of buffers along streams is also being planned by the state (Personal communication, Plum Creek Timber staff, March 2005).

Hence, trigger for corrective action are now developed from stream temperature monitoring and fish and aquatic insect response to the harvest treatments (Personal communication, Plum Creek Timber staff, March 2005).

### *Perennial Seeps and Springs*

Perennial seeps/spring definitions and prescriptions that had not been addressed in the HCP were developed cooperatively with the Services and other stakeholders. Perennial seeps/springs are linear flowing water bodies that typically have no mineral bed or bank and that often occur outside of mass wasting areas. The prescriptions were independent of Watershed Analysis, but augment riparian protection (Central Cascades HCP Field Manual, 2001).

### *Yarding Corridors*

The 15% yarding corridor riparian prescription (20% in special circumstances) was found to be challenging. Plum Creek Timber foresters experienced difficulty in finding local conditions that permit the harvest of opposite hillsides from one side of the stream. The Westside of the crest was found to have more suitable conditions comparable to the eastside due to steep topography however, the 15% threshold was difficult to achieve. Plum Creek Timber is considering building more roads to access timber from the opposite ridge, or using helicopter logging techniques to fulfill the yarding prescription. The company agreed to collect additional information on the nature and extent of the operational difficulties imposed by the 15% yarding corridor prescription. Subsequently, modifications to the prescriptions may be proposed (Plum Creek 2001).

### *Streamflow Monitoring in South Fork Taneum Creek*

Two stream gauges were installed along South Fork Taneum Creek in 1995 to provide data on baseline conditions and to monitor trends as timber harvest occurred in the basin. Equipment problems and other data collection difficulties limited the available period of record to November 1997 through June 2002. Stream flow monitoring at the two gauges were discontinued after July 2002. The lower station will be dismantled if the landowner chooses to have it removed. The upper facility will remain in place but will not be maintained. Stream flow monitoring is discontinued for the following reasons:

- Inadequate pre-harvest monitoring period to establish baseline conditions. The gages were only operating a few months before timber harvesting began in 1998 in the study basin.
- Insufficient number of flow peaks in the record to support statistical comparisons of pre- and post-harvest flows. Only a few peak flow events are recorded each year in the Taneum Creek and other eastside streams. The spring snowmelt period consistently produces the largest peak of most years.

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Summer and fall rainstorms produce a few other peaks, and occasional rain-on-snow events produce very large peaks. The duration of the study would have to be fairly large to generate enough samples to test for differences before and after harvest.

- Insufficient amount of projected timber harvest in the study basin to generate a detectable difference between upstream and downstream gages with statistical reliability.
- Research shows that peak flow differences are generally not detectable unless at least 20% of a basin is clearcut. Ownership changes in the South Fork Taneum sub-basin since streamflow monitoring began make it likely that timber harvest will occur in less than 10% of the sub-basin.
- High cost and effort of maintaining stations and ensuring data quality. Annual equipment maintenance and streamflow rating work is expensive (Plum Creek 2001)

Since 1996 stream type verification surveys have been conducted on 172 miles of stream in the HCP project area (Plum Creek Timber 2001). Plum Creek Timber found evidence of channel and habitat changes from flooding. A recent streamside harvest using a 200 ft. riparian habitat area was discounted as a contributing factor to channel and habitat changes (2003 Central Cascades HCP Annual Report).

Stream type surveys are expected to decline in next few years for following reasons: (1) Changes in land base; (2) anticipated declines in timber harvest; (3) Use of Service protocols for water type downgrades that streamline HCP implementation and (4) previously gathered information (Plum Creek Timber 2001).

### 5.5.8 Cooperative Experimental Areas

The HCP was designed to complement the Northwest Forest Plan that established guidelines to protect late successional forests for the Northern Spotted Owl within Adaptive Management Areas (pg. 7, Chapter 4). Plum Creek Timber and the U.S. Forest Service have not employed active adaptive management in the Snoqualmie Pass Adaptive Management Area (SPAMA) for a host of reasons to include:

1. Irreconcilable management objectives
2. Resurrection of Private property rights and deference to economic interests;
3. Mistrust; and
4. Limited USFS funding and changes in priorities; and
5. Differences in institutional cultures.

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### ***Irreconcilable Management Objectives***

Interviews with various U.S. Forest Service scientists and administrators, Plum Creek Timber staff, and environmental stakeholders are the basis for these diverse claims. Comments from some U.S. Forest Service scientists imply that the HCP is not intended to protect late successional habitat.

Having worked with the FWS and Plum Creek in the development of an Environmental Impact Statement for the SPAMA, a U.S. Forest Service scientist provided a historical perspective of the planning process: “Based upon an analysis of how much Northern Spotted Owl habitat would be left 10-20 years in the AMA...Plum Creek ...would be able to reduce habitat in the AMA at 10% making adaptive management impossible. There was no cutting in U.S. Forest Service land (personal communication, Forest Service official, February 18, 2004).”

Another scientist corroborated these claims by arguing, “HCPs never managed for late successional forest, they allow harvest of owl habitat. Plum Creek Timber redefined their forest classifications and habitat types that associated species with second growth instead of old growth. This reclassification was published as a company technical report that contradicted the current literature (personal communication, Forest Service official June 2004).”

### ***Resurrection of Private Property Rights and Deference to Economic Interests***

These scientists were very passionate in their statements with one admitting that he was personally upset about the decision process. Other statements from U.S. Forest Service scientists are consistent with the idea of the HCP being favorable toward Plum Creek Timber’s interest. However, scientists blamed the FWS for not requiring Plum Creek Timber to protect late successional forests (Northern Spotted Owl habitat). The following statements suggest the uneven distribution of conservation responsibility and the political pressure to approve an HCP that was acceptable to Plum Creek Timber:

“ The USFWS held the USFS to the federal standard but not Plum Creek (personal communication, Forest Service official, February 18, 2004).”

“It was clear that the FWS was trying to hit a home run with the HCP (personal communication, U.S. Forest Service official, February 18, 2004).”

“The burden of conservation was placed on the agency to allow Plum Creek to be more liberal with “take” (personal communication, environmental stakeholder, February 2004).”

Plum Creek Timber staff did not directly address the issue of private property rights. However, company staff did mention its regulatory certainty of not having to provide additional land or finances toward species/habitat protections beyond the HCP agreement.

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### *Mistrust*

Another U.S. Forest Service scientist freely disclosed his bias against HCPs.

“...I have a cynical view of HCPs for owls particularly as implemented by Plum Creek and Weyerheuser. HCPS are prescriptions for extinction. (February 23, 2004)”

An environmental stakeholder did not have much expectation for adaptive management in the SPAMA given the limited quantity of suitable habitat:

“... there was not much room for adaptive management on late successional forest given its limited amount in public and private landownership and its fragmentation (personal communication, environmental stakeholder, February 2004).”

U.S. Forest Service administrators were more philosophical and diplomatic in their responses. Sharing his experience in planning for adaptive management in AMAs, one official stated: “there are few successful examples of adaptive management—because of the culture. People are not interested in taking an objective look. They have low trust. People in agencies stick to their own personal values in implementing initiatives. They want to implement their own resource goals (personal communications with Forest Service official, April 9, 2004).”

### *Limited U.S. Forest Service Funding and Changes in Priorities*

In response to my question about the implications of not cooperatively implementing adaptive management given the checkerboard configuration, another U.S. Forest Service official said “the land exchange was worked out cooperatively within the Snoqualmie Pass area to eliminate edge effects of forest management.”

He further stated that “with the exception of some isolated areas, the checkerboard ownership no longer exists; 62K acres has been blocked up. In addition, there is \$2 million allotted for additional land exchanges with the Forest Service (personal communication, Forest Service official, February 2004).” This official’s response indicated that unlike some Plum Creek Timber staff, he was not familiar with the concept of adaptive management. He further defended Plum Creek Timber by stating: “Plum Creek was willing to implement adaptive management, but failure of implementation may be the fault of the Forest Service that had restrictive standards and guidelines and no money for work in the AMA.

There was also a shift in Forest Service priorities— where the focus became ecological restoration of areas outside of the AMAs (drier forest, e.g., Ponderosa Pine, prone to catastrophic fires and lower elevation forests where NFP stopped clear cutting) (personal communication, Forest Service official February 18, 2004)”

In general, there have been few examples of adaptive management for Northern Spotted Owls in AMAs as suggested by this U.S. Forest Service Official. A state official further suggested that the lack of implementation was more of a federal issue rather than an issue of Plum Creek Timber (State official interview, January 2004).

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### *Differences in Institutional Cultures*

Plum Creek Timber mentioned the lack of consensus on procedural responsibilities for cooperative experimentation. Specifically Plum Creek and the U.S. Forest Service could not agree on whose ownership would be used for treatments and controls.

“They had a lot of the forests that were amenable to that kind of thing right next to ours, to where we could have done some larger treatments. But as long as they were resistant and unable to do any active timber management, even in an experimental way, we just couldn’t make that work (Plum Creek Timber staff Interview, April 5, 2004).”

### **5.5.9 Short Term Outcomes**

Plum Creek Timber is divesting from Washington for a number of reasons. First, Washington’s regulations have been a deterrent for the company. Apparently, the state’s Forest Practice Act and Timber Fish and Wildlife Agreement restrict timber harvest and require expensive road maintenance.

Second, Plum Creek Timber engaged in a major land exchange with the U.S. Forest Service and has placed a number of stands and watershed administrative units under “Options-to-Buy”. The company soon discovered that their land is valuable to numerous stakeholders for conservation, acquisition or development. Having just acquired over 300,000 acres in Oregon, the company is investing in other states. Subsequently, Plum Creek Timber is “exploring lands sales in an upcoming HCP and will be looking to amend the Central Cascades HCP in the future, to bring land sales into the HCP as an accepted practice”(Plum Creek Timber staff interview, April 2004).

As Plum Creek Timber continues to divest their lands in Kittitas County, other developers have encroached into previous wildlands. Specifically, Plum Creek Timber land that was not a part of the HCP project area is now being subdivided for residential development in the towns of Cle Elum and Roslyn (State official interview, February 2004). Part of the land in Cle Elum is being configured for a golf course.

Third, to achieve immediate maximize returns from timber, quickly clear-cut old growth forest over the years, planting regeneration forests, with species mixes as replacements. Consequently, Plum Creek Timber’s short- term rotation strategy has reached a drop in yield (Plum Creek Timber staff interview, April 2004). In addition, the demand for timber in the Pacific Northwest has declined. This would provide little economic incentive over the long term to maintain remaining old growth and to retain the integrity of the forest for the Northern Spotted Owl.

According to Plum Creek Timber there is no commercial thinning occurring in the HCP project area because there is an age gap of stands with trees 30 to 40 years old (Plum Creek Timber staff interviews, April & May 2004). Most of the trees in the landscape are very tall with a relative small diameter width (Site visit May 2004). However, an experiment could explore how to thin stands to accelerate diameter growth and produce old growth at a faster rate. This process could also be achieved through selective harvesting (personal communication, U.S. Forest Service official, June 2004).

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### *Native Fish Habitat HCP 2000*

A review of the Native Fish Habitat Plan (NFHP) was conducted based upon the limited requirements for and approach to adaptive management for the Central Cascades HCP. In addition, both the Services and Plum Creek Timber recommended the NFHP for evaluation. The NFHP is based on the protection of the bull trout. Approved in 2000, the Plan is implemented in Montana.

Plum Creek Timber admitted that adaptive management for the Central Cascades is much smaller relative to the NFHP. A Services official asserted that ~ 98% of the NFHP relies on adaptive management (Services interview, January 2004). Plum Creek Timber's strategy for adaptive management for the NFHP benefited from the Services' 5-Point Policy and the company's experience with the Central Cascades HCP. In addition, Plum Creek Timber hired a fisheries biologist who wrote the NFHP.

Findings and recommendation from the Kareiva *et al.*, (1999) study of the scientific adequacy of HCPs contributed to the 5- Point Policy. The Policy suggested that HCPs include:

- Broad biological goals
- Specific objectives
- Measurable targets for success
- A clear statement of the range of possible adjustments and circumstances under which adjustments are to be triggered
- Better monitoring strategies to determine compliance, the achievement of goals/objectives and whether adaptive management provisions should be triggered.

The 5-Point Policy resulted in an amended HCP Handbook (FWS/NMFS 2000) that provides a more detailed discussion on adaptive management. A cursory review of the NFHP reveals a more explicit statement of the biological goals compared to the Central Cascades HCP. The plan includes a monitoring protocol, hypothesis testing and clear triggers for corrective action.

### **5.6 Summary**

Section 5.4 reveals that Plum Creek Timber is passively managing habitat and species. Early Northern Spotted Owl experiments were conducted previous to the HCP and or were not revisited after a couple years of implementation. These experiments were small in scale and did not include controls and replication sites.

The HCP incorporates state Forest Practices Rules and Regulations and does not require the company to implement mitigation strategies beyond what Plum Creek Timber has implemented prior to the HCP. Opportunities to provide greater habitat protections through adaptive management as articulated in the plan have virtually been eliminated through renegotiation.

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This highlights Plum Creek Timber's concern about the bottom line and company effectiveness in convincing the Services approve minor modifications that benefit the company's interest. Changes to management practices have occurred based upon stakeholder suggestions, rather than through active adaptive management. Furthermore, the company provides anecdotal evidence of habitat condition improvements.

Finally, an overriding theme is the company's deference to U.S. Forest Service lands for Northern Spotted Owl habitat protections as evidenced in the Northern Spotted Owl decline discussion. Given Plum Creek Timber's HCP divestment through implementation renegotiation and land sales and the lack of HCP performance measures the fate of the Northern Spotted Owl over the life of the HCP is uncertain.

### 5.7 Discussion

The HCP represents a policy decision with the assumption that proposed mitigation will not appreciably diminish the survival and recovery of species (Incidental Take Permit, 1996). Theoretically, adaptive management is intended to remove uncertainty caused by incomplete science about the effectiveness of mitigation strategies to protect species and habitat. However, "adaptive management" for the Central Cascades HCP has been used as a mechanism for addressing unresolved issues during plan negotiation (Services interview, January and March 2004) and making minor adjustments to management practices based upon stakeholder suggestions during plan implementation, rather than for enhancing incomplete science to remove uncertainty.

Regarding unresolved issues, some natural resources were identified for protection on a conceptual level in the HCP, but were not sufficiently addressed for implementation, so plan implementation was used to address them. For example, procedural changes included the establishment of guidelines for identifying perennial seeps and springs and measuring the relative density and quadratic mean diameter of trees in riparian habitat areas. Guidance was also provided for interpreting HCP prescriptions for special habitat areas, e.g., talus slopes, caves, snag recruitment trees, and ponderosa pine stands. A Ponderosa Pine Strategy was established based upon on going discussions with the State Fish and Wildlife Service and the Yakima Indian Nation.

Minor adjustments that were unanticipated during plan implementation include: (1) the establishment of channel migration zones throughout the HCP Planning Area, (2) harvest avoidance in a riparian habitat area and (3) the protection of a nest site within portions of a stand that was an outlier in the HCP Planning Area. Harvest avoidance and protections in an area of a stand or riparian habitat area results in the exchange of harvesting values in another location.

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### 5.7.1 Adaptive Management as Negotiation

HCP implementers have different understandings of the concept. “Learning while doing” was commonly defined as adaptive management by Plum Creek Timber staff. However, subjects revealed nuances in their level of understanding. For example Plum Creek Timber foresters viewed adaptive management from an operational perspective at the scale of a stand (timber sale).

Their responses to my question “how do you define adaptive management” insinuated the challenge of implementing the HCP and other regulatory requirements while also meeting economic objectives. One forester defined adaptive management as: “Adjust harvest based on what you see. Learning as you go. Try different things... keep options open, don’t always fit in with definition used in the HCP.”

Another forester defined the concept as: “rolling with the punches... Adaptive management for me is to be able to work with the Services and to work with the State in order to modify my harvest technique to satisfy their goals.” Expanding upon his definition of adaptive management by sharing his experiences, another forester talked about adapting to meet new objectives: “Over the last 10 years the number of demands and constraints on forest resources has steadily increased. For every logging unit that you plan, you take the constraints and then attempt to provide a logging plan that meets the environmental requirements; while remaining economically feasible. You adapt your management plans to the needs of the situation.”

The theme of economic feasibility is supported by further evidence. In answering my question “how are economic goals of harvesting balanced with ecological goals”, another forester associated adaptive management with minimizing costs to meet ecological objectives: “not meeting ecological goals is not an option. But within the variability of a given stand, you can often minimize the cost by selecting the right leave trees or clumps of trees.” The forester went on to say: “Going to my micro definition of adaptive management, planning a logging unit comes down to tree-by-tree management. You try and select leave areas (individual trees or clumps) that provide the wanted ecological benefits while at the same time minimizing the costs. If the stand logging conditions and environmental requirements don’t fall into place, you may not be able to log some stands...for a forester, it’s more a matter of finding the low cost alternative within the given constraints (Plum Creek Timber staff interview, April 2004)”.

The forester later defined ecological goals as the “extensive list of log/leave and HCP prescriptions, cultural surveys, state prescriptions, etc.” Hence for the forester, adaptive management is an impediment to economic objectives. Implementation involves trade-offs between economic and ecological goals to meet regulatory requirements. Additionally, the spatial scale upon which adaptive management is applied has implications for Plum Creek Timber’s approach to adaptive management that is discussed later in this chapter.

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On the other hand, Plum Creek Timber scientists were quite familiar with the adaptive management literature, with one scientist appearing to be defensive in his definition of adaptive management: “Adaptive management is learning by doing, revising by learning from successes and failures. We aren’t implementing classic adaptive management. In fact most HCPs aren’t implementing adaptive management as conceptualized by Kai Lee and Walters.” In rationalizing his argument, the scientist continued by discussing the challenge of reaching consensus on alternative management options: “Launching competing options would be unwieldy when you consider getting people together to reach agreement. It is challenging enough to get people to agree on one option let alone a range of options.” Another scientist, who began the interview by sharing books and articles on adaptive management, confused passive and trial and error, in attempting to define approaches to adaptive management. He also tried to justify Plum Creek Timber’s approach to adaptive management by using a metaphor: “...I use the analogy of you’re firing, you know, multiple missiles off the pad at once and then you look to see which ones hit the target. And- and you set-up what that target is, you- you’ve done that by design rather than by default. And- and so ... that’s a very important part of adaptive management that I think is...one of the more difficult things to do, because we either lack the landscapes, the budgets or the institutional will to really launch all these missiles and then abide by the results. ...and if you read that paper by Carl Walters in the- the online journal I think he- he really alludes to that. ... so to me, I think it’s the multiple or simultaneous evaluation of experimental alternatives”.

According to a Services official, “I started working with Plum Creek Timber and (identifies a Plum Creek Timber scientist) I had sort of a concept, but overtime in working with him I came to understand that adaptive management doesn’t always have to be formal or other contextual factors can determine how formal we worked whether we actually had mathematic models or whether you just agree that if we learn well change.” The Services official then uses a similar metaphor: “so over time I’ve been describing adaptive management as you shoot, you usually get two or three shots, a version of statistically significant and weigh the, if you hit too low, you adjust, you move up and short of shoot and then adjust and adaptive management can be in between those”. The ability of Plum Creek Timber to convince the Services to the company’s point of view is another running theme throughout this case study.

Although Plum Creek Timber scientists were clear on the definition of active adaptive management, the classic approach, on the ground examples were not consistent with this definition. Upon asking for examples of adaptive management most Plum Creek Timber staff, the Services and a state official identified “Prospector”. Located on the edge of the HCP project area, “Prospector” is a timber sale or stand with known Northern Spotted Owl and goshawk nest sites that originally allowed for “take”.

The adjacent landowner was restricted from cutting the circle because of active owls, yet Plum Creek Timber planned to clear-cut approximately 140 acres of remaining suitable habitat in this stand. Since the site was not in their plan to protect, the company did not consider it for adaptive management.

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In reviewing Plum Creek Timber's harvest plans, representatives from the Yakama Indian Nation and Department of Fish and Wildlife informed Plum Creek Timber and the Services about the site history. After ongoing negotiation, Plum Creek Timber modified their stand management by linking habitat and deferring a portion of the site based upon trades of equivalent conservation value in another area. The following year, goshawks were found occupying the timber sale (Plum Creek Timber staff interview, April 5, 2004; State and Tribal official interview, February 2004).

When indicating "Prospector" as an example of adaptive management, a forester unconsciously suggested "on the ground adaptive management" as an ad hoc negotiation process: "so it was kind of a request more than anything. So we took a *look at it, and we figured out a way that we could get most of the value* that we needed out of there and still leave some habitat. We kind of worked with the state on that. It wasn't anything we had to do, but we did it. And I think those kinds of things are –where you say-...we're working with these organizations. We want to have a give and take here. And so you make some decisions like that".

This same forester continues to ponder other adaptive management examples and the spatial scale of application: "so what really qualifies for adaptive management versus just doing your job? ...every single harvest is unique. But to me, adaptive management is something above and beyond the uniqueness of the little nuances of each individual sale." What makes adaptive management above and beyond and unique, I ask, he responds, "probably its scale, the size of it. And the thing that really makes it unique is what's called for in habitat.

There is so many people that have different views about every area that, you know, it gets back to the negotiations". The forester recognizes the incongruence between the various definitions of adaptive management and its implementation, but after struggling, he defers to his operational lens of stand management.

According to the literature, adaptive management involves the process of learning how to improve management through iterative experimentation, hypothesis testing and feedback that guides management redesign and implementation (Holling 1978, Walters 1986, Borman 1994, Nyberg and Taylor 1995). In the case of HCPs with "No Surprises" assurance, changes in management are limited beyond contingencies already provided as part of the Implementation Agreement. Since certainty is essential for making strategic decisions and future investments, company staff is well aware of their legal protection under the "No Surprises" policy.

Plum Creek Timber is most concerned about expending funds cost effectively and ensuring that conservation efforts benefit the natural resources identified in the HCP. According to a Plum Creek Timber scientist, a decision to change management practices involves the weighing of "economic feasibility, biological credibility, legal defensibility and socially responsibility (Plum Creek Timber staff interviews, April 2004)".

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The Services are quite sympathetic to Plum Creek Timber's desire to be cost efficient. In response to my question that asked how adaptive management influenced HCP goals, objectives, criteria and mitigation strategies", the Services response was: "You have these objectives and goals and you try to meet them with agreed upon set of prescriptions or conservation measures and when you can't get to agreement on what to do, what's appropriate, people fall back on adaptive management, which we need to be careful we don't fall back on too much because then you have a large amount of work set aside that has a low acceptance price tag or may not be realistic uhm so I think with other things affect whether or not you use adaptive management, maybe more than you know..."

The statement about adaptive management implementation having a low acceptance price tag or perhaps being unrealistic alludes to the "No Surprises" assurances that protect landowners from having to provide additional land and financial compensation for protections beyond their HCP agreement. The implication is that since adaptive management can be a costly endeavor it more than likely will not be implemented.

Subsequently, the natural resources for which adaptive management is applied, consists of Northern Spotted Owl protection and watershed analysis conducted through assessment, verification and monitoring. The Northern Spotted Owl monitoring strategy serves as an extra layer of harvest restrictions within sideboards.

Implementation consists of the least costly approaches to protection through avoidance (by not harvesting during breeding season 20 year harvest deferrals) or minimization (modify harvesting to reduce impacts to species and habitat). The HCP incorporated the state watershed analysis process whose implementation by Plum Creek Timber began prior to HCP approval. Unlike the formerly state administered watershed analysis process that made evaluation voluntary, the HCP incorporates a mandatory 5-year Review of watersheds (Services interview, January 2004).

Plum Creek Timber and the Services saw the collaborative nature of the watershed analysis process as a means to demonstrate HCP performance. Public scrutiny from environmental groups motivated the desire to link watershed analysis with adaptive management (Services interview, January 2004).

The riparian management strategy, identified in the HCP as an adaptive management opportunity consists primarily of buffer and road management prescriptions. These prescriptions serve as a baseline of protection for fish and non-fish bearing streams that are refined through the watershed analyses process.

Thus, watershed analysis and riparian management work in tandem with watershed analysis being an integral part of Plum Creek Timber's aquatic resource protection strategy. Plum Creek Timber was "relatively certain that significant modifications to their management strategies would not be necessary to protect its aquatic resources (Services interview, January 2004)." This certainty is based upon Plum Creek Timber's reliance on the state Forest Practices Rules and Regulations and Best Management Practices that are mandated by the state in compliance with the Clean Water Act.

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Riparian baseline prescriptions are derived from Best Management Practices. Finally, cooperative experiments also identified as an adaptive management opportunity have not transpired for a host of reasons previously discussed.

### **5.7.2 Diminishing Returns on HCP Commitments**

As a regulated private company with a profit motive, Plum Creek Timber is willing to abide by the HCP agreement, but the company will try to keep modifications to HCP management strategies that may impact company profits to a minimum. The terrestrial and aquatic resources monitoring and reporting schedule is the mechanism Plum Creek Timber uses to determine compliance and the achievement of short-term objectives. The company is satisfied that it is adequately addressing the requirements of the HCP and that short-term objectives are being met. Plum Creek Timber's annual reports and 5-year Review of HCP performance conducted in 2001 supports its position.

Plum Creek Timber tracks habitat quantity and trends in quantities rather than species status. Annual stand targets are being met, and watershed analysis and riparian management is performing as planned. With Services support, the company is confident that their management strategies need not be changed. Minor procedural modifications are recorded in a Field Manual.

Plum Creek Timber has sought ways to consolidate their implementation requirements that will decrease throughout the duration of the permit. The company spent \$500,000 in developing the HCP and over \$1 million in HCP implementation (Plum Creek Timber staff interview, April 2004). Subsequently, future implementation costs for monitoring and adaptive management is expected to decline as monitoring commitments are reduced overtime.

HCP implementation is to continue for the next 42 years. It is too soon to assume that complete knowledge about the system has been obtained. Yet the monitoring schedule indicates that learning will diminish as implementation proceeds and as the company finds quick solutions that provide a cost-effective means of conservation. Plum Creek Timber has been able to reduce some costs of implementation by engaging and coordinating the monitoring of species status and habitat quality with academic researchers and students and the Department of Fish and Wildlife. The company also conducts joint surveys and exchanges of Northern Spotted Owl information with the Forest Service.

Furthermore, collaboration has benefited Plum Creek Timber by providing a means to showcase the performance of the HCP through its professional affiliations with organizations such as the Wildlife Society, American Fisheries Society, and the American Forestry Association (Plum Creek Timber staff interview, April 2004). The company is also active with the National Council of Air and Stream Improvement, an outreach and forestry and wildlife research organization representing the Timber industry. Finally, Plum Creek Timber publishes technical reports and publications that reflect company research conducted in the HCP Project Area.

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Since Plum Creek Timber is sensitive about balancing ecological with economic objectives, the question about costs and benefits of adaptive management was posed. Based upon a forester's point of view, "it usually costs more to leave merchantable trees or change logging systems in order to achieve ecological benefits. My responsibility is to try and minimize these costs, and still achieve the desired biological benefits (personal communication, April 2003)."

In contrast, a Plum Creek Timber scientist focused more on the benefits rather than costs of adaptive management, identifying agency partnership and scientific credibility as important benefits: "there's been un- and a- quite a significant investment dollar-wise and person-wise into, from the company uh... There's always that sort of concern that can we afford that if we have to go there... So there is that little bit of uncertainty that you put into the plan. But I think the benefits, for us the benefits have been uh... two-fold. One- it's- it's allowed us to ...work with the services as a partner. Cause we're going forward together in this sort of quest. So they understand the HCP. We understand their needs, their uncertainties.

So it allows us to kind of have a common language, or endeavor, if you will... beyond that, the second benefit is... it allows us to really pass the laugh [ph?] test with uhm... the scientific community, cause they know that we're not just saying, we knew everything in 1996 and so we're gonna implement this thing and we're never gonna change, ... So it allows the scientific community to look at this and say, o.k. there are side boards on experimentation, but that that experimentation will be done in a credible way. And the information that comes out of that is fed back into management in a- in a feasible manner. So I guess that's the benefit."

### **5.7.3 Plum Creek Timber Passively Manages for Species and Habitat Covered in the Central Cascades Habitat Conservation Plan**

Plum Creek Timber is passively managing its species and habitat. Monitoring is the primary mode for learning occurring primarily through descriptive and observational studies, expert opinion and local knowledge (Tribal and State agency observations and recommendations).

Data is collected to either answer questions concerning current status and trends in habitat quantity, or to compare two or more areas where there has been non-randomization of treatments. Specifically, passive adaptive management includes activities such as presence/absence surveys, descriptions of stream and riparian conditions, Best Management Practices audits, stand inventories, road condition inventories, and stream temperature monitoring.

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As part of the Northern Spotted Owl strategy, monitoring is conducted for the purpose of recalibrating the Northern Spotted Owl carrying capacity model, assessing habitat conditions, and establishing baseline data and habitat trends. Monitoring is also conducted to ensure that Best Management Practices are implemented as intended and comply with state regulations. This information provides circumstantial evidence to support or reject a particular management activity (Taylor *et al.*, 1997).

Demographic monitoring is conducted to verify the assumptions of the RSPF Northern Spotted Owl carrying capacity model otherwise presumed to be correct without factoring threats to the landscape. Landscape scale experiments that facilitate understanding of system processes, relationships and external threats are not occurring. For example, the relationship between harvesting and Northern Spotted Owl declines, cumulative effects, changes in the populations of Northern Spotted Owl competitors, predators, and prey populations and fluctuations in the physical environment (Berkes and Folke 1998) are not required for consideration.

### **5.7.4 Plum Creek Presents Early Examples of Active Adaptive Management for Central Cascades Habitat Conservation Plan Implementation**

Active adaptive management is limited by the: 1) failure to use null and alternative hypotheses, 2) lack of replicates of treatment and control units, 3) lack of treatment and control units in time and space, to control for random variation; and 4) allocation of treatments in space and in time to control for bias and environmental gradients.

Early examples of active adaptive management initiated prior to the HCP were not revisited after a couple of years of implementation. These early experiments likely contributed to the approval of Plum Creek Timber's incidental take permit and served as examples for the foresters to implement.

However, there were few on the ground examples of adaptive management. Adaptive management is subject to the intent of the forester and Plum Creek Timber's foresters' intentions and decisions did not lead to active adaptive management during implementation.

Besides the lack of hypothesis testing, Plum Creek Timber's early experiments were employed at the stand rather than the landscape scale. According to a forester, silvicultural approaches vary based upon the type of forests, operational conditions and local opportunities at each stand. Modifications to forests occur at the stand scale where foresters have experience with and control over operations (Plum Creek Timber staff interview, April 2004).

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At the stand level, silvicultural techniques can alter species composition and the physical structure of vegetation. At a landscape scale changes in stand structure have significant cumulative impacts on animal habitat. Activities occurring at the same time in different parts of the landscape may have much greater total effects on wildlife than could be expected from looking at a single stand or activity (Nyberg and Taylor 1997).

Moreover, adaptive management involves more than modifying practices at the stand scale. There must be a feedback loop that incorporates new information and knowledge about management outcomes into decision--making which leads to the iterative changing of management practices based upon new learning.

Spatial and temporal scales must also be factored into replication and evaluation (Hilborn *et al.*, 1995). The replication of treatments and controls are not employed on the landscape. Although time scales are long, it may be impractical or impossible to employ replicates in forestry. And while treatments may be replicable at a small scale, extrapolating results to the large scale at which many management actions occur can be controversial and uncertain (Taylor *et al.*, 1997).

### **5.7.5 Habitat Condition and Species Fate Unknown**

The objective of the HCP is to remove uncertainty of species fate in a positive direction. However, Plum Creek Timber's approach to HCP implementation has not removed uncertainty. Implementation is primarily focused on meeting monitoring and reporting schedules and complying with state regulations.

Costs and feasibility are the primary criteria for incorporating new information in their decision--making. Adjustments to mitigation are based upon political and economic constraints rather than empirical data on species' ecology, life history and habitat requirements. If implemented in the theoretical sense active adaptive management would involve the adjustment of management strategies based upon management outcomes.

The terrestrial and aquatic resources monitoring and reporting schedule (See Table 15, Chapter 4) serves multiple purposes. Besides serving as a vehicle to measure compliance, (Plum Creek Timber staff interview, April 2004) the monitoring schedule is used to determine the achievement of short-term objectives (Plum Creek Timber staff interview, April 2004). The schedule also serves as a "trigger point at which to consider adjusting mitigation strategies (Services interview, January 2004)."

However, the lack of formal performance standards/benchmarks made the determination of short-term objective achievement challenging. Thus it is unclear how Plum Creek Timber will ultimately determine the effect of their management practices on the species and habitat conditions.

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The terrestrial and aquatic monitoring and reporting schedule identifies the frequency upon which monitoring is to occur. Although not explicitly stated, it is assumed that analysis and evaluation begins shortly after each monitoring activity. However analysis did not involve the testing of alternative hypotheses about species status and habitat quality responses to permit the appropriate modification of mitigation measures. Moreover, cumulative effects that develop over time and across the landscape were not considered.

### Northern Spotted Owl.

Unlike forests, wildlife management has the potential for replication and transfer of historical experience (Hilborn *et al.*, 1995). At the landscape level, maintaining forest animal diversity depends on maintaining an adequate range of habitats, from early-successional forest to mature and old growth stands (White Paper 1995). Expanding beyond the annually reporting quantities of forest classes, Plum Creek Timber should consider designing experiments to assess the effectiveness of forest classes for species diversity. For example, information obtained from a 2000 bird breeding survey thesis (Manuwal and Gergen 2001) and could be used to design an experiment to further understand avian response to habitat types.

An experiment designed to assess the effectiveness of foraging dispersal corridors for Northern Spotted Owls could be initiated by comparing species response to nesting, roosting and foraging with foraging dispersal habitat. Another experiment may involve linking nesting, roosting and foraging habitat with foraging dispersal habitat to assess species response.

Experiments implemented to understand and compare species response to various harvesting activities, e.g., clear cutting, shelterwood, seed tree, selective harvesting, is a way to determine the most effective mitigation strategy. The leaving of wildlife and green trees is a requirement of the state. As one forester stated "...the forester has the flexibility to leave those however he sees fit. However it fits in best with his harvest plan..." Designing harvesting activities as experiments may result in better outcomes for species and habitat.

Plum Creek Timber's decision with the approval of the Services to remove the occupancy rate of Northern Spotted Owl site expectancy from the Resource Selection Probability Function model equation absolves the company from understanding why Northern Spotted Owls are not present.

Estimating the number of available owl sites does not inform the company about the quality of the habitat on Plum Creek Timber land. The rationale that mature and old growth habitat is present on adjacent U.S. Forest Service further provides the excuse not to learn about Northern Spotted Owl responses to mitigation and management practices.

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Given the precipitous decline of Northern Spotted Owl populations, Plum Creek Timber might consider increasing the frequency of their Northern Spotted Owl demography studies. Surveys are currently conducted for two consecutive years every seven years of the HCP Planning period. Additionally, Plum Creek Timber might consider altering its presence and absence surveys that emphasize habitat use to address Northern Spotted Owl habitat preference.

By exclusively focusing on habitat use, Plum Creek Timber is observing species within habitats without an understanding the habitat use context. If Plum Creek Timber were to also investigate habitat preference, the company could begin to understand for example, Northern Spotted Owl habitat selection between nesting, roosting, and foraging habitat versus foraging dispersal habitat or foraging dispersal corridors versus riparian habitat corridors.

Finally, Northern Spotted Owls are not responding to calls when Barred Owls are present, thus Plum Creek Timber might consider changing their assessment tool. The current protocols appear to no longer be valid for determining whether Northern Spotted Owl sites are occupied since Barred Owls compromise their ability to detect Northern Spotted Owls (State official interview, February 2004).

### Watershed Analysis.

Plum Creek Timber relies heavily on Best Management Practices to mitigate the impacts of forest management on water quality. Sections 319 of the Clean Water Act, requires states to formulate programs to reduce water pollution from non-point sources, including forestry.

Specifically, each state must describe Best Management Practices that will prevent or significantly reduce impacts on water quality from forestry management activities such as road construction and road stream crossings, streamside management zones, and harvesting operations (Paper Task Force 1995). Apparently, the stringency and scope of Best Management Practices vary widely from state to state (Paper Task Force 1995).

Strict adherence to Best Management Practices and regulations without testing their effectiveness limits Plum Creek Timber's flexibility and willingness to learn about the structure and function of the ecosystem in the HCP Project Area. Thus active adaptive management is not employed.

The watershed analysis process had the potential for hypothesis testing and understanding cumulative effects, but Plum Creek Timber has conceded to extrapolating best management practices from completed watershed analysis to nearby watersheds. Active adaptive management would seem to be the solution for understanding key processes and relationships in the watershed. Ironically, the lack of scientific certainty about processes and relationships was the very reason Plum Creek Timber decided to extrapolate (Plum Creek Timber 2001).

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By applying replicates and a wide range of treatments throughout the HCP project area the company can understand the effectiveness of watershed analysis prescriptions. Unfortunately, adequate replication and measurement of replicate response are rare and watersheds must be similar and treatments must produce differential response (Hilborn, *et al.*, 1995).

There are other challenges in implementing adaptive management for aquatic species. First, there are lag times for biological response to disturbance. Second, it is difficult to separate natural from anthropogenic influences.

Third, the response and sensitivity of aquatic ecosystems to human disturbance differ due to varying site conditions (Walters 1978). This level of complexity may have precipitated Plum Creek Timber to extrapolate, lessons learned from completed watershed to nearby watersheds. However, extrapolating lessons learned on a landscape scale may not be appropriate (Hilborn *et al.*, 1995) for these very reasons.

### 5.8 Conclusion

While HCPs are vehicles for accomplishing economic objectives and species conservation, there must be an incentive to encourage learning over the long term. The business of forestry involves long-term management, requiring regulatory certainty for timber companies to make future investments (Plum Creek Timber staff interview, February 2004). Decision analysis involves weighing the potential benefits and cost of alternative management actions. The rate of learning about the ecological system must be rapid enough to provide useful information for subsequent decisions (Hilborn *et al.*, 1995).

The value of long-term learning is reduced uncertainty that may lead to species survival and recovery. Yet, it is uncertain that watershed extrapolation and the small spatial and short temporal scale experiments (Hilborn *et al.*, 1995) employed prior to the HCP and during early implementation provides a platform for adequate learning.

Adaptive management must be integrated into forestry management such that the rapid return in timber revenue is balanced with the long-term value of reducing uncertainty for terrestrial and aquatic resources. Adaptive management is an iterative process--the more that is learned about a system, the more is yet to be learned (Hilborn *et al.*, 1995). Incorporating adaptive management into the Sustainable Forestry Initiative that involves a third party auditor of company performance is one way to demonstrate company commitment to adaptive management. In addition, foresters should be rewarded for implementing adaptive management. Without corporate commitment and incentives, individuals within organizations cannot build the capacity for learning alone.

## Chapter 6

### 6.1 Introduction

Much of the remaining undeveloped land in Southern California is coastal sage scrub. The federal listing of the California gnatcatcher, a coastal sage scrub dependent species, became a highly political and contentious issue for developers in Southern California. The Natural Community Conservation Plan (NCCP) Act of 1991 facilitated regional protection of a range of species inhabiting a designated natural community rather than a single species. The Orange Central-Coastal County Natural Community Conservation Plan /Habitat Conservation Plan (NCCP-HCP) was created by multiple landowners in response to the March 20, 1993 federal listing of the California gnatcatcher and the California NCCP Act. On July 17, 1996, the U.S. Fish and Wildlife Service (FWS) approved the Orange Central Coastal County, NCCP/HCP.

The FWS authorized the incidental “take” of 44 species within a 38,000 acre reserve, (See Figure 6-1) to include the following 7 listed species: the Coastal California Gnatcatcher, (*Poliophtila californica californica*); American Peregrine Falcon, (*Falco peregrinus*); Riverside Fairy Shrimp, (*Stretocephalus woottoni*); Arroyo Toad (*Bufo microscaphus californicus*); Least Bell’s Vireo, (*Vireo bellii pusillus*); Southwestern Willow Flycatcher, (*Empidonax traillii eximius*); and Pacific Pocket Mouse (*Perognathus longimembris pacificus*). Incidental “take” is defined as coastal sage scrub habitat conversion and modification regardless of the populations of targeted and identified species.

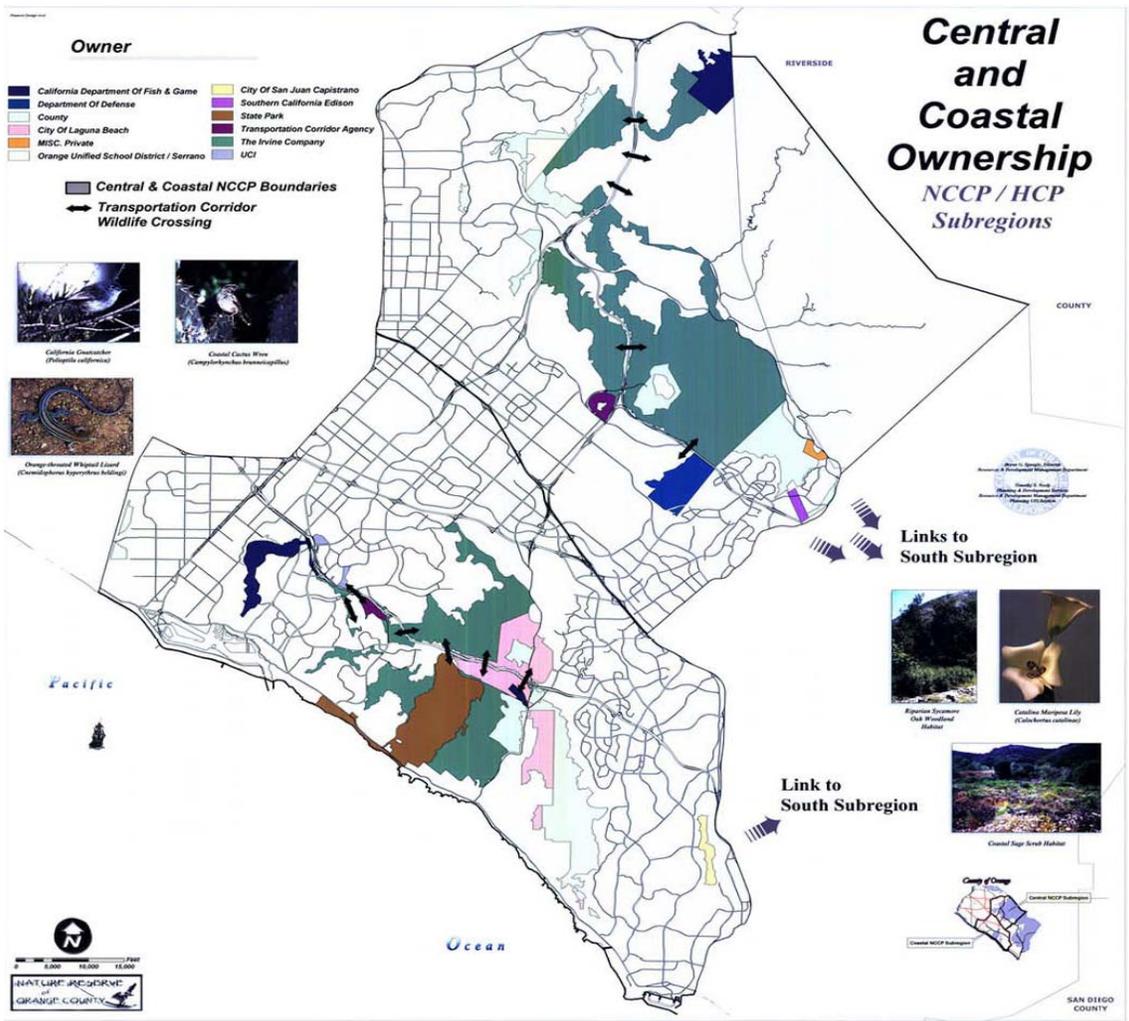
The targeted species for the NCCP/HCP are the: Coastal California Gnatcatcher, the Coastal Cactus Wren (*Campylorhynchus brunneicapillus*), and the Orange Throat Whiptail Lizard (*Cnemidophorus hyperythrus beldingi*) (Orange Central Coastal NCCP-HCP Implementation Agreement 1996). The Coastal Cactus Wren, Orange Throat Whiptail Lizard and 37 identified species are unlisted but treated as if they are listed under the ESA and participating landowners are authorized future “take” of these species under “No Surprises”.

Listed species dependent upon or associated with coastal sage scrub and/or covered habitats are also authorized for incidental take. Consistent with the legislative intent of the NCCP Act to protect multiple habitat types, the oak woodlands, Tecate cypress forest, cliff and rock and chaparral (Coastal sub area only) are also protected. These habitats naturally mixed with coastal sage scrub and are not subject to additional mitigation and compensatory requirements should they become listed (Orange Central Coastal NCCP-HCP Implementation Agreement 1996).

The FWS issued incidental take permits to 11 multi-jurisdictional landowners in Orange County, California. Existing and new activities within the 38,000-acre Reserve System are permitted with the understanding that these activities will not significantly reduce the likelihood of target and identified species survival. Existing uses include: sand and gravel operations, landfills, cattle grazing, agriculture, and habitat management, enhancement and restoration, recreation and docent/public access programs.

# Chapter 6

## Figure 6-1



Source: Harbors, Beaches and Parks, Orange County, CA.

New uses and activities within the Reserve include: public access and passive recreational use, and infrastructure (e.g., utilities, i.e., sewer lines, electric, cable and natural gas, and storm drain and flood control). The participating landowners listed below agreed to implement the NCCP-HCP for 75-years (Orange Central Coastal NCCP-HCP Implementation Agreement, 1996).

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### Signatories:

- ✓ The County of Orange
- ✓ The Irvine Company
- ✓ City of Irvine
- ✓ M.H. Sherman Company
- ✓ Chandis Securities Company (now Headlands Reserve LLC)
- ✓ Sherman Foundation
- ✓ University of California at Irvine
- ✓ Irvine Ranch Water District
- ✓ Metropolitan Water District
- ✓ Santiago County Water District
- ✓ Southern California Edison Company
- ✓ The Transportation Corridor Agencies

Finally, the NCCP-HCP also allows for the incidental take of the federal listed species by non-participating landowners who elect to pay mitigation fees. “Take” is permitted provided the jurisdiction within which the non-participating landowners land is found has signed the NCCP-HCP Implementation Agreement and received an incidental take permit (NCCP-HCP Implementation Agreement 1996). Planned activities of these landowners include development of communities, infrastructure, and transportation projects outside of the reserve. This chapter is divided into the following two sections:

1. Natural Communities Conservation Planning Program and HCP Planning  
Context: A summary of the NCCP and its relationship with the HCP Program, Nature Reserve of Orange County and Board of Directors, a description of the Environmental Setting for HCP implementation and Coordination with other NCCPs (Section 6.2).
2. Habitat Conservation Planning: Provisional Knowing: A Summary of the Adaptive Management Program and Monitoring and Reporting requirements (Section 6.3).

### **6.2 Natural Communities Conservation Planning Program and HCP Planning**

The purpose of this section is to introduce the state and federal regulatory authorities of the NCCP-HCP and its’ relationship to other NCCP sub regional planning efforts. Also described is the make up and responsibilities of the Nature Reserve of Orange (NROC) County Board and the role of the resource agencies, the California Department of Fish and Game and the FWS. Background information about The Irvine Company, a major driver for the NCCP-HCP also provided.

In addition, the relationship of the Nature Conservancy with the Irvine Company and the NROC is explained. Finally, briefly summarized is the environmental setting of the Reserve, along with a description of the Central and Coastal portions of the NROC.

## Chapter 6

### 6.2.1 Natural Communities Conservation Plan Act and Implementing Program

The Natural Communities Conservation Plan (NCCP) Act of 1991 established California's Natural Communities Conservation Planning Program. The intent of the Act was to ensure the conservation and long-term regional protection of natural vegetation and wildlife diversity that would facilitate compatible land uses in and growth and economic development outside of open space reserves (Orange Central Coastal NCCP-HCP, Environmental Impact Report/Environmental Impact Statement; FWS, July 10, 1996). The NCCP Program is a voluntary program that engages private landowners, local governments, state and federal agencies, environmental organizations and the public at large in planning, approving and implementing NCCPs (Orange Central Coastal NCCP-HCP 1996).

California's regional multiple species conservation plans meet the requirements of both federal HCPs and state NCCPs. The California Department of Fish and Game in cooperation with the FWS established the NCCP Process and Conservation Guidelines. The NCCP Process Guidelines explain the steps to be followed during preparation of NCCPs. The NCCP Conservation Guidelines outline the biological principles and standards to be applied during preparation, review and approval of sub regional NCCPs. The implementation of Adaptive Management within Reserves is among the conservation planning principles. NCCPs must be prepared by local governments and landowners in compliance with: (1) Section 10 (a) of the ESA, (2) the NCCP Act and (3) the California Environmental Species Act. A 1991 FWS/ California Department of Fish and Game Memorandum of Understanding solidified the roles and responsibilities of the agencies (Orange Central Coastal NCCP-HCP 1996).

The NCCP program was initiated as a pilot program in Southern California. The goal of the Southern California pilot program is to conserve coastal sage scrub, a habitat found only in Southern California and parts of Mexico (Pollak 2001).

#### *Special 4 (d) Rule*

Concurrent with the listing decision for the gnatcatcher, the FWS published a proposed rule under Section 4(d) of the ESA that allows special provisions for addressing threatened species. In essence, the coastal California gnatcatcher is exempt from the Section 9 ESA "take" prohibition if activities are conducted under the guidance of California's NCCP for the protection of coastal sage scrub.

In addition, instead of seeking permits from and consulting with the FWS, landowners seek development permits from local jurisdictions based upon the NCCP planning and process guidelines. Specifically, the Special 4(d) rule authorizes the interim loss of coastal sage scrub up to 5% while landowners proceed with their development projects and prepare a NCCP.

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The plan must adhere to NCCP conservation guidelines and contain mitigation measures to prove that development activities will not jeopardize coastal sage scrub and associated species. Once completed, the NCCP-HCP replaces the interim management measures and local jurisdictions receive a Section 10 permit agreeing to conserve coastal sage scrub habitat over the long-term (Orange Central Coastal NCCP-HCP 1996).

In summary, the Special Rule requires that: (1) the NCCP planning process comprehensively addresses coastal sage scrub habitat conservation concerns, (2) Section 10(a) (1) (B) of the ESA serves as the FWS standard of review, and (3) the NCCP Conservation Guidelines and 1991 FWS/California Department of Fish and Game Memorandum of Understanding guide the review and approval of NCCP plans (Orange Central Coastal NCCP-HCP, 1996).

### ***Relationship with other NCCP efforts***

The NCCP process is designed to coordinate subregional conservation planning within five-county study areas. Encompassing 6,000 square miles, the counties include: (1) Orange, (2) San Diego, (3) Riverside, (4) San Bernardino and (5) Los Angeles (See Figure 6-2) (Orange Central Coastal NCCP-HCP Implementation Agreement, 1996). Orange County was the first county with an approved NCCP-HCP, otherwise referred to as the Orange Central-Coastal NCCP-HCP.

The local conditions of each sub-regional planning effort allows for flexibility in implementing the NCCP while also adhering to basic regional conservation principles established in the NCCP Process and Conservation Guidelines (NCCP-HCP Implementation Agreement, 1996). The County's appear to be implementing their respective NCCP-HCPs independently. Most recently, the U.S. Geological Survey in partnership with the California Department of Fish and Game and U.S. Fish and Wildlife Service developed a Monitoring Program Guide for southern California regional NCCP-HCPs. The document provides recommendations for designing monitoring programs in an adaptive management framework (Atkinson *et al.*, 2004).

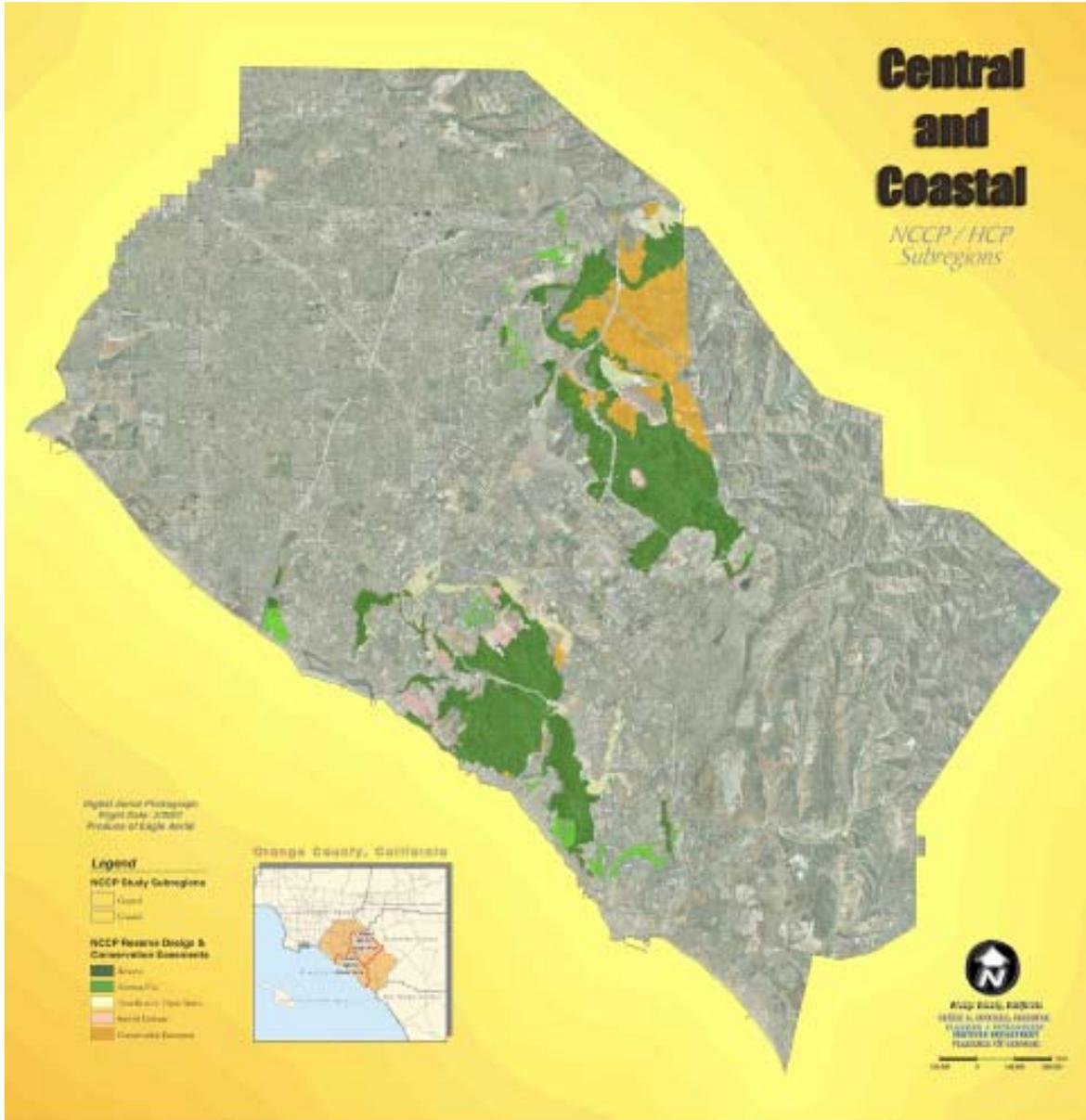
### **6.2.2 The Nature Reserve of Orange County**

The Nature Reserve of Orange County (NROC) is a non-profit organization responsible for coordinating the nature reserve assembly and overseeing and implementing the NCCP-HCP adaptive management program (Bylaws of The Nature Reserve of Orange County 1996). A \$10.6 million endowment was established by contributions from some of the landowners to fund the administrative costs of the non-profit. Reserve management is funded by annual interest earned from the endowment.

An Executive Director is responsible for the financial and contractual management, and coordinates biological monitoring and management in the Reserve (Orange Central Coastal NCCP-HCP and Implementation Agreement 1996). The Executive Director works with a NROC Board of Directors made up of local jurisdictions, public representatives, and a private property owner, established to protect and enhance the environmental, natural, wildlife habitat and recreational values of the reserve.

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Figure 6-2



Source: Harbors, Beaches and Parks, Orange County, CA.

The sixteen-member Board is the decision-making entity that directs the acquisition, holding, management and disposal of land within the Reserve (Bylaws of Nature Reserve of Orange County 1996). In particular, the Board is responsible for: (1) reviewing and updating NROC goals and objectives, (2) reviewing and approving management plans, monitoring reports and annual reports, and (3) receiving and taking action on the recommendations of a Technical Advisory Committee.

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These landowners must ensure that Reserve managers provide an annual report to the Executive Director for inclusion into a Nature Reserve of Orange County Annual Report submitted to the FWS and California Department of Fish and Game. The California Department of Fish and Game and FWS—the resource agencies also hold a seat on the board as non-voting members. The Annual Report shall include at a minimum the following information:

- (1) Recommendations for modifications to management policies and program consistent with Adaptive Management.
- (2) Management program/budgets for the following year and funding recommendations and priorities.
- (3) Updates to the previous year budget.
- (4) Summaries of activities implemented by Reserve managers.
- (5) Amounts and locations of “Identified” species “take” and habitat loss that occurred in the NROC during the previous year.
- (6) Restoration and enhancement actions.
- (7) An accounting for mitigation fees and related habitat loss of habitat in the Central/Coastal sub region by amount and location outside the Reserve.
- (8) An accounting for all other funds received and dispersed to participating agencies for management and acquisition activities related to the NCCP/HCP.
- (9) An accounting for land added to the Reserve System.

The Board meets quarterly. The California Department of Fish and Game and FWS are responsible for reviewing and commenting on annual reports, and monitoring landowner and local government compliance with the provisions of the NCCP/HCP. The resource agencies may also provide funding, and staff support when appropriated funds are available (Orange Central Coastal NCCP-HCP and Implementation Agreement 1996). The Board and Resource agencies are among the key actors responsible for implementing adaptive management within the Reserve as reflected in Figure 6-3.



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The Technical Advisory Committee is shown in a discontinuous circle to indicate temporary disbandment. Finally, The now defunct Recreation Ecology Committee was established to identify measures for tracking public access in parks. Some members of the Recreation Ecology Committee work for Harbors, Beaches and Parks, represented by a square, the second largest landowner and manager within the Reserve.

### **6.2.3 The Irvine Company**

The Irvine Company was the driver for the NCCP in Orange County. The company dedicated between 17,000 to 20,000 acres of land to the Reserve. Incorporated in 1894, the Irvine Company began as an agricultural and grazing business. In the 1960s the company evolved into the business of community planning and designing. Company land was sold to builders who constructed residential villages based upon Irvine Company design standards. The Irvine Company's real estate investment portfolio includes apartments, schools, retail centers, office buildings, parks and open spaces in Orange County, Los Angeles, San Diego and Silicon Valley. Most of the company land and property holdings are in Orange County (<http://irvineco.com>).

The Irvine Company still maintains the Irvine Ranch that comprises 93,000 acres, and is approximately one-fifth of the County of Orange's total land area. The Ranch contains portions of six cities, including the entire City of Irvine. In cooperation with municipalities, conservationists and resource agencies, the company is permanently protecting 50,000 acres of land on The Irvine Ranch through donations, land sales, development agreements and ballot measures. This action has culminated into the creation of an Irvine Ranch Land Reserve that is protected in perpetuity as wilderness, greenbelts, parks and recreational areas. To ensure long-term preservation and restoration of the Reserve, the company chairman made a \$30 million land stewardship commitment (<http://irvineco.com>, Irvine interview, March 2004). The Nature Conservancy manages most of The Irvine Ranch lands some of which will be transferred to the NROC.

### ***Interim Management***

Approximately 20,000 acres of the Reserve are under phased dedication commitments. Open space commitments are based upon the Irvine Company's development agreements involving dedications in fee to the County of Orange and various cities. These development agreements preceded the NCCP-HCP and will take many years to complete (Resource Agency interview, March 2004; NROC Board member interview, March 2004).

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In the interim, The Nature Conservancy is implementing habitat restoration and enhancement measures on Irvine land designated for inclusion in the Reserve to sustain and improve Coastal sage scrub habitat values. This land will eventually be transferred to the County of Orange Harbors, Beaches and Parks for management within the NROC (NROC Board and Resource Agency interviews, March 2004). In 2002, the City of Irvine received ownership of 2,144 acres from The Irvine Company, comprised of Boomer Canyon and the eastern portion of Shady Canyon.

### 6.2.4 The Nature Conservancy

The Nature Conservancy has three tiered management responsibility for land conservation within Orange County. As land trustee for The Irvine Company, The Nature Conservancy facilitated the development of the NCCP-HCP and has been active in plan implementation specifically directing the management of Irvine land within the reserve (i.e., Weir and Boomer Canyons) (Federal official interview, March 2004).

The Nature Conservancy wrote and implemented the grazing management plan on behalf of The Irvine Company for the Reserve. As “biological monitoring advisor” for NROC, a Nature Conservancy employee led the biological monitoring program and coordinated habitat restoration and enhancement activities within the Reserve (NROC Board interviews, March 2004, Resource agency interviews, March 2004).

Through the leadership of The Nature Conservancy, the Technical Advisory Committee is responsible for prioritizing research and monitoring activities and evaluating biological response to management practices within the Reserve. The Technical Advisory Committee also provided input on the Fire, and Habitat Restoration and Enhancement Plans. The management plans direct the NCCP-HCP adaptive management program.

The Technical Advisory Committee stopped meeting in 2002 but reconvened under a new membership in 2005 (Resource Agency interviews and personal communication, March 2004, July 2005). A conflict of interest was recognized within the makeup of the Committee that consisted of biologists who conducted research within the Reserve.

In 2001, the Irvine Company established \$7 million Irvine Ranch Enhancement fund for habitat restoration, enhancement and study on 12,000-acres of land some of which is apart of NROC. The Nature Conservancy will distribute \$700,000 annually for ten years for ten priority Enhancement Projects within the Reserve to include exotic plant control, Arundo removal, African clawed frog removal, native grassland restoration, a bat study, and pond turtle and spade foot toad enhancement (Nature Reserve of Orange County 2002 Annual Report).

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Since The Nature Conservancy will also be managing this effort for lands outside of the Reserve, their relationship with NROC has significantly reduced (Resource Agency interview, March 2004). Subsequently, NROC hired a part time biologist in 2003 and planned to replace the part time biologist with a full time Ecologist in 2004 to lead the biological monitoring efforts for the Reserve (Nature Reserve of Orange County 2003 Annual Report). Finally, The Nature Conservancy manages open space within the City of Irvine (NROC Board interview, March 2004).

### 6.2.5 Environmental setting

Coastal sage scrub habitat constitutes about one-third of the existing natural lands remaining within the Central and Coastal Sub region of Southern California. Coastal sage scrub considered to be an indicator for the California gnatcatcher, is a naturally fragmented and dispersed community of Venturan/Diegan Riversidian sage scrub sub associations. Associations include communities of California sagebrush, California buckwheat, goldenbush, coastal prickly pear that are embedded within a mosaic of chaparral, grasslands, etc. California gnatcatchers appear to prefer California sagebrush, buckwheat, white sage, and black sage. Southern cactus scrub containing greater than 20 percent cactus is also among the Venturan/Diegan sage scrub community. Cactus scrub provides high quality habitat value particularly for the coastal cactus wren (Orange Central Coastal County NCCP-HCP 1996).

The Central and Coastal sub region covers approximately 208,000 acres of developed, agricultural and undeveloped natural lands, comprising two fifths of the County of Orange (NCCP-HCP Implementation Agreement 1996). The sub region includes all or portions of fourteen cities: Newport Beach, Costa Mesa, Irvine, Santa Ana, Laguna Beach, Laguna Niguel, Laguna Hills, Dana Point, Orange, Anaheim, Villa Park, Tustin, Lake Forest, and San Juan Capistrano (Orange Central Coastal County NCCP-HCP 1996).

The 38,000-acre Reserve is an open space network comprised of two major sub areas: the Central Sub area and the Coastal Sub area. The non-coastal sage scrub habitats and resident species within the Reserve create a multiple species and multiple habitat reserve system (NCCP-HCP, 1996). The Reserve protects approximately 18,527 acres of coastal sage scrub habitat, 6,950 acres of chaparral, 5,732 acres of grasslands, 1,770 acres of riparian habitat, 940 acres of oak woodland, 191 acres of Tecate forest habitat and other existing habitat within the sub region (NCCP-HCP Implementation Agreement 1996).

There are no corridors that link the Central and Coastal sub areas of the Reserve. Special Linkage and Existing Use areas outside of the Reserve System augment the Reserve System to enhance biological connectivity and or maintain existing populations of NCCP target species (Orange Central Coastal County NCCP-HCP 1996).

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However, Special Linkage Areas are not considered essential areas for inclusion in the Reserve, nor are they actively managed under the Adaptive Management Program (NCCP-HCP 1996). Finally, existing parkland and open space and additional dedications are the basis of the Reserve.

Publicly owned and managed lands within the sub regional study area include Peters Canyon Regional Park, Laguna Coast Wilderness Park, Aliso and Wood Canyons Regional Park, Whiting Ranch Wilderness Park, the Marine Corps Air Station El Toro, Crystal Cove State Park, and, the Cleveland National Forest.

### **6.3 Habitat Conservation Planning: “Provisional Knowing”**

The Orange Central Coastal County NCCP-HCP is structured to support the needs of the coastal California gnatcatcher, cactus wren and the orange-throated whiptail lizard, while also protecting multiple species and habitat. The primary strategy for protection is habitat restoration. Plan impacts are quantified according to loss of coastal sage scrub rather than the individual species. Thus, management within the Reserve is designed to provide an ecosystem with essential habitat necessary to sustain viable populations of “target and identified species” within the sub region. The assumption is that participating landowners who manage the Reserve over the long-term will maintain net habitat value otherwise lost due to incidental take (Orange Central Coastal NCCP-HCP 1996).

This section presents the parameters of the NCCP-HCP Adaptive Management Program. It also summarizes approaches to biological monitoring and studies that have been implemented within the Reserve. The section concludes with a description of the biological monitoring reporting requirements.

#### **6.3.1 Adaptive Management Program**

The NCCP-HCP adaptive management program is intended to facilitate long-term no net loss of habitat value within the Reserve (Orange Central Coastal NCCP-HCP, Environmental Impact Report/Environmental Impact Statement, 1996). Adaptive management is defined as “a flexible, iterative approach to the long-term management of biotic resources directed overtime by the results of ongoing monitoring activities and other information (Orange Central Coastal County NCCP-HCP 1996).” Management techniques and specific objectives are evaluated in light of monitoring results and other new information and subsequently modified to achieve overall management goals (Orange Central Coastal County NCCP-HCP, 1996). Hence, adaptive management should demonstrate the extent to which the NCCP program is successful in conserving coastal sage scrub habitat values for native plant and wildlife species covered in the NCCP/HCP (Draft Umbrella Monitoring Plan 2000). Key elements of the NROC adaptive management program include:

- Monitoring and managing identified species and associated habitat and native grasslands;

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- Restoring and enhancing actions such as eradication of invasive or pest plant and animal species; grazing management and revegetation;
- Implementing short and long-term fire management measures;
- Managing public access and recreational uses;
- Minimizing ongoing operational impacts and maintaining uses that existed prior to creation of the Reserve system;
- Providing guidance to minimize impacts of new infrastructure uses permitted within the reserve,
- Restoring and enhancing coastal sage scrub habitat through the acquisition of existing coastal sage scrub habitat or the creation of new coastal sage scrub, and;
- Managing on an interim basis, privately owned lands that will be transferred to the NROC for oversight and management.

These activities implemented by respective landowners within NROC are driven by management plans that direct adaptive management. Plans include:

- ❖ Fire management.
- ❖ Grazing management.
- ❖ Habitat enhancement and restoration.

### 6.3.2 Biological Monitoring

The NCCP-HCP biological monitoring program is intended to be the primary method for examining the relationship between reserve management and the long-term net habitat value of coastal sage scrub within the sub regional Reserve (Draft Umbrella Monitoring Plan 2000). Hence, biological monitoring is a critical component of adaptive management.

In 1997, the NROC Board of Directors appointed a Technical Advisory Committee to identify research and monitoring priorities and to evaluate management and monitoring results. The Committee, led by The Nature Conservancy “biological monitoring” advisor was first tasked to develop a long-term adaptive monitoring framework to guide the Reserve’s management efforts. NROC approved the monitoring framework in 1998. The framework is organized into biodiversity studies and special studies (Draft Umbrella Monitoring Plan 2000, Nature Reserve of Orange County 1998 Annual Report).

Biodiversity studies involve long-term monitoring of various taxonomic groups at several sampling locations to assess habitat value and concomitant need for management intervention within the Reserve. The Reserve landscape is partitioned into sixteen management units that represent core, fragment and edge habitat conditions for monitoring (Draft Umbrella Monitoring Plan 2000).

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Biodiversity studies are intended to assist in the identification of (1) detrimental changes within the reserve system that may be reversed through appropriate management action and (2) positive trends that may (or may not) be traced to specific management actions (Draft 2000 Umbrella Monitoring Plan). Biodiversity studies are identified in Table 6-1 that shows four biodiversity studies along with a description of study purpose and duration. The duration column not only identifies when the study began but also includes notes about the status.

**Table 6-1 Biodiversity Studies**

Study	Purpose	Duration/Observations
Herpetofauna	Quantitatively sample all reptile and amphibian species from the Central portion of NROC to determine species diversity and abundance and identify factors correlated to herpetofaunal diversity.	Began data collection in 1995 (pre NCCP-HCP) until 2000.  Orange Throated Whiptail-- Minimal monitoring information  Data analysis planned for 2006/07.
Pitfall Trapping of Ants	Quantitatively sample all ant species from the Central and Coastal sub areas of NROC to monitor and compare changes in species richness and abundance and identify management needs resulting from reserve changes.	1999 – 2003  No subsequent mention of study until 2001 & 2002 with minimal monitoring information provided.  Data analysis planned for 2006/07.
Small Mammals	To understand patterns of change in major taxonomic groups to increasing levels of exotic invasion within coastal sage scrub and use data to develop an IBI for coastal sage scrub that could be incorporated into monitoring programs across NCCP reserves.	2001-2003  Final report due in 2004.  First comprehensive reporting in 2003 Annual Report.  Data analysis planned for 2006/07.
Vegetation Monitoring	To measure vegetation composition and structural diversity. Changes in vegetation parameters and impacts of changes on selected taxa will be correlated.	Protocol to be finalized in 2006.  <u>Activities funded by the Irvine Co.</u> 1998 – 2000 Limestone Canyon Sycamore program.  1999-Limestone Canyon Native Grassland monitoring.
<b>Note:</b> Biodiversity studies are based upon a stratified sampling framework. A sampling design of (2) core management units, (4) (two residential and two road edge) edge management units and (2) fragment management units were selected.		
<b>Source:</b> Draft Umbrella Monitoring Report, personal communication with Resource Agency official, July 18, 2005.		

Of particular note is vegetation monitoring, the one active adaptive management opportunity approved by the NROC Board. Experimental designs are proposed to address the effects of exotic plant control and prescribed burning on floral composition. Table 6-1 identifies vegetation activities conducted by The Irvine Company, but no further information is provided in the NROC's documents.

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Table 6-2 identifies four special studies that have been conducted within the Reserve along with the study purpose, duration and status. Special studies are directed at identifying trends for specific species or groups of species that cannot be monitored within the framework of biodiversity studies.

**Table 6-2 Special Studies**

<b>Study</b>	<b>Purpose</b>	<b>Duration</b>
California Gnatcatcher and Cactus Wren (Targeted Bird Study)	The target bird study is designed to monitor population trends (quantity of territories) for the California Gnatcatcher and Cactus Wren to document the level of population conservation success overtime in each sub area of the reserve.	1999- 2004  5 yr. baseline study data analysis of Cactus Wren study planned for 2006.
Monitoring Avian Productivity and Survivorship (MAPS)	Monitors avian population trends within the reserve and the potential causes of trends to conserve avian biodiversity over the long-term.	1998- recommended to continue according to 2002 Annual Report.
Raptor Studies	Detect long-term changes in quantities of breeding adults and proportion of successful breeding territories of eleven raptor species. Will also track changes in the proportion of active roost sites for four roosting species and produce annual estimates of propagation of turkey vultures carrying elevated levels of lead in their tissue.	1999-2001 Status uncertain  Minimal monitoring information.  No mention of planned data analysis.
Large Mammal Studies	Identify wildlife corridors in and around developing areas in the Reserve and monitor mammal movement (mountain lions, bobcats and coyotes).	1998-2002  Data analysis planned for 2004.
* <b>Source:</b> Draft Umbrella Monitoring Plan 2000; personal communication with Resource Agency official, July 18, 2005.		

The targeted bird study has culminated into 5 years of baseline data collection. The intent of bird monitoring is to elucidate relationships between physical site characteristics and the abundance and distribution of target bird populations to assist with Reserve adaptive management (Nature Reserve of Orange County 2003 and 2004 Annual Reports). The results of the study are discussed in Section 7.2.5.

For the most part, biodiversity and special studies are not designed to answer questions about specific management actions. However, the studies are to meet the following monitoring objectives that will assist NROC in identifying when management intervention is necessary (Umbrella Monitoring Plan draft 2000).

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- Document the relationship between reserve management and status and spatial distribution of native species and habitats.
- Monitor relationships in temporal trends between native and exotic species.
- Monitor the relationship between natural disturbances (flood, fire, disease, etc.) and the status and distribution (spatial and succession) of Native and Exotic species of concern and unique plant assemblages.
- Detect factors threatening native species and habitats of concern.
- Detect changes in the status and distribution of California gnatcatcher and coastal cactus wren.

### ***Passive monitoring and management***

The NCCP-HCP calls for the establishment of semi permanent plots with size and configuration specifications to allow statistically valid analysis. Plot areas are to be strategically placed for monitoring the population status of gnatcatchers, cactus wren and orange whiptail lizards, observing reserve function and detecting vegetation changes (Orange Central Coastal NCCP-HCP and Implementation Agreement 1996)

### ***Active management and monitoring***

The active manipulation of Reserve biological resources is monitored to directly assess the efficacy of management activities in meeting the NCCP-HCP net habitat value goal. Provisions for manipulation include cowbird trapping, prescribed burns, grazing management, and the re-introduction of extirpated species, e.g., pacific pocket mouse, noxious weed eradication, and recreational zone designations (Orange Central Coastal NCCP-HCP and Implementation Agreement 1996).

All adaptive management activities involve the documentation of baseline conditions in the absence of and prior to active management. Monitoring occurs during and following management actions to assess population trends and ecological function. Monitoring data is to be analyzed and used as a basis for evaluating and guiding reserve management (Orange Central Coastal NCCP-HCP 1996). “Active” management activities that have been conducted within the Reserve include Cowbird Trapping and Artichoke Thistle and Veldt Grass removal.

A Pacific Pocket Mouse Conservation Custodial Fund was created in 1998 to support research, recovery and enhancement efforts for the mouse. Headlands Reserve LLC funds a segregated custodial account held by NROC (Nature Reserve of Orange County 2003 Annual Report). A temporary, 22-acre pocket mouse preserve on the Headlands site is to be established and maintained for eight years.

Biological studies and field surveys conducted within the temporary preserve is intended to provide information for identifying specific sites within the Reserve System for the establishment and expansion of the Pacific pocket mouse population. Relocated Pacific pocket mice will be monitored to ensure conservation within the Reserve.

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The status of Pacific Pocket Mouse research at the Headlands site and the imminent transfer of mice to the Reserve are uncertain since no such discussions are reflected in the Nature Reserve of Orange County 1997 – 2004 Annual Reports. The FWS and California Department of Fish and Game extended the 8-year temporary preserve period for one year (Nature Reserve of Orange County 2004 Annual Report).

### ***Research***

Field surveys, monitoring, data collection, data analysis and management conducted during plan implementation are considered research activities that contribute to the ongoing operation and management of the Reserve. Additional research is discretionary and not the primary activity for the NCCP-HCP (Orange Central Coastal NCCP-HCP 1996).

### **6.3.3 Mitigation**

There are three avenues for mitigation for the NCCP-HCP. First, the Reserve serves as mitigation for participating landowners who have financially contributed to its creation and long-term management. Second, mitigation fees are paid to NROC by non-participating land owners for impacts on occupied coastal sage scrub habitat outside of the reserve. Third, there are participating landowner mitigation projects within the reserve for development impacts that occur outside of the reserve (Orange Coastal and Central Sub region Environmental Impact Report/Environmental Impact Statement, 1996).

The Transportation Corridor Agency, the main financial contributor implements several small mitigation projects within the Reserve. The Transportation Corridor Agency received permits from the Corp of Engineers, FWS and California Department of Fish and Game for numerous construction projects to include the 73 Freeway and the eastern corridor that intersect the reserve. In return, the Agency is required to implement coastal sage scrub restoration projects and monitor results. Transportation Corridor Agency has 2,000 acres set aside for mitigation of which approximately 480 acres reside within the reserve.

While most mitigation projects involve invasive plant removal and coastal sage scrub revegetation, Transportation Corridor Agency also conducts some gnatcatcher and cactus wren monitoring and cowbird trapping (Resource official interview, March 2004, Nature Reserve of Orange County 1998- 2003 Annual Reports). Table 6-3 shows a selection of the many mitigation projects and activities conducted within the Reserve.

The Irvine Company also conducts mitigation projects to include wetland expansion and riparian, marsh and pond creation, coastal sage scrub restoration, artichoke thistle removal and other habitat restoration and enhancement activities. The Nature Reserve of Orange County 2001 Annual Report shows such activities occurred on a total of approximately 300 acres, however, no further information is provided in subsequent reports and there was no information available on mitigation performance standards and criteria.

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**Table 6-3 Transportation Corridor Agency Mitigation Project Examples**

<b>Project</b>	<b>Activity</b>
Siphon Reservoir	<p>112- acre coastal sage scrub habitat restoration to mitigate for construction of the Eastern Transportation Corridor.</p> <p>Revegetation of 102- acre adjacent area &amp; gnatcatcher dispersal studies at site.</p> <p>Cowbird trapping—Ongoing</p> <p>Arbuscular mycorrhizal research—Ongoing</p> <p>Dudleya multicaulis outplanting research--Ongoing</p>
Coyote Canyon Landfill	<p><u>Coastal sage scrub revegetation &amp; gnatcatcher monitoring</u></p> <p>91 acres Coyote Canyon            8 acres East Canyon            5 acres South Canyon            18 acres @ adjacent restoration site</p> <p>Arbuscular mycorrhizal research--Ongoing</p>
Bonita Channel	<p>21.1-acre coastal sage scrub revegetation for construction of a retail center</p> <p>Monitoring of coastal sage scrub revegetation site.</p>
Eastern Transportation Corridor	200 acre coastal sage scrub revegetation along roadway slopes
California Gnatcatcher and Cactus Wren and their habitat in San Joaquin Burn Study	Monitor sites to detect natural revegetation of habitat and the return of gnatcatcher and Cactus Wren via population census.

***Performance standards and criteria***

The FWS established performance standards and criteria for mitigation projects to be implemented for five years within which time performance criteria must be met. Specifically, coastal sage scrub habitat is restored if: 1) the site supports breeding pairs of gnatcatchers, or 2) the site has the structure and composition of naturally occurring gnatcatcher habitat or fully functional coastal sage scrub or 3) the site is not statistically different from functional coastal sage scrub for cover and diversity of coastal sage scrub species. The performance criteria include the establishment of total cover by self-sustaining coastal sage scrub species at 70 percent or more.

Interim coastal sage scrub cover goals of 45%, and 60%, are set for specific time periods during implementation. If standards are not achieved, other remedial measures must be taken (2001 Coyote Canyon Landfill Performance Monitoring Report 2001, Nature Reserve of Orange County 1999 Annual Report).



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**Table 6-4 NCCP MONITORING SCHEDULE (continued)**

Year 1	Year 2	Year 3																																	
<b>Months</b>																																			
J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
<b>Intensive Monitoring</b>																																			
<b>Cactus Wren</b>																																			
<b>NESTING</b>																																			
		x	x	X	x	x								x	x	x	x	x																	
<b>(Includes years 1, 3, 5 &amp; 6)</b>																																			
<b>Year 5</b>				<b>Year 6</b>				<b>Year 7</b>																											
x	x	x	x	x										x																					

### Management Monitoring

Prescribed fire	Baseline data to be collected before prescribed burns, and post burn in years 1,2, 4, and 6.
Grazing	Baseline data to be collected concurrently, semi-monthly qualitative monitoring during grazing season.
Vertebrate Pests	Baseline data to be collected concurrently.
Weed management	Baseline data to be collected before prescribed burns, and post-burn in years 1, 2, 4 and 6.
Recreation	Baseline data to be collected before allowing recreational use, and afterwards in years 1, 2, 4, and 6.
Restoration and Enhancement	Plans for baseline and post-treatment monitoring to be developed on a project basis.

Source: NCCP EIR Map Book 1996

## 6.4 Summary

This chapter reveals that a lot of planning went into establishing the NCCP-HCP, not an easy feat considering the number of participating landowners involved. The aims of the NCCP-HCP and the roles and responsibilities of the NROC Board are well articulated. The reporting requirements and parameters for adaptive management are also clearly defined.

The NROC's biological monitoring program could be strengthened through improved integration and long-term visioning. Most notably, biological monitoring studies were proposed and implemented without the guidance of an approved comprehensive, Reserve wide monitoring plan and protocol. Although the NROC Board approved the biological monitoring framework, the proposed site selection, data collection, analysis and interpretation and statistical validation has not been officially approved. Most of the monitoring studies are designed to establish baseline data of population trends and patterns of changes in species richness, abundance and quantities.

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In an early section of the draft Umbrella Monitoring Plan states that biological monitoring is the primary method for examining the relationship between reserve management and habitat value to assure that net long-term habitat value is maintained. Another later section of the Plan states, “for the most part, biodiversity and special studies are not designed to answer questions about specific management actions (pg. 1, Umbrella Monitoring Plan draft 2000).” None of the studies relate specific conservation actions with performance criteria to assess implementation performance.

The link between management efficacy and habitat value is intended to be made through activities such as cowbird trapping, and weed eradication. These activities are defined as “active” management in the NCCP-HCP, but would not qualify as active adaptive management.

Final approval from the NROC Board on Reserve activities takes a long time despite quarterly meetings to review and approve Reserve activities. An Executive Committee was established in 2001 to further analyze and make final decisions on Reserve proposals presented to the Board. In particular, the Technical Advisory Committee prepared a draft Umbrella Monitoring plan in 1998. Another draft was produced in 2000; however the NROC Board has yet to approve the Plan (subject interviews, March 2004, personal communication with Resource official, July 2005).

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### 7.1 Adaptive Management Implementation

NROC defines enhancement and restoration as “all activities and measures designed to improve biological productivity and diversity within the Reserve, including but not limited to the control of invasive and exotic species, fire management, controlling public access and managing agricultural practices” (NCCP & HCP, pg. 309). This Chapter presents management plans that guide adaptive management implementation, management techniques implemented within the Reserve and associated outcomes and NCCP-HCP implementation progress.

The first eight years of NCCP-HCP implementation reveal that Reserve owners and managers are independently conducting habitat enhancement and restoration, and fire, grazing, and recreation/public access management within the Reserve. Some activities have proceeded well with the guidance of a management plan while other activities were initiated with out the guidance of a management plan. In addition, some activities have been conducted on a limited basis attributed to a poorly coordinated and communicated draft management plan. This Chapter will reveal that not all Reserve owners and managers are aware of the adaptive management requirements articulated in the Implementation Agreement. Moreover, most of the Reserve activities are not designed to employ active adaptive management.

### 7.2 Management Plans and their Relationship to Biological Monitoring

Activities specifically intended for adaptive management are: habitat enhancement and restoration, fire and grazing management, and recreation and public access control. These activities are to be monitored to: (1) evaluate effectiveness and progress and (2) identify new enhancement and restoration opportunities/priorities within the Reserve (NCCP & HCP, pg. 310). The management plans that guide adaptive management are the:

- ❖ Habitat Enhancement and Restoration Management Plan
- ❖ Fire Management Plan
- ❖ Grazing Management Plan

#### 7.2.1 Habitat Restoration and Enhancement Plan

Habitat enhancement and restoration is an integral part of adaptive management for the NROC. It is assumed that restoring and enhancing habitat within the Reserve will result in high long-term values compared to maintaining existing isolated habitat or restoring coastal sage scrub habitat on lands geographically removed from the Reserve (NCCP & HCP 1996).

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The NROC approved a Habitat Restoration and Enhancement Plan in June 2003. The Plan outlines management goals, the existing conditions in the Central and Coastal sub region, and restoration and enhancement activities within the Reserve. The Plan also contains: (1) a summary of exotic species of management concern, (2) restoration and enhancement methods that suggests conditions for use, timing and costs per method, (3) a project planning and implementation checklist, (4) a map of the type and location of potential habitat restoration areas, and (5) a map of priority areas for artichoke thistle control, including a schedule and cost estimate for artichoke thistle control for the Coastal Sub area (Habitat Restoration and Enhancement Plan 2003).

The goals of habitat restoration and enhancement are to:

- Maintain biological values.
- Enhance degraded habitat areas to improve their ability to support native biodiversity.
- Restore non-wildland areas to native habitats.
- Safeguard unique biotic assemblages from degradation.
- Improve the ability of the Reserve to support identified species of particular sensitivity through targeted restoration and enhancement actions.
- Promote development of state of the art restoration and enhancement methods by monitoring to track the success of various methods and inform restoration decisions.
- Minimize disturbances to resist invasion and establish an early warning system of infestations.

Areas within the Reserve without exotic species and with minimal exotic species will undergo natural, passive restoration to their optimal habitat type, given site-specific soil conditions. The greatest impediments to natural, passive restoration are invasive and competitive exotic species, e.g., artichoke thistle, veldt grass, Cape ivy and extensive seed dispersal routes, such as roads, trails, rights-of-way and watercourses throughout the Reserve (Habitat Restoration and Enhancement Plan 2003).

The two main strategies implemented within the Reserve are: (1) invasive species control within intact native habitat areas and (2) active restoration of areas with low native cover where exotic plant control has been completed. Restoration activities are informed by Conservation Biology principles. Restoration and enhancement project monitoring plans are site specific. Plans provide for baseline data collection and analysis and the collection of post treatment data to determine project success. The design and implementation of multi-factorial experiments is contingent upon fund availability (Habitat Restoration and Enhancement Plan 2003).

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All restoration activities are to be coordinated through the NROC. The NROC should: (1) track the location of invasive exotics, (2) ensure monitoring obligations are fulfilled, and (3) allocate funds in high priority locations throughout the Reserve (Habitat Restoration and Enhancement Plan 2003). Data from these activities are to be included in NROC annual reports and used in the overall adaptive management program.

The goal of habitat enhancement and restoration is to replicate the existing distribution patterns and relative portions of key coastal sage scrub species in existing high quality habitat within the Reserve. Performance standards are determined on a case-by-case basis, commensurate with the scale of the project and location within the Reserve. Performance is assessed based on the restoration areas developing a trend of vegetative cover, diversity, and species dominance that is similar to the coastal sage scrub communities naturally occurring in adjacent areas of the Reserve. Suggested performance standards are:

- Low cover of the most problematic invasive species, rather than species or habitat specific goals;
- Evidence that the site is sustainable by showing signs of regeneration (progeny and new growth), nutrient cycling, healthy plants, low mortality rate, resistance to weeds (less than 15% cover and minimal weed maintenance during the previous spring season), and lack of significant erosion); and,
- The habitat supports foraging or nesting coastal California gnatcatchers or there is mutual agency agreement that the site is suitable habitat for coastal California gnatcatchers (Habitat Restoration and Enhancement Plan 2003).

### **7.2.1.1 Exotic Plant Management**

The two highest priorities for habitat enhancement and restoration activity are: (1) active restoration of agricultural areas as agricultural production ceases; and (2) control of invasive exotic species, i.e., new weed infestations and weed dispersal control along the seed dispersal routes. The primary exotic plant species targeted for control include artichoke thistle (*Cynara cardunculus*), and veldt grass (*Ehrharta calycina*). Exotic plant management entails prioritizing areas for treatment, collecting ongoing vegetation cover data from several established monitoring plots within a subset of treatment areas, and controlling targeted exotic species through herbicide application (Habitat Restoration and Enhancement Plan, 2003; Nature Reserve of Orange County 2004 Annual Report).

#### **Artichoke Thistle Control**

Artichoke thistle control efforts by the Nature Conservancy began in the San Joaquin Hills portion of the Coastal NCCP sub region in 1994 following the Laguna Canyon fire. Control efforts involved spraying herbicide solutions consisting of Roundup and Transline.

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Roundup is a non-selective contact herbicide and Transline is a selective broadleaf pre-emergent herbicide. Six, 20 X 20-meter plots were established before treatment. Five 20 meter transects were established along the baseline of each plot at 0, 5, 10, 15 and 20 meters. Visual estimates were made on total percent cover of artichoke thistle and any other plant species occurring within each quadrant.

In addition, the number of re-sprouts and seedlings of artichoke thistle were counted, and a height measurement was recorded for each individual thistle plant (Nature Reserve of Orange County 1998 Annual Report). Results in terms of relative cover values are summarized as follows in Table 7-1:

**Table 7-1 Artichoke Thistle Control in Coastal Sub Region**

<b>Location</b>	<b>Treatment 1996 - 1998</b>	<b>Pre-treatment Coverage (%)</b>	<b>Post-Treatment Coverage (%)</b>	<b>Difference (%)</b>
Muddy Canyon	2% Roundup and spring burn (2 year)	48	13	35
Muddy Canyon	2% Roundup (2 year)	63	13	50
Boomer Ridge	2% Roundup and Transline (1 year)	39	9	30
Shady Spur	2% Roundup and Transline (1 year)	80	3	77
<b>Source:</b> Nature Reserve of Orange County 1998 Annual Report				

Table 7-1 shows that two-year treatments extended from 1996 to 1998 and one-year treatments went from 1997 to 1998. Included in these results are data collected from treatment plots established and treated in previous years. Data collected from the 1996 and 1997 treatment plots showed a significant reduction in the cover of artichoke thistle one year after treatment (Nature Reserve of Orange County 1998 Annual Report).

However, it was noted that the number of seedlings per square meter greatly increased after one year of treatment in the Roundup only plots, as compared to the Roundup-plus Transline treatment plots. The application of Transline appears to have made a significant reduction in the number of seedlings the first year following treatment (Nature Reserve of Orange County 1998 Annual Report).

Between 1999 and 2004 artichoke thistle control efforts have since been extended to Laguna Coast Wilderness Park (Emerald Canyon, Bid Bend), City of Irvine Southern Open Space Preserve (Shady and Boomer Canyons, North Laguna Canyon, Bonita Canyon), University of California, Irvine Ecological Reserve, Crystal Cove State Park and Aliso and Wood Canyons Wilderness Park. Monitoring results reveal that NROC has been successful in controlling the invasive weed at sites receiving repeated annual herbicide treatment (Nature Reserve of Orange County 2004 Annual Report).

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Specifically, an evaluation of monitoring data from 22 artichoke thistle plots suggests that artichoke thistle cover has decreased significantly at nearly every plot. Successful control is attributed to at least three successive years of treatment at each location and the switch from using the non-selective herbicide Round Up prior to 2001 to the current focused use of the broadleaf selective herbicide Transline.

At locations where three successive years of treatment have not been accomplished, such as the UCI Ecological Reserve and the Aliso and Wood Canyon Wilderness Park, artichoke thistle has also rebounded. Moreover, the use of Transline herbicide provides earlier effective control of artichoke thistle than Round Up. In addition, the early season application of Transline greatly increases thistle control effectiveness and is believed to reduce the number of years of repeat treatment (Nature Reserve of Orange County 2004 Annual Report).

Concurrent with declines in artichoke thistle have been marked increases in the percent cover by other exotic species such as non-native grasses, and mustard, particularly at locations where native plant species cover was non-existent prior to treatment. The percent cover of artichoke thistle is now less than 10 percent in 17 of the 22 artichoke monitoring plots (Nature Reserve of Orange County 2004 Annual Report). At monitoring locations where native plant species co-existed with artichoke thistle prior to treatment, native cover has remained stable or slightly increased at four of six locations treated consistently with the herbicide Transline. At the six locations supporting native plant cover where artichoke thistle was initially treated with Round Up, native plant cover and diversity decreased the year following initial treatment, indicating that the non-selective nature of this herbicide has negatively affected native plant species persistence and spread (Nature Reserve of Orange County 2004 Annual Report).

Besides herbicide treatment, precipitation levels and timing, phenology, and competition may also cause native plant cover to decrease at the monitoring locations (Nature Reserve of Orange County 2004 Annual Report). Table 7-2 shows the amount of money dedicated to the effort of artichoke thistle control (Nature Reserve of Orange County 2003 Annual Report).

**Table 7-2 Nature Reserve of Orange County Artichoke Thistle Funding**

<b>Year</b>	<b>Funds</b>	<b>Treatment Acreage</b>
1999	\$50,000	*
2000	\$125,000 includes California Department of Fish and Game matching funds	*
2001	\$102,000 includes California Department of Fish and Game matching funds	1,600
2002	\$160,000	2,235
2003	\$80,000	575
2004	\$89,464	*
* Acreage unknown		
<b>Sources:</b> Nature Reserve of Orange County 1999 – 2004 Annual Reports		

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### Veldt Grass Control

Observation of expansive invasive veldt grass that was out competing coastal sage scrub and native grass communities in the Coastal Sub region The Nature Conservancy initiated veldtgrass control and management. Prior to the 1993 Laguna Canyon fire, there was approximately three acres of veldtgrass in upper Emerald and Moro Canyons in the Coastal Sub region.

By 1999, the grass spread to over 30 acres. To prevent further spread of this highly invasive grass throughout the rest of the sub region, (3) 20 x 20 meter plots were established in the Laguna Coast Wilderness and Crystal Cove State Parks. Baseline data was collected to include the identification of other exotics within monitoring plots among native shrubs, e.g., black sage, California buckwheat, coastal sagebrush, laurel sumac, and herbs, e.g., doveweed, collar lupine and rattlesnake weed (Nature Reserve of Orange County 1999 Annual Report).

Relative percent cover of veldtgrass was 57% within three monitoring stations prior to herbicide treatment. Thirty acres of veldtgrass was treated with a grass selective herbicide (Fusillade). The percent of veldtgrass cover declined every year from an average of 57 percent in 1999 to 8.3 percent in 2004. The application of Fusilade II has greatly increased the effectiveness of control efforts and is believed to reduce the number of years of repeat treatment necessary to control veldt grass. The percent cover of native species has increased over the past five years from an average of 21% in 1999 to 40.1% in 2004. Although the data reflects a significant reduction in veldt grass cover, veldt grass still continues to be found in new locations throughout the coastal sage scrub in both the Laguna Coast Wilderness Park and Crystal Cove State Park. Veldt grass is spreading along wildlife trails, hiking trails and remains difficult to control in the thicker areas of scrub where it is less visible to crews. The Nature Conservancy recommends additional control efforts to continue to reduce veldtgrass cover and to control its spread to other unaffected areas. Table 7-3 shows the amount of funds dedicated to veldtgrass control efforts.

**Table 7-3 Nature Reserve of Orange County Veldtgrass Control in Laguna Coast Wilderness Park and Crystal Cove State Park Funding**

<b>Year</b>	<b>Funds</b>
1999	\$14,000 California Department of Fish and Game grant
2000	\$6,800 and 8,257 from California Department of Fish and Game grant
2001	\$32,539
2002	\$30,000
2003	\$10,000
2004	\$30,000
*Funding amount not noted in the Nature Reserve of Orange County 2000 Annual Report	
<b>Sources:</b> Nature Reserve of Orange County 1999 – 2004 Annual Reports	

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Assuming that The Nature Conservancy is applying the performance standards previously described, invasive plant species removal has not achieved performance goals. The Nature Conservancy recommends the following future habitat restoration and enhancement activities:

- ❖ Reassess five and ten-year exotic plant control treatment goals, and adjust future budgets to meet treatment goals.
- ❖ Continue field monitoring to assess the effectiveness of exotic plant control.
- ❖ Initiate artichoke thistle control early in the season, focusing on using the herbicide Transline.
- ❖ Treat other broadleaf weeds in artichoke thistle treatment areas.
- ❖ Initiate veldtgrass treatment when the majority of the plants are actively growing and flowering – mid to late March.
- ❖ Work with Reserve managers to assess the need to close certain trails where veldtgrass has the potential to spread.
- ❖ Implement small-scale restoration studies to restore native habitat in treatment areas where native plant recover has been poor due to lack of native plant propagules.
- ❖ Begin competitive bidding for exotic control work to ensure that the best qualified and most cost efficient contractor is awarded the work (Nature Reserve of Orange County 2004 Annual Report).

### **7.2.1.2**    *Native Grasslands*

The Nature Conservancy also recognized mixed native grass/exotic annual grasslands as having the potential to increase habitat value and biodiversity within the sub region. Thus, in 2001 grasslands, a non- coastal sage scrub habitat was identified for priority treatment (Nature Reserve of Orange County 2001 Annual Report).

### **7.2.1.3**    *Active Adaptive Management*

There is one example of active experimentation involving a pilot native grassland restoration project for the Irvine Ranch open space lands including NROC land (Limestone Canyon, Peters Canyon Regional Park, Boomer Canyon and Crystal Cove State Park). The experiment initiated in 2003 tests “relatively non-invasive, reverse fertilization methods to establish native perennial grassland species.

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Fertilization methods were applied in sites dominated by exotic species, either naturalized annual grasses or artichoke thistle. The purpose of this study was to use pre-treatment and seeding methods that have the least negative impact on the soil (The Nature Conservancy 2004).

Four and two test sites were selected in the coastal and central cores of the reserve, respectively. Each site consisted of two acres and was selected based upon soil type, plant species composition, topography, accessibility and size. The site size was determined based upon the accessibility of equipment to the sites and the associated cost efficiency.

The experimental design employed four main treatments that may enhance germination and native species growth over the increase of exotic species within 16 experimental plots. Baseline data was collected prior to treatment applications and monitoring will continue annually. Results will be compared within and across all sites using parametric and non-parametric analysis of variance (The Nature Conservancy 2004).

### ***7.2.1.4 Mitigation Projects***

#### ***Non-native animal species control***

Mitigation projects involve coastal sage scrub salvage, translocation and Brown Headed Cowbird trapping and Post Burn Study. The Habitat Restoration and Enhancement Plan did not address the specifics of controlling populations of invasive, non-native animal species. Brown headed cowbird trapping was implemented by the Transportation Corridor Agency to mitigate for the construction of the San Joaquin Hills and Eastern Transportation Corridors. Cowbird trapping was also conducted to improve the reproductive success of the coastal California gnatcatcher. Cowbirds have been found to nest in the nests of California gnatcatchers, particularly in areas fragmented by human developments. The Transportation Corridor Agency has been trapping cowbirds since 1994 with fewer observations each year. Since 2003, no cowbirds have been detected (Nature Reserve of Orange County 1999 - 2004 Annual Reports).

#### ***Native Plant Salvage and Relocation Project***

Native plant salvage from developed areas and its relocation to degraded areas within the Reserve began in 2000. Specifically, The Nature Conservancy coordinated the salvage and relocation of coastal prickly pear, coastal cholla, lichen-covered rocks and high quality grassland topsoil to several locations within the Reserve that provided coastal cactus wren habitat that was lost during the 1993 Laguna Canyon Fire. This project has been supported by NROC, the Irvine Company and a California Department of Fish and Game grant (Nature Reserve of Orange County 2000 & 2001 Annual Report). As of 2002 more than 8,000 native shrubs, grasses and cacti were relocated to six degraded areas in the Reserve. Survivorship was 65% in coastal sagebrush, 83% in black sage and bush monkey flower. Survivorship in cacti was not measured (Nature Reserve of Orange County 2002 Annual Report).

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### ***Post Burn Study***

The Transportation Corridor Agency funded a post burn study following the 1993 Laguna Beach Fire that burned 75% of the coastal sub area as part of their mitigation obligation. The study funded between 1994 and 1998 assessed the suitability of habitat for the cactus wren population in the San Joaquin Hills Burn Area. In 1999, the study was contracted to the same consultant that conducts the targeted bird studies. The NROC funded study is discussed in Table 6-3 of Chapter 6.

### **7.2.2 Fire Management Plans**

Coastal sage scrub is a fire tolerant community. Fire events have played an important role in the origin, rejuvenation and maintenance of the Reserve's nature biodiversity. Fire is also a periodic source of disturbance to which Reserve habitat types have adapted during their evolution.

Many plant communities relied on a pre-settlement natural fire regime for germination or creation of gaps for colonization. However, grazing, fire control regulations and urban development patterns within and or surrounding the NROC regional planning area has changed natural fire regimes (NCCP & HCP 1996).

The accumulation of NROC native vegetation open space, expanding wildland/urban interface, and historic fire weather patterns combined contributes to thick layers of thatch and dense patches of vegetation. The layers and patches impede a healthy functioning ecosystem and increase the likelihood of intense wildland fires (NCCP & HCP 1996).

In October 1993, wildfires in the Laguna/San Joaquin Hills burned 60% of coastal sage scrub in the Coastal sub area as a result of vegetation/fuel build up in the Laguna Canyon, adjoining portions of coastal hills and strong Santa Ana winds. Subsequently, post burn studies were initiated in 1994 during preparation of the NCCP-HCP to monitor gnatcatcher and cactus wren in the San Joaquin Hills burn area and to assess habitat suitability for the cactus wren (Final California Gnatcatcher and Coastal Cactus Wren Monitoring Report, January 2002).

The Laguna fires precipitated the need for short-term and long-term fire management policies for the NCCP sub region governed by the California Department of Forestry and Fire and the Orange County Fire Authority. To support these policies, the NCCP-HCP calls for the preparation and implementation of a short-term, tactical fire plan and a long-term fire management plan (NCCP & HCP, July 1996).

### ***Short-Term Fire Management Plan***

The NROC short-term fire plan identifies suppression and control methods that will cause the least damage to natural resources commensurate with fire fighting control to protect human life and property (Short Term Fire Tactical Plan, 1999). In event of wildfire, the NCCP-HCP requires the establishment of "compartments encompassing major populations of target species in the Reserve, and associated fire attack measures that have the least impact on sensitive habitat in or near areas where species take refuge (NCCP & HCP, II-331)".

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Specifically, the Reserve is divided into (12) fire management compartments established based upon fire history and areas with the majority of NCCP target species potentially subject to frequent fires. The compartments are:

1. Aliso-Wood Canyon Wilderness Park;
2. Coastal San Joaquin Hills/Newport Coast;
3. West San Joaquin Hills/Upper Newport Bay/UCI);
4. Inland San Joaquin Hills (City of Irvine Open Space);
5. El Toro MCAS Conservation Area;
6. Limestone Canyon/Whiting Ranch Wilderness Park;
7. Lomas Ridge;
8. Peters Canyon;
9. Shirley Grindle Open Space/Santiago Oaks Regional Park;
10. Irvine Lake/Santiago Canyon;
11. Weir Canyon Wilderness Park; and
12. Gypsum Canyon/Coal Canyon Ecological Reserve (Short Term Fire Tactical Plan, 1999).

The following fire suppression operational measures as prescribed by a fire suppression plan are to be implemented within fire management units:

- A fire fighting prescription that considers pre-suppression, suppression and post suppression activities;
- A tactical map that defines the boundary of the fire management unit in relation to urban development, roads, water supply locations, power lines, etc.;
- A vegetation map that identifies all significant vegetation types in the unit; and
- Fuel-break management recommendations (NCCP & HCP, 1996).

Criteria were established to protect urban development from fire while minimizing impacts on coastal sage scrub habitat for open space areas adjacent to development in immediate proximity to the Reserve boundary. There are policies for the use of bulldozers, creation of new fire roads, backfiring from existing fire roads, ground tactical operations, grading techniques and erosion control methods, and water saturation techniques (NCCP & HCP, 1996; Tactical Fire Suppression Plan, 1999).

A post fire evaluation is recommended that involves documenting the: (1) date/time of fire, (2) Fire management compartment/fire unit affected, (3) Reserve land rating for affected fire management compartment and unit, (4) fire suppression tactics used, (5) estimated size of fire (acres), (6) affected habitat, (7) types of disturbance (new roads, hand clearing, erosion, etc.), and (8) measures undertaken to control disturbance (Tactical Fire Suppression Plan, 1999).

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Reserve landowners must report all fire incidents and responses to the NROC, FWS and California Department of Fish and Game. Reports must include: (1) the types of resource affected, (2) number of acres by habitat type affected, (3) cause of fire, (4) a post fire evaluation, and (5) the cause of incident (Tactical Fire Suppression Plan, 1999).

Finally, the Orange County Fire Authority and The Nature Conservancy shall conduct a training session for interagency coordination with the following stakeholders:

- NROC Reserve managers. Annual training was to begin November 1999.
- City of Irvine, Anaheim, and Laguna Beach wildland fire agencies. Annual training was to begin in November 1999.
- Orange County Fire Authority Battalion Chief, annual training was to begin August 3, 1999 (Tactical Fire Suppression Plan, 1999).

### ***Long-Term Fire Management Plan***

The County of Orange is the lead agency for preparing the Long-Term Fire Management Plan that focuses on pre-suppression fire management activities and the use of prescribed burns as a management tool (NCCP & HCP 1996). According to a Resource official, "...the long-term fire management plan addresses the ecological ramifications of fire, either applying fire or preventing fire ... an ecological approach...(Resource agency interview, March 2004).

The goals of the NROC Fire Management Program are to:

- Ensure the persistence of a native-dominated vegetation mosaic in the planning area.
- Restore or enhance the quality of degraded vegetation communities and other habitat types in a manner consistent with overall conservation goals for species and natural communities.
- Maintain landscape function, at all identified scales, for the planning area.
- Identify and develop target structural characteristics for selected species habitat (NCCP/HCP Wildland Fire Management Plan, March 2002).

The Plan Management objectives include:

- Developing active fire management prescriptions for valley grasslands, focused on increasing diversity of native plants and promoting community structure and composition favored by target wildlife species;
- Utilizing prescribed fire to reduce unplanned fire events from known ignition corridors;
- Defining fire prescriptions that aid in the restoration of degraded shrublands;
- Quantifying the effects of varying fire regimes on selected wildlife species;
- Developing a social environment supportive of active fire management;
- Investigating active restoration techniques following fire treatments; and
- Identifying appropriate spatial scales and patterns for the long-term fire management.

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The Long-term Fire Management Plan addressed findings of the Orange County Wildland /Urban Interface Task Force that convened following the aftermath of the October 1993 Laguna Canyon fire. In particular, the Task force recommended the use of prescribed burns to reduce fuel loads and the related possibility of an uncontrolled reserve wildfire. Thus the NCCP-HCP recommends that the NROC Long-Term Fire Management Plan include:

- A Wildland Management Planning Model;
- Fire Management Techniques and Implementation Measures; and
- Monitoring and Integration into the Reserve Adaptive Management Regime.

### ***Wildland Fire Management Model***

In addition to the development of a Wildland Fire Model, the Long-Term Fire Management Plan recommended the following actions:

- Creation of databases for information relevant to fire management planning, including long-term monitoring of recovery for areas impacted by the 1993 Laguna fire;
- Development of fire prescription models to create a mosaic of seral stages; and
- Incorporation of fire prescription models into the fire management program.

The preparation of an implementation MOU involving Orange County Fire Department, California Department of Fish and Game, FWS and the South Coast Air Quality Management District is also recommended.

### ***Fire Management Techniques and Implementation Measures***

The following fire management techniques and implementation measures were recommended:

- A fuel load reduction program that emulates fire regimes approximating pre-urban conditions. The program will identify the timing of burns, including season and frequency;
- Mechanical or other fire management techniques, i.e., crush and burn, chip and place, grazing;
- Fire behavior patterns including proposed intensity/severity of prescribed burns and burn size/pattern;
- Pre-burn surveys for sensitive species;
- Refuge areas for NCCP target and identified species;
- Habitat restoration measures that reduce fuel load buildups of non-native vegetation such as invasive grasses and that replace non-native vegetation with native species such as native grasses that have a much lower fire fuel content;
- The use of fire as a coastal sage scrub restoration site-preparation technique to reduce populations of invasive plant species prior to undertaking propagation of coastal sage scrub plants in restoration areas.

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### *Monitoring and Adaptive Management*

The Plan recommended monitoring and adaptive management involving:

- ❖ An evaluation of burn or other fire management programs to develop adaptive management strategies;
- ❖ Regrowth, regeneration and plant succession analyses for selected burn areas; and
- ❖ The sampling of burn sites for NCCP-target and other species.

A fire management implementation schedule/timetable was to be completed within one year of the signing of the Implementation Agreement and updated as necessary depending on fire recovery monitoring program results (NCCP/HCP Wildland Fire Management Plan, March 2002). According to the Plan most of the grassland burning is occurring within the Central Sub region and eastern portions of the Coastal Sub region. However, no documentation was provided to support this statement. Prescriptions targeted at coastal sage scrub enhancement were planned for both Sub regions. Chaparral/shrubland restoration was directed toward the Central Sub region while fire protection strategies were recommended for deployment in both Sub regions (NCCP/HCP Wildland Fire Management Plan, March 2002).

The Reserve is classified into four prescribed fire management categories: (1) Coastal Sage Scrub Enhancement Sites, (2) Native Grassland Management Sites, (3) Chaparral/Shrub Restoration Sites and (4) Protection of Life and Property Sites. Table 7-4 defines each category along with the type of burn intensity prescribed.

The Orange County Fire Authority is responsible for providing the resources and an overhead team for each planned burn. NROC is responsible for assisting Reserve managers with individual plan development and fire related monitoring. The NROC and the Technical Advisory Committee are responsible for reviewing monitoring results and adapting fire implementation (NCCP/HCP Wildland Fire Management Plan, March 2002).

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**Table 7-4 Prescribed Fire Management Categories**

<b>Category</b>	<b>Definition</b>	<b>Strategy</b>	<b>Burn intensity</b>
Coastal Sage Scrub Enhancement Sites	Areas with low-density shrubs and a significant component of non-native grass cover.	Burn selectively to reduce the cover of non-native grasses and increase the density of native shrubs. Burns are to be conducted within an experimental design to determine whether fire can improve the composition and structure of the coastal sage scrub community.	Selected units will be burned in different seasons, varied fire intensities and varied return intervals.
Native Grassland Management	Maintenance of open grassland communities, providing habitat for grassland-dependent species.	High frequency fire events.	Managed by moderate intensity.  Prescriptions will target frequent, moderate intensity prescribed fire.
Chaparral/Shrub Restoration Sites		A patchy burn (50-70% fuel volume consumption) & develop a low fuel profile zone around the Tecate Cypress Grove.	varying low to moderate fire intensities
Protection of Life and Property	Weir Canyon and Gypsum Canyon mix of vegetation types.	Prescribed burning may provide both fire protection for life and property and natural resource values.	

### ***7.2.2.1 Fire Ecology Research and Monitoring Criteria***

In addition to posing hypotheses for grassland and coastal sage scrub habitat management, the Wildland Fire Management Plan recommends a combination of long-term monitoring and experimentation. These activities were to be conducted to assess plant and animal responses, plant sampling techniques and data management (NCCP/HCP Wildland Fire Management Plan, March 15, 2002). Provided below is a brief description of plant and animal response monitoring, plant sampling techniques and data management suggested in the Long-Term Fire Management Plan.

#### **Plant community response.**

The monitoring of vegetation change and correlating the impact of those changes on selected taxa will provide relevant management information and inform NCCP-HCP implementation success. Through experimentation Reserve managers can better understand: (1) the degree of species interdependence within a plant community, (2) how community distribution depends upon past and present environmental factors (NCCP/HCP Wildland Fire Management Plan, March 2002) and (3) changes in vegetation dynamics in relation to fire.

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### *Animal response.*

NROC funded small mammal studies and vegetation sampling for which comparisons could be made among existing and future data sets for experiments on fire effects. A herpetofauna researcher is currently monitoring 26 sites throughout Coastal Southern California, some of which are in the Reserve. The intent of herpetofauna monitoring is to quantify direct mortality and population impacts through time.

During the course of sampling, a number of these sites have burned allowing for a better understanding of herpetofauna response to fire. The Fire Management Plan recommends that this researcher be contacted in the future prior to all prescribed burns and after each wildland fire for immediate post-fire sampling (NCCP/HCP Wildland Fire Management Plan, March 15, 2002).

### *Plant sampling techniques.*

Vegetation sampling has been completed on a number of sites throughout the Reserve. The same sampling methods are recommended for utility within burn units.

### *Data-management.*

The Wildland Fire Management Plan recommended the review of measurements at the end of each field day to eliminate recording errors on datasheets. Copies of these data sheets are to be delivered on a weekly basis to NROC Executive Director for another thorough review. This data should then be entered into project's central database that will have information on the geographic position of each transect as well as all biological and identification/attribute information sampling (NCCP/HCP Wildland Fire Management Plan, March 15, 2002).

#### ***7.2.2.2 Coastal Sage Scrub Seasonal and Frequency Experiment***

To gain a long-term monitoring perspective on fire management, the Plan recommends measuring habitat response through two or three fire cycles to objectively evaluate fire effects. NROC Reserve managers and the Technical Advisory Committee are advised to identify (9) coastal sage scrub units to test the long-term effect of varying the season frequency and intensity of burn treatments within a factorial design. Figure 7-1 shows the sampling design for coastal sage scrub. The design prescribes: Spring and Fall seasonal treatments, 10, 15, and 20 –year return intervals, as well as low and high intensity fire behavior. Initial treatments are recommended to begin between May and June of 2003, at such time 3 units should be burned.

Next, 3 units should be burned between September and November, while leaving (3) units as unburned controls (NCCP/HCP Wildland Fire Management Plan, March 15, 2002). Each unit should be partitioned by a fire intensity treatment. One portion of the unit should be burned under the lowest intensity that can be safely generated given fuels and holding considerations. The remaining portion of the unit is to be burned under the highest intensity possible. The partitioning of the units may or may not be of equal size, though plots are to be equally distributed within (3) in each intensity treatment (NCCP/HCP Wildland Fire Management Plan, March 15, 2002).

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The location of intensity treatments should be driven by factors effecting fire behavior and holding considerations. Firing patterns will be determined prior to plot placement. Plots will be randomly located within these broadly defined areas (NCCP/HCP Wildland Fire Management Plan, March 15, 2002).

**Figure 7-1 Coastal Sage Scrub Sampling Design**

<p><b><u>Plots will consider Plant:</u></b> Structure     Density     Height Composition     Cover     Diversity</p>	<p><b><u>Planned Prescribed Fire Treatments for:</u></b> Spring Burning = 3 units Fall Burning = 3 units Control Burning = 3 units  Burn Every: 10 yrs. = 6 plots 1/ 15 yrs. = 6 plots 1/ 20 yrs. = 6 plots 1/  1/: 3 Plots High Intensity &amp; 3 plots Low intensity</p>
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**Source:** Wildland Fire Management Plan, Revised March 2002.

### ***7.2.2.3 Fire Management Plan Implementation Status***

The Fire Management Plan continues to undergo review and revision. Some Reserve managers believe the Plan is too theoretical and needs practical interpretation for on the ground implementation. According to one manager “ I’m not real happy with it... it’s a nice coffee table document...you know, has the philosophies and the theories behind it but you want the one that somebody out in the field pulls out of their briefcase during a fire, they open it up to page 87 and here is the match that tells them what to do, where to do it and how to do it so there is no room for error or at least you can reduce that error (Subject interview, April 2004)”. The subject is suggesting that the Plan be translated into an operation manual that would be a more user friendly for a Reserve manager.

### **Wildfires**

Since 1998, NROC has experienced wildfires. Since there was no plan to direct post evaluation of these fires, the annual reports reflect an inconsistent documentation. The Nature Reserve of Orange County 1998 Annual Report provides a description of the Santiago Fire of 1998 that comes the closest to meeting the post fire evaluation recommended in the Short-Term Tactical Fire Management Plan.

The date, location, size of, cause of, affected habitat and measures taken to control the fire are described. Subsequent reports were uneven in addressing the date, location, size, cause, and affected habitat/species and none addressed the measures taken to control the fire. Table 7-5 shows wildfires that have occurred within the Reserve since 1998 (Nature Reserve of Orange County 1998-2004 Annual Reports).

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### Prescribed burns

There is no evidence that a fire management implementation schedule/timetable for prescribed burns has been completed. Some prescribed burning has occurred within the Reserve on a limited basis. The Crystal Cove State Park has initiated prescribed burns for fuel modification, weed abatement and habitat enhancement (Nature Reserve of Orange County 2002 and 2003 Annual Reports). In 2002, there was mention of monthly post wildfire observations of erosion, regrowth and species recovery in California Department of Fish and Game's Coal Canyon Ecological Reserve. The Irvine Company reported a 45-acre burn on its land as pre-treatment for coastal sage scrub restoration in 1998 and a 0.5-mile fuel break construction in Gypsum Canyon in 2002.

**Table 7-5 Wildfires within the Nature Reserve of Orange County**

<b>Date</b>	<b>Location</b>	<b>Size</b>	<b>Cause</b>	<b>Habitat/species affected</b>	<b>Control</b>
August 31, 1998	Santiago Regional Park fire near Limestone Canyon, 2 ½ miles east of Irvine Lake. Irvine Co. land managed by The Nature Conservancy.	Fire burned 6,519 reserve acres, 100 acres within Whiting Ranch Park and 4,086 coastal sage scrub acres.	Lightening. Topography and chaparral, sage scrub and grass were the dominant fuels in the area.	94 GC, 236 cactus wren were affected	Construction of two bulldozer lines within burn area. Bulldozer lines will be reshaped to natural contours with water breaks installed every 100 feet.
June 19, 2000	Weir Canyon	50 X 20 feet spot fire grassland	A spark from large equipment operation.	*	*
July 11, 2000	Whiting Ranch Wilderness,	5 acres in chaparral, coastal sage Scrub and oak woodland	*	*	*
August 1, 2000	Crystal Cove State Park	2 acre fire in Moro Canyon, coastal sage scrub	Wildlife interaction with electrical line.	*	*
August 7, 2001	El Moro Canyon portion of Crystal Cove State Park,	4 acres	*	*	*

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**Table 7-5 Wildfires within the Nature Reserve of Orange (continued)**

<b>Date</b>	<b>Location</b>	<b>Size</b>	<b>Cause</b>	<b>Habitat/species affected</b>	<b>Control</b>
September, 15, 2001	Sunflower trail portion of Jim Dilly Greenbelt Preserve	6 acres	*	*	*
June 26, 2002	Laguna Canyon	83 acres started by Affected habitat included.	Sparks from a mowing operation.	Coastal sage scrub, cactus and rock outcrops. Sensitive species in or near the burn area to include the cactus wren.	*
July 13, 2002	Aliso Woods Canyon Regional Park	.68 acres burned	Probable cause a power line.	riparian habitat	*
July 16, 2002	Talbert Park Fire	15.5 acre fire in riparian habitat	Cause unknown.	*	*
August 10, 2003	Peters Canyon Regional Park	5 acres	Under investigation	Affected habitat was riparian with species known to inhabit riparian areas.	*
August 12, 2003	Peters Canyon Regional Park	20 acres burned	Probable cause arson.	Sensitive species affected CGC and CACTUS WREN	
December, 16, 2003	Laguna Coast	18 acres	Probable cause arson	*	*
February 4, 2004	El Toro Conservation Area	5 acres	*	*	*
June 6 2004	Irvine incident mostly outside of the Reserve boundary	57 acres	*	*	*
* No information provided					
<b>Sources:</b> Nature Reserve of Orange County 1998-2004 Annual Reports					

### 7.2.3 Grazing Management Plan

The NCCP-HCP Implementation Agreement requires that the Irvine Company maintain and protect coastal sage scrub within portions of the Reserve that are grazed. The Nature Conservancy wrote a Grazing Monitoring Plan on behalf of The Irvine Company June of 1996.

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The Plan describes the physical and biological context of grazing parcels, establishes grazing areas, prescribes allowable cattle stocking rates, and outlines monitoring protocols for grazed lands. According to the Plan, “the long term protection of sensitive resources from potential overgrazing is dependent upon the continual adjustment of the grazing management plan and the flexibility of the range manager and lessee (Grazing Management Plan, 1996).”

The NCCP-HCP specifically requires the establishment of permanent vegetation monitoring stations throughout the Reserve at the grassland/ coastal sage scrub ecotone. Twenty stations consisting of five 50-meter point intercept vegetation monitoring transects per station have been established (2001 Grazing Monitoring Program Summary Report, Nature Reserve of Orange County 1998 & 2002 Annual Report). A subset of these monitoring stations is controls within grazing exclosures.

Eight locations are in the Coastal Subregion including Boomer Canyon, Sand Canyon, Shady Canyon and Laguna Canyon. Twelve locations are in the Central Sub region including Lomas Ridge, Limestone Canyon, Hicks Canyon, Fremont Canyon and Weir Canyon. The type of species and height (for grasses and shrubs) are recorded at 0.5 meter intervals along the transect. Photos of each transect are taken from 0 and 50 meters. Additional species that are present but not on the transect are also recorded (The Nature Conservancy memorandum, August 18, 2000).

Forage residue monitoring is also required at the end of each grazing season to ensure that a minimum of 500 pound per acre of residual dry matter is maintained within all pastures (Nature Reserve of Orange County 1998 Annual Report). The grazing season begins in December and ends at the end of May. The Nature Conservancy designed its monitoring plan by statistical estimations of potential forage production (Grazing Plan 1996). Based upon vegetation monitoring data collected between 1996 and 1998, in 1999 The Nature Conservancy recommended that the residual dry matter value be raised to 1,000 pound per acre to reduce impacts of grazing on coastal sage scrub and grassland habitats. See Table 7-6 for Relative Cover Comparisons within the Coastal Sub area (Boomer Canyon and Sand Canyon) and Central Sub area (Limestone Canyon and Hicks Canyon) for years 1997-2000 (2000 Irvine Ranch Grazing Management Program Data Summary Report).

Grazing Monitoring results revealed that:

1. In areas that have not been grazed, there has been a general increase in both exotic and native plant cover as well as an increase in thatch/litter.
2. In areas that have been grazed seasonally (December – May) since 1997, there has been a noticeable increase in native herb cover and a slight increase in native shrub cover and exotic plant cover and decrease in thatch/litter.
3. In areas that were grazed one year and rested the next, the year following grazing experienced an increase in native herb and shrub cover.

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4. Grazing does appear to benefit native herb diversity and abundance at the scrub/grassland ecotone. This is likely because grazing reduced thatch and exotic grass cover, thereby reducing competition with native herbs.

The 2001/2002 season was the final year for grazing on all NROC and Irvine Company land. A total of 561 cattle were grazed. Areas grazed within NROC lands during that period include Quail Hill, Hicks Canyon, Loma Ridge, Weir Canyon, Lower Fremont Canyon and Irvine Lake (Nature Reserve of Orange County 2002 Annual Report).

Annual monitoring reports are to be submitted to the NROC, FWS and California Department of Fish and Game at the end of each monitoring season. Adjustment to stocking rates, monitoring requirements and range improvements will be discussed with The Irvine Company should grazing negatively affect coastal sage scrub vegetative trends (Grazing Plan, 1996).

**Table 7-6      Irvine Company Open Space Reserve Grazing Monitoring Program Relative Cover Comparison (1997-2000)**

### Coastal Reserve Plots

	Relative Cover 1997	Relative Cover 1998	Relative Cover 1999	Relative Cover 2000	% change 97-98	% change 98-99	% change 99-00	% change 97-00
<b>Sand Canyon</b>	Control (Since 1996)							
Native Shrub	31.51%	30.44%	26.39%	28.57%	-1.07%	-4/05%	2.18%	-2.94%
Native Herb	9.35%	8.43%	1.80%	8.29%	-0.92%	-6.63%	6.49%	-1.06%
Native Tree	0.00%	0.00%	0.09%	0.00%	0.00%	0.09%	-0.09%	0.00%
Native % Rel. Cover	40.86%	38.87%	28.28%	36.86%	-1.99%	-10.59	8.58%	-4.00%
Exotic Shrub	2.31%	1.64%	1.89%	1.06%	-0.67%	0.25%	-0.83%	-4.00%
Exotic Herb	50.32%	52.46%	23.88%	31.48%	2.14%	-28.58%	7.60%	-18.84%
Exotic % Rel. Cover	52.63%	54.10%	25.77%	32.54%	1.47%	-28.33%	6.77%	-20.09%
Bare Ground/Rock	1.79%	1.76%	9.25%	6.68%	-0.03%	7.49%	-2.37%	5.09%
Litter	4.73%	5.27%	35.73%	23.37%	0.54%	30.46%	-12.36%	18.64%
Moss	0.00%	0.00%	0.09%	0.00%	0.00%	0.09%	-0.09%	0.00%
Other	0.00%	0.00%	0.90%	0.35%	0.00%	0.90%	-0.55%	0.35%
Other % Rel. Cover	6.52%	7.03%	45.97%	30.60%	0.51%	38.94%	-15.37%	24.08%

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**Table 7-6 Irvine Company Open Space Reserve Grazing Monitoring Program Relative Cover Comparison (1997-2000) (continued)**

<b>Bommer Canyon 1</b>	<b>Rested</b>	<b>Grazed</b>	<b>Grazed</b>	<b>Grazed</b>	<b>% change 97-98</b>	<b>% change 98-99</b>	<b>% change 99-00</b>	<b>% change 97-00</b>
Native Shrub	19.62%	17.14%	18.14%	24.82%	-2.48%	1.00%	6.68%	5.20%
Native Herb	6.82%	7.38%	6.19%	10.32%	0.56%	-1.19%	4.13%	3.50%
Native Tree	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Native % Rel. Cover	26.44%	24.52%	24.33%	35.14%	-1.92%	-0.19%	10.81%	8.70%
Exotic Shrub	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Exotic Herb	66.21%	69.24%	50.00%	59.35%	3.03%	-19.24%	9.35%	-6.86%
Exotic % Rel. Cover	66.21%	69.24%	50.00%	59.35%	3.03%	-19.24%	9.35%	-6.86%
Bare Ground/Rock	6.40%	5.80	8.56%	1.02%	-0.60%	2.76%	-7.54%	-5.38%
Litter	0.94%	0.35%	16.02%	4.39%	-0.59%	15.67%	-11.63%	3.45%
Moss	0.00%	0.00%	0.17%	0.10%	0.00%	0.17%	-0.07%	0.10%
Other	0.00%	0.08%	0.93%	0.00%	0.08%	0.85%	-0.93%	0.00%
Other % Rel. Cover	7.34%	6.23%	25.68%	5.51%	-1.11%	19.45%	-20.17%	-1.83%

<b>Bommer Canyon 2</b>	<b>Rested</b>	<b>Grazed</b>	<b>Grazed</b>	<b>Grazed</b>	<b>% change 97-98</b>	<b>% change 98-99</b>	<b>% change 99-00</b>	<b>% change 97-00</b>
Native Shrub	12.32%	13.22%	11.45%	15.63%	0.90%	-1.77%	4.18%	3.31%
Native Herb	3.82%	3.30%	3.35%	8.42%	0.52%	0.05%	5.07%	4.60%
Native Tree	0.00%	0.00%	0.18%	0.00%	0.00%	0.18%	-0.18%	0.00%
Native % Rel. Cover	16.14%	16.52%	14.98%	24.05%	0.38%	-1.54%	9.07%	7.91%
Exotic Shrub	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Exotic Herb	82.22%	78.23%	48.37%	69.07%	-3.99%	-29.86%	20.70%	-13.15%
Exotic % Rel. Cover	82.22%	78.23%	48.37%	69.07%	-3.99%	-29.86%	20.70%	-13.15%
Bare Ground/Rock	1.13%	4.28%	11.01%	2.51%	3.15%	6.73%	-8.50%	1.38%
Litter	0.52%	0.97%	25.46%	4.15%	0.45%	24.49%	-21.31%	3.63%
Moss	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other	0.00%	0.00%	0.18%	0.22%	0.00%	0.18%	0.04%	0.22%
Other % Rel. Cover	1.65%	5.25%	36.65%	6.88%	3.60%	31.40%	-29.77%	5.23%

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**Table 7-6 Irvine Company Open Space Reserve Grazing Monitoring Program Relative Cover Comparison (1997-2000) (continued)**

### Central Reserve Plots

	Relative Cover 1997	Relative Cover 1998	Relative Cover 1999	Relative Cover 2000	% change 97-98	% change 98-99	% change 99-00	% change 97-00
<b>Limestone Canyon</b>	Control (Since 1995)							
Native Shrub	19.92%	20.00%	3.84%	8.56%	0.08%	-16.16%	4.72%	-11.36%
Native Herb	40.11%	31.82%	24.79%	27.30%	-8.29%	-7.03%	2.51%	-12.81%
Native Tree	0.14%	0.00%	0.00%	0.00%	-0.14%	0.00%	0.00%	-0.14%
Native % Rel. Cover	60.17%	51.82%	28.63%	35.86%	-8.35%	-23.19%	7.2%3	-24.31%
Exotic Shrub	0.27%	0.15%	0.27%	0.09%	-0.12%	0.12%	-0.18%	-0.18%
Exotic Herb	38.88%	47.14%	53.34%	61.08%	8.26%	6.20%	7.74%	22.20%
Exotic % Rel. Cover	39.15%	47.29%	53.61%	61.17%	8.14%	6.32%	7.56%	22.02%
Bare Ground/Rock	0.27%	0.22%	16.93%	1.44%	-0.05%	16.71%	-15.49%	1.17%
Litter	0.41%	0.67%	0.82%	1.53%	0.26%	0.15%	0.71%	1.12%
Moss	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other % Rel. Cover	0.68%	0.89%	17.75%	2.97%	0.21%	16.86%	-14.78%	2.29%

<b>Hicks Canyon 1</b>	<b>Rested</b>	<b>Grazed</b>	<b>Grazed</b>	<b>Grazed</b>	% change 97-98	% change 98-99	% change 99-00	% change 97-00
Native Shrub	32.07%	17.81%	21.53%	16.87%	-14.26%	3.72%	-4.66%	-15.20%
Native Herb	4.33%	21.17%	5.78%	13.37%	16.84%	-15.39%	7.59%	9.04%
Native Tree	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Native % Rel. Cover	36.40%	38.98%	27.31%	30.24%	2.58%	-11.67%	2.93%	-6.16%
Exotic Shrub	0.41%	0.43%	0.41%	0.07%	0.02%	-0.02%	-0.34%	-0.34%
Exotic Herb	61.71%	55.08%	32.43%	36.38%	-6.63%	-22.65%	3.95%	-25.33%
Exotic % Rel. Cover	62.12%	55.51%	32.84%	36.48%	-6.61%	-22.67%	3.61%	-25.67%
Bare Ground/Rock	1.49%	4.15%	2.23%	3.87%	2.66%	-1.92%	1.64%	2.38%
Litter	0.00%	1.29%	37.46%	29.44%	1.29%	36.17%	-8.02%	29.44%
Moss	0.00%	0.07%	0.00%	0.00%	0.07%	-0.07%	0.00%	0.00%
Other	0.00%	0.00%	0.17%	0.00%	0.00%	0.17%	-0.17%	0.00%
Other % Rel. Cover	1.49%	5.51%	39.86%	33.31%	4.02%	34.35%	-6.55%	31.82%

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### *Grazing Management Status*

According to a subject, in addition to measuring vegetation left in grazing areas, The Irvine Company must also monitor riparian areas to ensure that cows in search for shade are not entering these areas. However, there was no such information provided in the Annual reports or in the 2001 Grazing Monitoring Program Summary Report.

According to The Irvine Company, there is no grazing in the Reserve. Yet, two NROC Board members indicated that while most of the grazing has been eliminated, there is some grazing activity in a limited capacity. The following quotes support this conclusion. “Eventually grazing will be phased out but in the interim ... It’s been very reduced... it’s really not much of an issue anymore because they pulled off a lot of the cows. They had cow/calf operations and most of that is gone now (Resource Agency interview, March 2004)”.

Another subject specifies where grazing has been eliminated and where grazing still occurs. “There used to be grazing in this southern, in the coastal sub region at the time that the plan was approved, that’s been discontinued altogether. And then up in the central area, ...called Weir Canyon, as one of the last remnant grazing areas, it’s (grazing) been taken off of certain areas in the central, and then where it’s left it’s at a reduced rate (NROC Board member interview, March 2004).”

The subject went on to justify the reason for limited grazing, “...they needed to demonstrate that they could continue with some appropriate level of carrying capacity within the reserve to allow grazing to monitoring the effects of limited grazing and to evaluate whether or not that was an appropriate long-term use or not...the plan calls for all the grazing to be eradicated, to be stopped overtime and that is happening” (NROC Board member interview, March 2004).”

Other agricultural activities are occurring within the Irvine Company ownership portion of the Reserve with implications for future habitat restoration. A subject indicated “...those are areas that were actively farmed by the Irvine Company when they owned the land, or are currently being actively farmed...avocado groves, and row farming and things that are not habitat...and when those properties get handed over to a public agency like the County, they’ll need to be restored to gain some habitat value. So probably the most extensive restoration that’s going to take place is reconverting that farmland into native habitat...when these dedications of land go to the public agencies, and that’s spread out over like the next 25 years (NROC Board member interview, March 2004)”

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### 7.2.4 Recreation and Public Access Control

A substantial component of the Reserve is comprised of existing public parklands operated as County Regional and State Parks by the Orange County Department of Harbors, Beaches and Parks (HBP) and California State Parks, respectively. These entities are also responsible for planning, constructing and managing recreational facilities within County. The Reserve was hence created with the assumption that public access, passive recreational uses and the development of future recreation facilities would be compatible with and permitted within the habitat Reserve (NCCP & HCP 1996).

Only a few vulnerable areas were identified due to the potential for serious adverse impacts on “Target Species” and sensitive habitats and public access to these areas is prohibited. NROC is responsible for reviewing access and recreation prohibitions on a regular basis in response to changing conditions and the availability of new information.

Furthermore, it was determined that the goals of the NCCP-HCP were not in conflict with recreational uses permitted under the HBP General Development Plans (GDP) and Resource Management Plans (RMP). Each park is responsible for developing GDPS and RMPs that address park design and future access uses and park facilities. However, not every regional park within the Reserve has written a Resource Management Plan (NCCP & HCP 1996). According to a subject “we’re at that level of planning at Santiago oaks, Laguna Coast and at Irvine Lake, but not Aliso Wood Canyons...we have yet to do the same at Peters Canyon and Whiting Ranch and we don’t do it for Limestone until we have all the property from the Irvine Company...we have one for Upper Newport Bay, but not for Talbert Nature Reserve. It’s a mixed bag situation...but we at least have an interim operations plan that identifies fundamental access points, the trails, allowable activities and even some restoration sites—the exotic invasive things that need to be done. (Reserve Manager interview, March 2004)”

It was anticipated that public access and use conflict within the Reserve will result from one or a combination of: (a) uncontrolled off-trail activities, (b) inadequate maintenance/management of trails and park facilities, or (c) overuse of designated areas. Compatible public access and recreation activities within the reserve can be assured by:

- Effectively monitoring and managing trails and facilities;
- Enforcing user compliance with NCCP-HCP policies and GDP/RMP policies;
- Providing technical Reserve management expertise; and
- Providing funding for the above adequate to assure that proposed access/recreation use can be accommodated consistent with the NCCP/HCP policies and the GDP/RMPs.
- Protecting habitat and identified species or reducing or temporarily restricting public access and recreation within portions of the Reserve.

The County Regional Parks included in the Reserve are:

- ❖ Aliso and Wood Canyon Regional Park
- ❖ Irvine Regional Park
- ❖ Laguna Coast Wilderness Park

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- ❖ Limestone-Whiting Ranch Wilderness Park
- ❖ Peters Canyon Regional Park
- ❖ Santiago Oaks Regional Park
- ❖ Talbert Nature Preserve
- ❖ Upper Newport Bay Regional Park

State Park and California Department of Fish and Game Ecological Reserves

- ❖ Crystal Cove State Park
- ❖ Coal Canyon Ecological Reserve
- ❖ Laguna Laurel Ecological Reserve
- ❖ Upper Newport Bay Ecological Reserve

University of California, Irvine (UCI) Reserve:

- ❖ University of California, Irvine Ecological Preserve

The Irvine Company Parkland

- ❖ Limestone Canyon (includes Weir and Gypsum Canyons)
- ❖ Fremont Canyon Mouth
- ❖ Shady Canyon

The City of Irvine open space includes 2,144 acres comprised of Boomer Canyon and the eastern portion of Shady Canyon, transferred by Gift Deed from the Irvine Company as part of the Open Space Ballot initiative in May 2002 (Nature Reserve of Orange County 2002-2004 Annual Reports).

Passive recreation includes:

- Hiking, mountain biking and equestrian activities on designated and existing truck trails.
- Nature interpretation.
- Picnicking in areas designated by the RMP.
- Overnight camping in designated locations.
- Vehicular parking in areas designated in adopted RMPs and staging areas serving as existing truck trails.
- Continued operation of pre-existing park facilities, including active recreation facilities within disturbed areas, provided that existing act: facility expansions, or conversion of passive use facilities to active use must be consistent with the NCCP/HCP.
- Park and Reserve administrative and interpretive facilities.
- Public access and hunting as determined appropriate by California Department of Fish and Game within Coal Canyon Ecological Reserve.
- Construction, operation and maintenance of new facilities necessary to support permitted recreation uses, including concessions that support permitted uses/activities within the reserve.

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Public access is to be carefully monitored by respective reserve landowners/managers consistent to ensure long-term net habitat value and to assure that overuse for recreation does not create problems leading to impacts on Target Species or sensitive habitat. The following activities are to be conducted to ensure avoidance of biological resource degradation to include:

- Using existing truck trails and minimizing new trail construction;
- Closing unneeded truck trails and restore impacted habitat to natural conditions;
- Managing and changing the intensity of trail and facility use based on observed conditions;
- Restricting access to areas unsafe for users;
- Minimizing impacts to sensitive habitat and impacts that jeopardize biological research.

The following activities are to be conducted to monitor the ongoing use and maintenance of trails to minimize adverse effects on habitat resources to include:

- Prohibiting equestrian and mountain bike use of trails following heavy rains to avoid trail damage and subsequent effects on adjacent habitat;
- Conducting seasonal trail guidelines, including the rotation of access points, to protect sensitive species from significant adverse user impacts during nesting or other sensitive periods;
- Monitoring trail use to minimize off trail use, particularly by equestrian and mountain bike users; and
- Educating trail users and other users about the importance of restricting recreational use to designated trails through docent/educational programs.

To protect habitat from intrusions the following steps shall be taken to increase enforcement capabilities:

- Give park rangers authority to issue citations for misuse of trail or other park facilities (if allowed by state and local regulations);
- Allow the issuance of fines levied for abuse of park facilities resulting in harm to species or sensitive habitat;
- Temporary closure of trail segments and where necessary, entire park when repeated offenses by multiple users occurs to avoid adverse impacts;
- Review access and recreational uses within the reserve periodically to determine consistency with Reserve management policies, practices and priorities under the adaptive management program.

Reserve managers are to provide at the minimum, the following information in annual reports for submission to the NROC:

- Results of recreational use monitoring (trail conditions, adverse habitat impacts);

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- Recommendations involving modifications to existing management practices aimed at minimizing impacts;
- Recommendations to initiate new management programs in response to changing circumstances/conditions (e.g., educational programs, trail patrols)

Finally, the NCCP-HCP public access and recreation policies are consistent with existing state and federal statutes and programs that address or impact public access and recreation use of wildlands. These policies include the:

- ❖ Recreation element of the County of Orange General Plan;
- ❖ City of Irvine Open Space Plan;
- ❖ Terms of existing dedication and development agreements involving recreational lands;
- ❖ Approved Land Use Plan and Newport Beach/TIC development agreement for Upper Newport Bay;
- ❖ CA Coastal Act of 1976;
- ❖ NCCP Act of 1991;
- ❖ NCCP Planning Guidelines; and
- ❖ Crystal Cove State Park General Plan of 1982.

### ***The Need for a Recreation Management Plan and Recreation Monitoring***

The need for a Recreation Plan was a source of confusion for NROC Reserve owners and managers. Many NROC Board members and Reserve managers believed that a Recreation Plan was required (subject interviews, March 2004). Even a resource agency official initially stated that a Recreation Plan was required as part of adaptive management, but later stated he was not sure about the necessity of a Plan (personal communication, December 2003; subject interview, March 2004). The June 2003 NROC minutes show that an NROC Board member asked about a Recreation Management Plan and the NROC Executive Director responded that it was a future goal for which progress would be presented the December 2003 Board meeting (NROC Board minutes, June 13, 2003). There is no mention of the Recreation Management Plan in the December minutes.

Several interview subjects identified the tension between public access and habitat/species in response to an interview question about “how conflicting mandates, policies and priorities are factored into decision-making.” As early as December 19, 1997, HBP reported concerns about trail users and damage to open space areas and explained efforts to seek authorization from the Board of Supervisors to issue citations for trail misuse (NROC Board minutes, December 1997).

On March 16, 2001, the NROC Board agreed to send a letter to the County in support of ongoing efforts by HBP to expand park ranger enforcement authority (NROC Board minutes, March 2001). Annual reports alluded to approved authority for park rangers to issue fines and citations (Nature Reserve of Orange County 2002 -2004 Annual Reports), yet not all rangers are aware of this authority.

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In describing a ranger's responsibility, a Reserve manager stated "enforcement tickets can't be written for speeding within parks...so its more of a passive role that the ranger plays in terms of its' interaction with this whole management of the reserve (subject interview, April 2004)."

A Recreation Ecology Committee was formed in July 1999 as a Subcommittee to the NROC Technical Advisory Committee to: (1) develop uniform trail prescriptions for Reserve lands, (2) develop and implement a recreation impact monitoring plan and (3) identify critical thresholds and appropriate management responses to reduce or eliminate recreational impacts to habitat. The Subcommittee consisted of representatives for HBP, California Department of Fish and Game, the City of Irvine, and The Nature Conservancy. Based upon NCCP-HCP provision, a review of the recreation ecology literature and observations within the Reserve, on December 15, 2000, the Subcommittee proposed a peer reviewed monitoring plan to the NROC Board that suggested the following activities: trail condition census, trail corridor habitat and trail density monitoring, and visitor non-compliance and depreciative behavior monitoring (Nature Reserve of Orange County 2000 Annual Report; Progress Report, November 2000; Final Draft Recreation Ecology Monitoring Plan, December 2000). Provided below is a brief description of each monitoring activity.

### **Trail Condition Census**

Monitor trail conditions based upon impact conditions (no impact, soil erosion, multiple treads, width greater than prescription and wet soil) and surface conditions (compacted, sandy, rocky) (Final Draft Recreation Ecology Monitoring Plan, December 2000).

### **Monitor trail corridor habitat**

Select 20 study sites throughout the Reserve that will consist of: (1) multiple-uses (hiking, running, mountain biking and equestrian use), (2) coastal sage scrub or coastal sage scrub/grassland intermix vegetation of which 40-60% of these sites are open to regular public recreational use and (3) control trails. Data collection in each site should consist of: (1) percent cover of woody species, herbaceous species and graminoids, (2) litter depth, canopy height and soil compaction and (3) visitor use intensity (number of visitors, method of travel, nature study indicators, and trail courtesy observance (Final Draft Recreation Ecology Monitoring Plan, December 2000)

### **Trail density monitoring**

Generate and update a base map/orthophoto of NROC trail system to show the designated trails and the off trail impact corridors. Each trail and off trail impact corridor will be used to create an areal index using buffers to represent areal impact zones associated with recreation, operations and maintenance of each land management unit (Final Draft Recreation Ecology Monitoring Plan, December 2000).

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### **Visitor noncompliance and depreciative behavior monitoring**

Rangers and other assigned enforcement personnel shall maintain a daily log of contact with visitors for noncompliance. The log shall consist of the: (1) time, (2) location (based upon a trail numbering system for each park and open space unit of NROC), (3) number of persons contacted, (4) violation (s), (5) trail user group (e.g., hiker, trail runner, equestrian, mountain biker, etc.), (6) disposition, and (7) patrol method (vehicle, foot, bicycle, horseback). Data reporting should also consist of visitor noncompliance and depreciative behavior frequency, relative frequency by patrol effort, and breakdowns of violations by category and user group (Final Draft Recreation Ecology Monitoring Plan, December 2000).

The Committee also proposed \$18,000 per year for five years to establish baseline data (NROC Board Minutes December 2000). The 2001 Annual Report states that the Plan was funded by NROC to identify and manage recreational use impacts. However, according to subsequent Annual Reports and subject interviews, the NROC Board reviewed the draft Recreation Ecology Monitoring Plan, but deferred action pending comment from The Nature Conservancy (Nature Reserve of Orange County 2002 and 2003 Annual Reports). Subsequently, Reserve managers occasionally collect data on a volunteer basis and maintain a database of trail and road maintenance (Final Draft Recreation Ecology Monitoring Plan, December 2000).

The Recreation Ecology Subcommittee disbanded in 2001/2002 for a variety of reasons. One member attributed personality differences among Subcommittee members others reference a leave of absence taken by the Subcommittee Chair. The Nature Conservancy and NROC Executive Director were also cited for recommending that recreational impact monitoring take another direction (Subject Interviews, March –April 2004).

The Nature Conservancy maintained the Subcommittee bylaws and minutes and a database of existing trails overlain with unauthorized trails. Measurements of road width and erosion through tread depth were recorded along with information on the number of single roads, the incremental loss of habitat and the spread of weeds (personal communication, Reserve Manager, March 2004). According to a subject, information was collected on the success of restoring unauthorized trails for wildlife habitats (personal communication, former Nature Conservancy official, March 2004).

The annual reports reveal that Reserve managers are tracking permitted uses within parks to include: park attendance, interpretive and other educational and outreach activities. The Nature Conservancy manages guided tours on Irvine land for hikers, mountain bikers, and equestrians (Nature Reserve of Orange County 2002- 2004 Annual Reports). The Nature Conservancy conducted 301 guided tours in 2003 (Nature Reserve of Orange County 2003 Annual Report). According to a NROC Board member, “the Irvine Company wanted the public to be able to see what they were getting in exchange for development.” The subject went on to say that “The Irvine Company met with environmental community and public and asked what they wanted to see as part of their development plan (NROC Board member interview, March 2004).”

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Annual reports consistently mentioned park violations to include: dogs off leashes, evening and rain closure trespass, unauthorized use of trails and trail development (Nature Reserve of Orange County 2000-2004 Annual Reports). In March 2003, the California Department of Fish and Game recommended that Reserve managers address how they will handle illegal trails. The NROC Executive Director stated that the matter would be addressed at an April 2003 workshop (NROC Board minutes, March 14, 2003). There was no specific mention of the issue of illegal trails in subsequent annual reports or NROC Board minutes.

Some Parks have made a concerted effort to deter the use of illegal trails. In particular, the Crystal Cove State Park Reserve manager identified approved trails, and marks illegal trails by posting signs noting closure and resource impacts, and fencing and obscuring trails with cut vegetation. A trail census was conducted to measure trail impacts and surface condition based upon protocols set by Recreation Ecology Subcommittee (Nature Reserve of Orange County 2001 - 2003 Annual Reports). However, the 2004 Annual Report revealed no proposed methods of trail monitoring currently exists other than staff and volunteer observations. Nevertheless, the report showed the timing of access restrictions, and compliance coordination with user groups and volunteers. Finally, senior volunteers and the California Department of Fish and Game warden patrol the Park.

The Irvine Company has not established a recreation monitoring program for its land under interim management. Instead, the company hired a full time security patrol officer to monitor its ownership on weekday, weekends and holidays. The Irvine Ranch Patrol works closely with a Nature Conservancy official who manages the land. New patrol officers attend a 24-hour natural history training course that provides an overview of ecological principles, sensitive plant and wildlife species of the Reserve, an overview of the habitat management programs and NROC. The Nature Conservancy conducts the course (2004 Nature Reserve Orange County Annual Report).

### **7.2.5 Target Bird Monitoring Study Design and Results**

The goal of the target bird monitoring study was to determine and document NROC's level of success in conserving populations of California gnatcatchers and cactus wren over time (Hamilton 2003, 2004 Nature Reserve Orange County Annual Reports). Target bird monitoring began as part of NCCP-HCP preparation and continued following Plan inception. NROC has funded target bird monitoring since 1997. The study design has undergone modification based upon advice from the FWS and consultants. Table 7-7 summarizes the evolution of the target bird study design.

Five years of baseline monitoring reveals that the gnatcatcher and cactus wren populations are declining. Gnatcatcher declines are attributed to patterns of drought and heavy storms. Cactus wren declines are attributed to the slow recovery of cactus from the 1993 Laguna coast fires (Hamilton 2003).

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**Table 7-7 History of Target Bird Study Design Modifications**

<u>Year</u>	<u>Design</u>	<u>Notes</u>
1997	California Gnatcatcher and Cactus wren were monitored at (6) sites.	Sites were hand elected.
1998	<p>Monitoring sites increased for (6) to (8) at request of the FWS.</p> <p>Sites had to support one or both target species, (2) of particular interest to NROC managers and (3) could be surveyed in a single morning.</p>	<p>Sites were hand selected.</p> <p>Limitations of 1997 and 1998 study design:</p> <p>Selecting target bird monitoring sites based on the interest of reserve managers and or resource agencies is inferior to selecting sites at random. Inferences about the Reserve cannot be made with non-random sampling.</p> <p>Conducting 4 surveys per site generates a finer level of detail than necessary to obtain a reliable index of the species' population levels across the Reserve. This approach is also labor intensive and costly.</p> <p>The annual survey of 8 sites is inadequate to monitor target species population trends across the reserve system.</p>
1999 +	<p>40 Sites were randomized and stratified:</p> <p><b>Stratified design:</b> Portions of Reserve partitioned to contain 50% cover coastal sage scrub into monitoring sites of approx 20 ha (50 acres) each.</p> <p>20 sites randomly selected within two sub areas for total of 40 sites: 20 sites within reserve core; 14 sites within reserve edge; and 6 sites within reserve fragment strata.</p> <p><b>Data analyses:</b> Comparisons between various sampling strata to detect trend and potential differences between strata.</p>	<p><b>New focus:</b> Estimation of temporal trends for target birds in coastal sage scrub within the Reserve. Brown headed Cowbirds abundance was also tracked across the Reserve.</p>
<p><b>Special Note:</b> Two to six years of pilot sampling was intended to answer study design hypotheses, but it was later determined too early to start testing hypotheses. Data gathered during the three years of the study and other relevant information, warranted discussion.</p>		

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### *California Gnatcatcher Results*

From 1999 to 2003, it is estimated that the overall gnatcatcher population declined 26 %. For the central reserve the estimated decline was 33%, and the coastal reserve estimated decrease was 17%. Medium term declines appeared to be drought related as rain fall during the 6 years of study averaged 30% below the 47 year average, including a 2 year drought (1998/99 and 1999/00) and the driest winter in recent times (2001/02) (Hamilton 2003, Nature Reserve of Orange County 2004 Annual Reports).

From 2003 to 2004, the gnatcatcher population in the Reserve is estimated to have increased 19%. For the central reserve, the one-year increase was 22% and for the coastal reserve, the estimated one-year increase was 16%. Populations rebounded in high-density habitat areas. Extreme drought conditions led to very low productivity of scrub dwelling passerines across the Reserve in spring 2002 causing the gnatcatcher population to drop an estimated 30% between 2002 and 2003. With normal rainfall in 2002/2003, productivity of scrub dwelling passerines rebounded in 2003 leading to reserve wide gnatcatcher population increase (Hamilton 2003, Nature Reserve of Orange County 2004 Annual Report).

Precipitation in 2003/04 was 47% below average, and anecdotal observations of relatively few gnatcatcher juveniles in spring 2004 lead to a prediction that gnatcatcher populations across the Reserve will be considerably lower in 2005 than in 2004. The magnitude of decline should depend, in part on weather conditions in 2004/2005 (Hamilton 2003, Nature Reserve of Orange County 2004 Annual Report).

Gnatcatchers are consistently found at much higher rates (five to ten times greater) along the reserve's edges and in habitat fragments than in the reserve core (i.e., areas >300 m from reserve boundaries). This distribution pattern apparently reflects the following considerations:

- Core sites tend to be steeper and higher than edge and fragment sites, and gnatcatchers tend to favor shallower slopes at lower elevations.
- Chaparral is generally unsuitable for gnatcatchers, and Reserve core sites appear to support a higher proportion of chaparral than do edge and fragment sites (Nature Reserve of Orange County 2003 Annual Report).
- The Reserve design is "biased" by nature, in that some habitat fragments and areas along reserve edges were included or excluded from the NROC based on target bird distribution (Hamilton 2003, Nature Reserve of Orange County 2004 Annual Report).

A California Gnatcatcher Post Burn Assessment of the San Joaquin Hills Burn Area was conducted to yield information as to whether gnatcatchers could recolonize the San Joaquin area following the Laguna fire. The study also monitored the recovery of gnatcatcher habitat. Researchers were able to take advantage of pre burn vegetation data that was collected for mapping the Reserve during the planning phase of the NCCP-HCP (Harmsworth Associates 2002).

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Data on bird census and bird location prior to burn was also available (NROC Board member March 2004). There was a 62% recovery in gnatcatcher pairs in burn areas. In comparison, cactus wren populations have not recovered nearly as well.

### *Cactus Wren Results*

From 1999 to 2004, it is estimated that the overall cactus wren population declined 33 %. The estimated decline in the central reserve, 26%, while the coastal reserve estimated decrease was 59%. These general declines appeared to be drought related. However, drought is not the only attributable factor to the very high decline rate in the coastal reserve (Hamilton 2003, Nature Reserve of Orange County 2004 Annual Report).

The 1993 Laguna Beach Fire burned 75% of the coastal reserve. The 1998 Santiago fire burned 38% of the central reserve. The fires consumed more vegetation in core stratum than in edge or fragment and drove target birds from core areas into unburned habitat refugia along reserve edges and reserve fragments (Nature Reserve of Orange County 2003 Annual Report).

Surveys within the fire perimeter conducted in 1994 revealed 72% fewer cactus wren pairs than were known from pre-fire surveys in 1992, and cactus scrub has not yet recovered significantly in the fire perimeter. Cactus wren may be occupying fire damaged cactus patches that are less than optimal for the species survival and reproduction. If this is a relevant factor in the species six-year decline, the situation should tend to improve over a period of many years as the cactus slowly recovers (Nature Reserve of Orange County 2004 Annual Report).

Precipitation in 2003/2004 was 47% below average and anecdotal observations of relatively few Wren juveniles in spring 2004 lead to a prediction that wren populations across the NROC will be lower in 2005 than in 2004. The magnitude of decline may depend to some degree on weather conditions in 2004/2005 (Nature Reserve of Orange County 2004 Annual Report).

The data collected to date suggest that cactus wrens are better equipped for surviving cold, wet weather, than are gnatcatchers. This is to be expected, as the wren is a much larger bird that builds enclosed brood nests to provide warmth and shelter during cold, rainy winter weather. For example, cactus wren detections at low-density sites remained nearly constant from 1999 to 2000 despite very poor survival conditions in winter 1999. The approximate 16 % decline at high-density sites in 2000 may reflect the rigors of greater competition in areas occupied at high-density more than weather-related declines in winter survival. The only major single-year cactus wren decline was registered in 2003, following a spring with record-low productivity and a winter with average rainfall and just one heavy storm. Both high density and low-density cactus wren populations were greatly affected. Thus, it appears that changes in productivity, and possibly other factors, have greater effects on cactus wren populations than do the effects of mild or severe winter weather (Nature Reserve of Orange County 2004 Annual Report).

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No substantial differences have been noted in the detection rates of cactus wren in core, edge, and fragment sampling strata. Unlike the gnatcatcher distribution, which appears to reflect a combination of factors, cactus wren are clearly tied to mature cactus scrub, with other factors appearing to play only minor roles in the species' distribution in the Reserve (Nature Reserve of Orange County 2004 Annual Report).

Study results reveal that the coastal reserve cactus wren population is of potential conservation concern. A recommendation was made to conduct a survey of the entire coastal reserve in spring 2005 to determine the actual number of cactus wren territories in the reserve. The survey is intended to identify the most heavily populated habitat areas, for close evaluation of the characteristics of occupied and unoccupied cactus scrub habitat areas. The results of the survey can also be used to develop a conservation strategy that will help to ensure the long-term viability of this vulnerable target bird population (Nature Reserve of Orange County 2004 Annual Report).

### 7.3 Summary

The transition from NCCP-HCP planning to implementation has been slow. The implementation of many activities began prior to NCCP-HCP inception. For example, the Irvine Company and the Transportation Corridor Agency was required to initiate habitat enhancement and restoration as part of their interim management and mitigation. Cowbird trapping, the post burn study of gnatcatcher and cactus wren habitat, and artichoke thistle removal are some specific examples of Transportation Corridor mitigation projects. The spread of artichoke thistle was a consequence of grazing and the Laguna Coast fire in the coastal portion of the Reserve. The Nature Conservancy, land manager for The Irvine Company, initiated artichoke thistle removal, the most visible threat on the landscape and obvious habitat enhancement and restoration opportunity to expand upon.

Despite the various stages of completion of management plans, Reserve owners more or less implemented habitat restoration and enhancement, fire management, and recreation monitoring. NROC intends on revising the fire management plan and the 2003 habitat enhancement and restoration plan (subject interview, April 2004; Nature Reserve of Orange County 2004 Annual Report). According to a resource official "... let's spend more money to modify the plan because it wasn't completely the way we wanted it...adaptive management is an ongoing iterative process and so there will be money spent modifying those plans over time (Resource official interview, March 2004)." The subject associates procedural refinement to the fire management plan as adaptive management. However, an example of adaptive management would involve adjusting the plan based upon lessons learned from plan implementation.

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The failure to complete plans within timeframes required by the Implementation Agreement, may be caused by the appointment of a part-time NROC Executive Director that was also working as a full time County employee. The grazing management plan was the only plan that was prepared within the prescribed timeframe. A full-time Executive Director was not hired until the summer of 2001 (NROC Board minutes, September 14, 2001).

Some may attribute the lack of funding with the delay in management plan preparation. However, the Irvine Company funded the grazing management plan. The habitat enhancement and restoration and long-term fire management was due in 1999. The stock market downturn occurred in 2001. In addition, many activities have occurred within the Reserve, but not in a coordinated manner.

For example, the format of the annual report was not standardized and not all Reserve owners and managers consistently provided the type of information that was needed according to the Implementation Agreement. The 1997 annual report was a 9-page document that discussed the NROC management structure and the financial management plan, summarized the physical description of the Reserve, and described the planned restoration and monitoring activities.

The 1998 and 1999 annual reports were fairly consistent and informative. However, annual reports covering 2000 and 2001 were cursory. These reports were not submitted and approved until 2003.

Plan implementation thus far reveals that there are dedicated Reserve managers and owners despite poor coordination early in the implementation process. There are signs that this trend is reversing with coordination meetings initiated by the full time Executive Director and the recent hiring of a full time ecologist that will direct the biological monitoring program, previously led by the already obligated The Nature Conservancy. Outcomes will be further explored in the Discussion and Conclusion Sections of this Chapter.

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### 7.4 Discussion

#### 7.4.1 “Learning while Doing”: When will Adaptive Management Become a Reality?

Monitoring provides the foundation for adaptive management. Monitoring is an essential component of understanding the eventual success and failure of any conservation strategy. Monitoring can provide information on threats and the condition of conservation targets, inform legal compliance, and test hypotheses about how an ecosystem functions (USDA Forest Service General Technical Report, 2002).

NROC has chosen to primarily focus on collecting baseline information on threats in the Reserve by eradicating invasive weeds, monitoring the status of gnatcatcher and cactus wren populations and the condition of their habitat, e.g., coastal sage scrub and cactus. Many baseline monitoring studies and active management activities began during NCCP-HCP preparation and have continued during Plan implementation, i.e., target bird and post burn monitoring studies, and invasive weed eradication. Yet these studies and activities were not explicitly designed within an adaptive management framework.

After eight years of implementation, NROC has conducted its five-year baseline monitoring of species within the Reserve, but has yet to perform a thorough statistically analysis of all the data. Preliminary statistical analysis has been conducted of the target bird data. Hence, NROC has not reached the stage of implementing adaptive management to evaluate, and guide Reserve management. Moreover, most studies are not designed to examine the relationship of species and habitat and Reserve management. Learning through expert advice has increased through the refinement of monitoring methodologies for the target bird and herptofauna studies.

A Nature Conservancy official who served as NROCs’ “biological monitoring resource advisor between 1996 and 2004 was not available to participate in this evaluation. Nevertheless, annual reports, NROC Board minutes, and other subject interviews are used to fill this void. To understand the extent of NCCP-HCP adaptive management implementation the definition of adaptive management must be understood. Adaptive management goals and objectives must also be defined.

#### 7.4.2 What is Adaptive Management?

NROC Board members and researchers had different understandings of adaptive management. The first two quotes suggest that you simply change based upon results. There is no statement about a commitment to learn from management outcomes.

According to one Board member, “by a long-term study of the reserve uh..determining uh.. what measures needed to be taken in place to increase the value or to maintain the value, the- the biological values. .. you do that through monitoring, over time, the health of your target species, as well as the health of the vegetative cover, and then determining, over time, if you see changes in that health, determining what needs to be done to maintain it uh.. and hopefully improve it (NROC Board member, March 2004).”

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This statement shows that the Board member did not understand the theoretical definition of adaptive management. There is no mention of a systematic approach to learning from management outcomes.

“Adaptive management is just a buzz word. You learn from your mistakes, we’re not just locked into anything. All good management is adaptive and it’s the idea of managing the land and then uhm... looking to see what you’re doing, we call it monitoring activities and then depending on the results altering your management if necessary (NROC Board member, March 2004). This statement implies that adaptive management occurs naturally. It also assumes a passive approach to adaptive management where a single management strategy is changed based upon monitoring results.

The next quote comes closer to the concept of adaptive management:

“Adaptive management involves using the best available data and the best available technical knowledge and assumptions how to manage the resources is to uhm essentially experiment with management practices, evaluate the results of those management practices to determine whether they are beneficial or detrimental or change, based on that feedback process uhm make adjustments if necessary at least to maintain the status quo or if not improve conditions” (NROC Board member, March 2004).”

This statement implies that the Board member read about the concept and used some of the key words, e.g., experiment, feedback. However, his statement about making adjustments if necessary at least to maintain the status quo, suggests that perhaps this Board member may not recognize the real aim of adaptive management that is continuous improvement.

According to a Resource official, “It- it’s learning by doing...you know, in an ideal sense, adaptive management allows you to uhm.. approach management in an experimental framework where you have environmental treatments and controls uhm.. we don’t have the luxury of having replication and controls, and so uhm.. minimally what you’re doing is you’re monitoring the results of your uhm how uh.. the management prescription affects the resource so that, you know, you invest your management over time (Resource official interview, March 2004).”

This official discusses the practicalities of implementing active adaptive management on the ground. However, there is no mention of changing management strategies based upon new information.

Surprisingly, NROC researchers did not have a full understanding of adaptive management. According to one researcher, “adaptive management is just a management action that takes into account results of ongoing monitoring and management that has a goal of improvement. Detection is made through monitoring (Researcher interview, September 2004).”

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The researcher alludes to the iterative process of adaptive management, but monitoring is a passive approach to achieving Reserve goals. There was no discussion about active learning through active management, research, and hypotheses testing.

Another researcher used the fire management plan as an example to demonstrate his knowledge of adaptive management, “I worked on the Fire management Plan where we identified units for burning. The fire management plan is based on the science, policy and politics within the reserve. Before we finished the plan, there was a fire at the Limestone Park in 1998 in which three burn units burned. Subsequently, we had to change the plan from a baseline approach to an experimental (pre/post burn) approach to address the changing landscape. There was feedback between the data collection and the changing needs for management.” He continued, “Once we have a better understanding about changing conditions we can make fiduciary decisions to figure how to invest in the enhancement for reserve management and adaptive management more effectively (Researcher interview, September 2004).”

The researcher’s comments suggest that NROC is not at the stage of employing adaptive management. The researcher took advantage of an opportunity to create an experimental design involving pre and post burn monitoring based upon the occurrence of a fire. However, there was no mention of monitoring to form hypothesis about ecosystem function. In addition, there was no mention of the potential use of prescribed burns to understand the relationship between reserve management and species response, e.g., herpetofauna, small mammals, etc. to the burned areas. These examples would have demonstrated his knowledge of adaptive management. Like the previous researcher’s comments suggests, the commitment to learning is driven by cost effectiveness.

### ***Nature Reserve of Orange County Adaptive Management Goals***

Resource agency officials provided different answers to the question of adaptive management goals. One official expressed uncertainty as to whether specific goals had been articulated referring instead to the pronouncement of broad statements. His response indicates that NROC had not crafted specific goals and objectives beyond the broader adaptive management vision in the NCCP-HCP. Another official concurred, indicating, “no specific objectives were set. NROC was to sustain the existing Reserve at the time of plan approval according to the Implementation Agreement and Permit and conduct some level of enhancement, these were some goals (NROC Board member interview, March 2004).”

However, another resource official claimed that the adaptive management “goals were fairly clear and well flushed out on baseline information we had. We knew that we wanted to retain X number of acres of habitat which should support large numbers of species or at least keep the number at breeding populations within the Reserve (NROC Board member interview, March 2004)”.

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While claiming that adaptive management goals were clear, this official was somewhat vague in his response about the amount of acres that needed to be retained within the Reserve and the number of species that should be reported. No one else mentioned acreage amounts and numbers of species as adaptive management goals. The necessity to maintain species at breeding populations is referenced in some of the mitigation projects conducted during interim management (See Chapter 6). This indicates that the resource agencies responsible for overseeing and providing guidance for NCCP-HCP implementation did not have a common understanding about the goals of adaptive management.

### *Nature Reserve of Orange County's Short-Term Objectives*

NROC Board members and Reserve managers provided different responses in identifying and different perceptions about short-term objectives. The resource agencies and a Reserve manager identified the development of management plans as short-term objectives. A Reserve owner mentioned the maintenance or increase in net habitat value as a short-term objective which is actually identified as the goal of the NCCP-HCP (NCCP-HCP 1996).

Another Reserve owner and manager kept hedging in trying to come up with an answer, "...well, you know short term for us is like 5 years, 10 years...we're not really gonna to really see much, in a couple of seasons, so its hard to say "oh, yeah its pretty good we've got this happening" that's why the resource agencies pick five years as their performance criteria that's really kind of when everything gets up and it starts to mature and you can tell what's there (NROC Board member interview, March 2004." The Board member's response appears to rationalize the implementation of the NCCP-HCP to avoid admitting the lack of formally established short-term objectives for which to measure progress. Performance criteria are only established for individual mitigation projects, habitat restoration and grazing management by the Irvine Company, and habitat restoration by the Transportation Corridor Agency conducted for interim management.

Another Board member was selective about the use of short-term objectives, "I would be more comfortable with short-term objectives that are totally within the control of the Reserve, is that you have an objective to restore, you know, 100 acres in the first year or something... you know, that's an achievable standard...to set a short-term objective of having a five percent increase in the gnatcatcher population, that is not under the direct control of anybody, and yet that's the kind of thing that a lot of people, I think, would like to see, that translation and make that the standard. And yet, short-term assessments of that are meaningless because there's so little known about what trends and uh <skips> situations are naturally occurring."

This statement indicates the discomfort of one Board member of establishing short-term objectives. Should the objectives not be accomplished, this Board member would not want to be held accountable, particularly if outside factors are negatively influencing the species. The Board member also mentions the challenge of understanding natural environmental variations. His statement alludes to the results of the targeted bird study that found significantly declining populations of gnatcatchers and cactus wrens.

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Finally, another Board member alludes to the management plans as short-term objectives as he mentions NROCs' intentions to formally establish objectives "...I would say the talk is in the process, is kind of establishing its own short-term goals. I mean the short-term goals were just to get some of these things thought through, get the plans approved, and keep moving forward (NROC Board member interview, March 2004)." This statement suggests that the NROC did not have a strategy for NCCP-HCP implementation after the completion of management plans.

### **7.4.3 The Nature Reserve of Orange County's Approach to Monitoring**

The Implementation Agreement required NROC to monitor the gnatcatcher, cactus wren and coastal sage scrub habitat. NROCs' approach to monitoring was to address pre-existing problems within the Reserve. The NCCP-HCP Permit requires that implementation and will not appreciably reduce species recovery and survival. The FWS defines recovery as the removal of threats, or the return of species to their former range. The goal of the HCP Program is to contribute to species recovery (personal communication with FWS official, December 12, 2003). Thus, a species is de-listed when there is no longer a threat to continued existence or when the species is moved from endangered to threatened status.

Since habitat enhancement and restoration is also an implementation requirement, NROC seized the opportunity to remove artichoke thistle that surfaced in the Coastal sub area following the Laguna Coast fire. Subsequently, weed eradication began prior to the preparation and approval of the Habitat Enhancement and Restoration Plan.

According to a Board member, the resource agencies eventually became relatively comfortable with the stability of the species in particular the threatened gnatcatcher showed signs of rebounded following the fire (NROC Board member interview, March 2004). The agencies no longer saw the necessity for NROC to spend so much money on target species monitoring target species that had become costly.

The Technical Advisory Committee suggested that the NROC Board shift its emphasis to addressing trends within the Reserve. Other NCCP-HCP covered species and non-native species e.g., Argentinean ants, were recommended for study (NROC Board member and Resource agency official interviews, March 2004).

The Technical Advisory Committee also recommended the creation of conceptual models that identified key variables, stressors, and indicators in the Reserve to distinguish natural fluctuations from human induced declines in target and identified species. This approach was later supported by the FWS 5-Point Policy created in 1999 that provided further guidance on adaptive management. Models were not developed, but an Umbrella Monitoring Plan was initiated in 1998. The Plan was revised in 2000 to establish a methodology and a protocol for identifying the appropriate type of data, and the approach to data collection (i.e., adequate sample size).

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Moreover, the Committee suggested that biological effectiveness be addressed by conducting 5 yr. baseline monitoring to understand the range of natural fluctuation and trends in species population. The NROC Board has yet to approve a monitoring methodology for the NCCP-HCP as well as a biological monitoring program (NROC Board member and Resource agency official interviews, March 2004).

### **7.4.4 Compliance: Nature Reserve of Orange County is Late in Meeting Implementation Deadlines**

The discussion below addresses the extent of adaptive management implementation as agreed in the Implementation Agreement. The status and quality of annual reports and the management plans are discussed.

#### *NCCP Monitoring Schedule*

The NCCP monitoring schedule outlines a timeline for target resource, special interest and management monitoring. This monitoring schedule was never mentioned during the interviews, so it is unclear whether NROC is aware of the schedule or whether it is no longer valid. It appears NROC has followed the schedule for monitoring gnatcatcher and cactus wren monitoring.

However, intensive monitoring of species reproduction and dispersal appears to have only been conducted in 1998 and 1999 (Nature Reserve of Orange County 1998 & 1999 Annual Reports). Specifically, the schedule calls for gnatcatcher nest monitoring in 1997, 1999, 2001 and 2003. Gnatcatcher dispersal monitoring is to occur in 1998 and 2000-2003.

Coastal sage scrub monitoring within transects were to occur in 1997, 1999, 2001 and 2003. Plot inventory monitoring was to occur in 1998, 2000 and 2002. However a vegetation monitoring protocol and program has yet to be established.

The monitoring of grazing, vertebrate pests, weed management, restoration and enhancement, fire, and recreation is also identified on the schedule. It is assumed that grazing management is occurring as scheduled based upon a 2001 summary report. There was mention of wildlife (deer, bobcat, golden eagle, coyote and badger) and road kill data collection from May 1999 to 2001 (Nature Reserve of Orange County 2001 Annual Report). However, there is no documentation about how this information was used.

Artichoke thistle and veldt grass eradications have been the focus of restoration and enhancement that has occurred within transects. There is no evidence that prescribed burns have been used for weed management. Habitat restoration and enhancement has consisted of revegetation of coastal sage scrub and the translocation of native vegetation conducted by the Transportation Corridor Agency and The Irvine Company for interim management.

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Pre and post burn monitoring of prescribed fire has not occurred in 1997, 1998, 2000 and 2002 as recommended. There is no evidence that baseline data has been collected prior to recreational use and after recreational use in 1997, 1998, 2000, and 2004.

### *Management Plans*

The Grazing Management Plan was completed on time and implementation appears to be within approved prescriptions. The Habitat Enhancement and Restoration Plan was finalized in 2003, with planned revisions in 2005. Artichoke Thistle and Veldt Grass removal appears to be successful, however there is some uncertainty on the NROC Board as to whether the Reserve will ever be able to control the invasive weed. Individual coastal sage scrub restoration and salvage projects are implemented on a project-by-project basis and there is no comprehensive tracking of the impacts of these projects.

The Short-Term or Tactical Fire Management Plan was not completed until 1999 and there were many iterations of the 2002 Long-term or Strategic Fire Management Plan. The Plans will be combined to form a Wildland Fire Plan with revisions in 2005.

The NROC focuses on fire suppression techniques but has not launched a comprehensive prescribed fire program. Annual Reports reflected two instances of small scale prescribed burns within The Irvine Company's ownership and Crystal Cove State Park. Fire has been an ongoing occurrence within the Reserve, many of which is related to accidents and arsons.

In 2004 NROC realized that a Recreation Management Plan was not needed. It was proposed that County Park Resource Management Plans be consolidated to form a Recreation Management Plan (Nature Reserve of Orange County 2004 Annual Report). However, not all parks have completed Resource Management Plans. The NCCP-HCP provides guidance to and Reserve managers have encouraged the NROC to track recreational impacts on natural resources. No sooner was a proposal initiated to track illegal trails and condition and data collection started, NROC choose not to pursue recreational impact monitoring. Very few parks have continued to track recreational impacts. Since NROC has not dedicated funding for this effort, recreational impacts are tracked on a voluntary and interim basis.

### *Annual reporting*

A particular responsibility of the NROC Executive Director is to collect Annual Reports from the eleven participating reserve landowners. Annual reports should include summary statistics on the management and monitoring activities and recommend changes in management based upon activity results. Recommendations have not been included in the annual reports. Annual work plans are included as part of the Annual Report to project NROC activities for the following year.

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In addition, Reserve owners and managers have not consistently provided annual reports the NROC Executive Director in a timely manner. According to the Executive Director, “prior to 2002, Reserve owners/managers did not submit written annual reports, but rather provided information verbally through an interview process”. A corroborating statement from a resource agency official revealed, “landowners did not submit the annual reports”.

He later clarified his statement by saying “the County did do some type of reporting, but I’m not sure reports were completed every year”. This statement is confirmed by the 2003 annual report that listed NROCs’ approval of the 2000, 2001 AND 2002 annual reports as an accomplishment (Nature Reserve of Orange County 2003 Annual Report).

Early annual reports reflected an unevenness of information. The 1998, 1999 and 2002 annual reports were relatively comprehensive compared to the 2000 and 2001 annual reports that consisted of up to 15 pages. The 1997 annual report was a brochure about the Reserve. Moreover, adaptive management was rarely mentioned if at in the annual reports covering 1998 to 2002.

In 2003, the NROC Executive Director held a coordination meeting with Reserve owners and managers about the NROC reporting requirements. This resulted in the submission of the 2000 and 2001 annual reports and the timely submission of the 2003 annual report. Another key role of the NROC Executive Director is to facilitate the compilation and analysis of monitoring data and to regularly assess Reserve management based upon analyzed data. NROC does not have centralized database for data collection and analysis nor does NROC have a database manager.

This was a weakness raised by the Technical Advisory Committee. Regardless, NROC has not taken action to address this matter. Instead, each researcher maintains his/her own data. The County Planning Department arranged GIS support for the Reserve. However, data themes such as topography, slope, elevation model data, roads, property boundaries, vegetation, sensitive species, invasive species, historical fire locations, and fire management zones are owned by the County and only accessible by the GIS department. An analysis of data generated by the various special and biodiversity monitoring studies will not begin until 2006-2007.

Finally, Reserve biologists are to submit annual monitoring reports containing recommendations to the NROC Board regarding needed adjustments to Reserve management. Some monitoring reports have been inconsistently incorporated into the annual reports. The Nature Conservancy maintains other monitoring reports. The following discussion focuses on the factors that influence the implementation process, NROC’s perspective on its progress and next steps to move implementation forward.

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### 7.4.5 Funding: Instability or Failure to Reallocate Resources

Some Reserve owners and managers cite limited funding as the reason for not being able to fully implement the adaptive management elements of the NCCP-HCP. According to a Board member, "... what may be the frustration we might have is we don't all have the money, and the time and the staffing to be able to do everything thing we'd like to do (NROC Board member interview, March 2004)"

Limited staffing for the control of public access and recreational impact monitoring may be an issue for the County Parks that bare most of the operating costs. The County Regional Parks and the Crystal Cove State Park have also sponsored invasive weed removals projects.

However, re-prioritizing habitat and enhancement efforts and reallocating resources may help NROC to advance their implementation efforts. Very early in implementation, NROC took advantage of an obvious opportunity to eradicate invasive species in the Coastal Reserve and has since extended these efforts to the Central sub area.

Up until 2003, NROC received California Department of Fish and Game grant funds to support habitat enhancement and restoration activities such as weed eradication (Nature Reserve of Orange County 1998 – 2004 Annual Reports; Nature Reserve of Orange County Board Meeting, March 12, 2004). Since the most effective herbicide has been identified and weeds have been significantly reduced, it is now time to reallocate resources to address other disturbances within the Reserve. A Board member may disagree with my suggestion to reduce artichoke thistle efforts, "can we claim the coastal area that was burned and treated to be fully recovered and move on to something else...the answer is probably never because there's other, even though we've got a pretty good handle on the artichoke, there's other species like veldt grass that's coming in to that area. And so you need to stay on top of that.

The Board member implies that the weed eradication will remain a priority of the NROC. Nevertheless, this habitat restoration activity could be reduced and attention could be directed to the use of prescribed burns to maintain landscape function and ensure persistence of native vegetation.

In addition, Transportation Corridor Agency funding allocated for cowbird-trapping studies since NCCP-HCP inception could also be redirected since very few cowbirds have been found in the Reserve since 2003 (Nature Reserve of Orange County 2003 Annual Report). The target bird studies also reveal that cowbirds are not having a huge impact on gnatcatchers (personal communication with Biologist, September 8, 2004).

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### 7.4.6 Cooperation & Coordination for Reserve Management Needs Improvement

While cooperation and coordination among multiple individuals and organizations might be expected to yield some disagreement, Reserve owners never admitted to conflict, instead they frame cooperation within the Reserve through the lens of agreements reached during the Board meetings. According to one Board member, “it is interesting to sit at those Board of Director meetings you have 11 different agencies completely different goals and it’s rare for us not to have a unanimous decision (subject interview, March 2004)”.

Despite the evidence of late annual reports the same NROC Board member continues, “...we get really good participation of people in providing the Annual Reports...and we really haven’t had any major disagreements or policy issues, that that I can remember, that have come before the Board (subject interview, March 2004).” This statement suggests that Board members are able to reach consensus on policy issues that based on the NROC Board meeting minutes policy issues relate to mostly to financial matters and the establishment of auxiliary committees.

A resource agency official shared similar thoughts regarding the lack of disagreements on the Board, “You know it’s odd. There doesn’t seem to be that many major differences on the Board. I mean, whether the plan is a great plan or not, it did give everybody the blueprint for what’s going to happen and so there aren’t any big surprises that come in (Resource official interview, March 2004).” The lack of disagreement is attributed to Board members being familiar with the NCCP-HCP and knowing what is expected for implementation.

Some state and county park managers are implementing independent monitoring and habitat enhancement activities in support of the NCCP-HCP. In addition to NROC sponsored biological monitoring within the park to include: herpetological/amphibian trap arrays, raptor studies, cowbird trapping, rare bird surveys, and artichoke thistle eradication (Nature Reserve of Orange County 2004 Annual Report), the Crystal Cove State Park conducts its own enhancement and monitoring studies. The Park has two ongoing coastal sage scrub restoration programs covering 18 acres of parkland and conducts presence/absence surveys.

However, observations within Parks and interviews with some Reserve managers reveal that landscaping activities involving the planting of trees in areas that do not typically support them are counter to habitat enhancement and restoration goals.

According to a Reserve manager, “we’re getting 8,000 trees and he’s gonna plant them in four different parks... in areas where trees probably didn’t grow because they’re shrub land or grasslands, it, it’s just, it’s counterproductive ‘cause that doesn’t follow, you know, ecological restoration principles. It’s just, now it’s just landscaping or it’s trying to force nature to being something else, you know?” This statement implies that some parks are not abiding by the NCCP-HCP and that there needs to be greater coordination between the recently approved management policies and on-the-ground implementation.

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Another example of coordination involves a marathon that was scheduled to take place along occupied Least Bell Vireo and potential Southwestern Willow Flycatcher habitat in the Irvine Regional Park and Santiago Oaks Regional Park. A NROC Board member apparently coordinated the marathon, but affected park management were not informed of the event until weeks before it was to occur. The timing of the marathon was during the listed species' breeding season. According to a Reserve manager, "that's the kind of disconnect that I see going on with this, maybe it's a function of the fact that there are too many landowners, maybe it's a function of the fact that within the county, we're disorganized, but uh..it doesn't seem like there is an adequate review process for a lot of things that are going on".

Finally, Harbors Beaches and Parks representatives have made presentations before the Board about illegal trails and sought support in their pursuit of receiving citation authority (NROC Board minutes). Interestingly, a Board member mentioned that the regional parks now have citation authority (NROC Board member interview, March 2004). The 2004 annual report also provides supporting evidence. Yet interviews with park rangers revealed that they were not aware of this authority (Reserve manager interviews, March 20, 2004).

### **7.4.7 Translating Science to On-the-Ground Implementation and the Nature Reserve of Orange County's Decision Making**

NROC has not done a good job of making sure research is translated into on the ground management. A reserve manager justifying why NROC has not been effective in ensuring the translation of science, stated, "You know, there's like a handful of people that it, it rests on their shoulders and everybody's trying so hard to do this nowadays, it's-- staffing is just so short with all the government agencies that I, I don't know. I just-- it just seems like that's just the big, the big uh... roadblock (Reserve manager interview, April 2004)". This statement suggests that perhaps there are not enough people to effectively manage the Reserve, which contributes to the delay in fulfilling implementation commitments.

When asked whether monitoring results are shared, a Reserve manager responded, "sometimes we get the results of their, their studies but, but, their report doesn't-- or at least what I've seen, uhm... it, it doesn't really relate to, to how we run our park, at least on our level...how do we really apply this and, and, and probably the big thing is, our department...we don't have anybody to kind of interpret all of that and to kind of give us directions because, if you give anybody their, paper, unless they're another scientist, they're looking at it going, okay, what are all these little Xs and lines and numbers on this graph and,...(Reserve manager interview, April 2004). This statement implies that Reserve managers need guidance in interpreting the science.

The Reserve manager gives an example of how researchers should articulate their results and inform park management, "...what this means for the parks is, if you have a park that has criterion areas that have these particular plants, to prevent this from happening, you'll need to change your operation to such and such.

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So it's uh... yeah, it's kind of, you know, step A, step B, step C but I think, if you don't tell people that way, then you won't get that. So, unless we're given some more concrete-- Unless we're given some handholding, those things aren't gonna happen the way we expect them (Reserve Manager interview, April 2004).” This manager is alluding to the need for guidance on the types of plants to place in the park based upon what researchers have found. It is suggested that park managers cannot translate research results on the ground unless specific interpretation and guidance is provided.

Results from a large carnivore monitoring study reveals how research was not used in decisions for park access. The study showed that large mammal activity was primarily nocturnal in areas of the reserve that are privately held or had limited recreational access. In closed areas under private ownership, large mammal activity was throughout the day, so there appeared to be a correlation between recreational use and activity patterns of mammals in the parks. Yet this information was not factored into a decision to alter recreational use. Instead the park where the study had been conducted began opening every weekend and will eventually open during the week and on a more regular basis (Reserve Manager interview, April 2004).

### **7.4.8 Protecting the Nature Reserve of Orange County’s Image**

The first sub region to initiate a NCCP-HCP and in some instances, a model for NCCP-HCP planning, the NROC was clearly concerned about how an implementation evaluation might impact its image. NROC Board members were more cautious in their responses to questions posed about implementation than Reserve managers who are responsible for on the ground implementation. Even the resource agencies, non-voting members of the NROC Board were more open about progress and objective about opportunities to improve implementation.

To prepare my subjects for my evaluation, I mailed my Interview Guide to NROC a month prior to my site visit. The Nature Conservancy expressed the following sentiment during my attempt to schedule a face-to-face meeting, “the NCCP-HCP does not fit, it is not a multi-landowner HCP...and if you are adamant about using the NCCP-HCP as a case study, you should change your questions (personal communication via phone, March 2004).”

An NROC Board member was more direct about NROCs’ concerns and provided the following advice “your title was promise keeping or something like that, you know, to be candid that is pretty politically charged... you kind of put yourself in a position of, uhm when we first read that we’re like, why do we want to talk to this person because they may be writing something that comes out really negative and we don’t, you know, we don’t know this person from Adam, “do they know a single thing about coastal scrub?”

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The Board member continues "... so the odds of you writing something poor, we're thinking are probably greater than writing something yeah this is succeeding because the snippet of time that you're gonna get out here...we don't want something to come out that says "this promise was not kept", we're like why do I want to spend my time with this person... at home that sounds great, but in a political arena it has a different charge to it, so its just that kind of interesting stuff that may be informative to you or maybe not (NROC Board member interview, March 19, 2004)."

In response to my explanation of the Institutional Review Board protocol that protects human subjects, another NROC Board member suggested that the outcome of my research could be a risk for NROC, "there could be a risk if, I mean, the title of your dissertation is Keeping Promises and Applying Adaptive Management (NROC Board member interview March 16, 2004). Even before the first interview question was asked another NROC Board member stated, "I- I was also curious of why you selected the title (NROC Board member interview, March 17, 2004).

These NROC Board member statements provided a perspective on the resistance of The Nature Conservancy to participate in the evaluation and the NROC Executive Director's hesitancy in providing NROC documents. The NROC was clearly concerned about how their slow implementation progress and delayed compliance with the implementation agreement would be cast.

### *Is Mitigation Occurring within the Reserve?*

The term mitigation was also a source of sensitivity and confusion among NROC Board members. Specifically, my interview guide contained four questions regarding mitigation. They included:

- 1) How were mitigation and management strategies determined?
- 2) How are biological responses to mitigation and minimization strategies monitored and evaluated?
- 3) What is the timetable for analyzing and interpreting biological responses to mitigation and minimization strategies?
- 4) Has the HCP been modified based upon responses to mitigation and minimization strategies?

The Nature Conservancy argued, "The HCP does not require mitigation and they are not tracking mitigation. The Reserve is a set aside that serves as mitigation and there is an endowment for long-term funding (personal communication via phone, March 2004)". According to a resource agency official, the NCCP-HCP does not have "an enforceable standard for the level of minimization and mitigation that must occur".

Instead, the plan adopts the NCCP Conservation Guideline standard of "no net loss of habitat value" (Resource agency interview, March 2004)". Another resource agency official stated, "We haven't looked at adaptive management and mitigation strategies that much.

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It's more in terms of restoration or the application of fire to the system.” However, adaptive management is only mentioned in the Fire Management Plan for prescribed burns that has been a source of debate for the NROC and thus has not been widely implemented.

According to the NCCP-HCP, adaptive management effectiveness is evaluated in relation to the “No Project and No Take Alternatives” that considers the impact on net habitat value without the creation of the reserve (NCCP-HCP EIR/EIS 1996). Taking action to resolve and prevent a problem is always better than taking no action. This criterion establishes a very low standard for attempting to elucidate the performance and measuring improvements of actions taken within the Reserve.

The NROC tracks the “take’ of coastal sage scrub which is a singular and passive approach to understanding the complexity of urban ecosystems. Understanding the threats to the system, species interactions and changes in species distribution and population are also important.

The NCCP-HCP adaptive management program attempts to address some of these issues, however, the efficacy of habitat restoration and enhancement, fire management, grazing management and recreation management remains uncertain. Moreover, benchmarks for performance and thresholds for triggering adaptive management have not been established.

### 7.4.9 Early Stage Outcomes

It was difficult for NROC to identify early stage outcomes, since NROC has not approached NCCP-HCP implementation methodically so that short term and long term objectives were established along with criteria for measuring performance. However, NROC Board members attempted to identify short-term objectives with some questioning the need for short-term objectives. Finally, all involved in NCCP-HCP implementation expressed concern about the declines of the gnatcatcher and cactus wren.

In answering “what is the process for determining early stage outcomes”, a NROC Board member in an attempt to provide examples of outcomes responded, “if you look at the annual report and in there it talks about acres of mitigation, that’s probably an easy way for you to track ...you could demonstrate the acres of restoration that have happened, you could probably demonstrate acreage of linear miles of new trails, and maybe cowbirds, restoration (NROC Board member interview, March 2004).” Much later in the interview, this same Board member came back to the question of early stage outcomes and stated, “...Unfortunately there is not a surplus of information. So I keep struggling to think what is tangible that you could get a hold of.”

Another NROC Board member was rather defensive in his response to “what is the process of determining early stage outcomes”, “it would be great to have, a quantifiable situation, but I don’t believe that enough is known of all of this for those types of standards to be meaningful, especially in the short-term.”

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He continues, "... those are the kind of standards that would give comfort to a lot of people who would like to be able to make pronouncements one way or another about whether something like this is working or not working. But I think that that's junk science, and I think it's I think impossible to come up with really a valid long-term projection with short-term data. And those that try to do it, I think they're being disingenuous, and I totally distrust those kinds of conclusions and that kind of an approach because it just, doesn't work (NROC Board member interview, March 2004)". Rather than respond to the question posed, this Board member gave his opinion about the evaluation of and the judgments that are made from short-term data.

Another Board member acknowledged the lack of criteria in identifying Reserve accomplishments "I- I think we have achieved the adaptive management goal. Uhm.. there's no set performance criteria but I think most people that I speak to regarding this feel that the habitat values have increased within the Reserve. Cow grazing is no longer allowed, so that's- that's increased the values. There is a very extensive invasive species removal program so the overall health of the vegetation out there has increased. Uh.. we have seen, you know, a reduction in some of the target bird populations, but a lot of- at least the explanation of that, right now, is that that's more larger environmental conditions that have nothing to do with how the reserve is doing (NROC Board member interview, March 2004)." In identifying Reserve accomplishments, this Board member directly approached the issue of species declines by attributing declines to environmental conditions rather than Reserve management. Unfortunately, the activities cited were not accomplished within an adaptive management framework and thus do not reflect learning from management outcomes.

A Reserve manager presents a different perspective from the three Board members, "the Reserve ...seems to be focused on enabling the use—the landowners to do the things they need to do. Uhm..and I can't say that that's at the expense of these other values but certainly we're very—we're still very early in this process –and to declare it a success after only a few years, when we've only just started to see trends in, you know, some of the biology...I mean we haven't even been through a full El Nino cycle yet to see the difference between drought years and wet year (Reserve manager, April 2005)".

Reflecting on NROCs' progress, some Board members shared the following thoughts that best captures the implementation process: "It took many years to come to an agreement. It will be the same for monitoring and adaptive management. The Orange Central Coastal NCCP-HCP is the first one. It was developed in a vacuum. What is learned, the dos and don'ts are used for other plans. It's a learning process. Unfortunately, it will take some time especially when you assess cost (personal communication with NROC Board member, March 2004)."

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According to another Board member, "...in truth there were a lot of details that needed to be resolved to advance the ball, and that just a resolution of those is something that, you know, was not really possible to have been anticipated. And so it's now, I think, you know, headed in the right direction. ...longer than we projected or thought, and but it's, I think inexorably going to where it needs to go, and that the resources are there to do what's needed over the long run, and it's going to require patience because this is a 75 year program. There's no way that there's money available to do everything at once, and so it has to be done according to a logical progression...(NROC Board member interview, March 2004)"

The same Board member continued to say "...sometimes it's been one step forward two steps back because there's so many people that have to be pleased in this process, the different agencies, outside interest groups, and ... sometimes things have to get resolved. But when it's all said and done, some of these things that we're doing for real world implementation are going to wind up being used by others... (NROC Board member interview, March 2004)"

### 7.5 Conclusions

It is apparent that the Nature Reserve of Orange County emphasized planning for the NCCP-HCP and focused less on implementation. The NCCP-HCP prescribes passive monitoring and management with some allowances for experimentation contingent upon available funds. The Plan provided prescribed resources to monitor and provided guidance on monitoring designs. The Technical Advisory Committee drafted an Umbrella Monitoring Plan/Protocol with some refinement to the NCCP-HCP guidance. However, NROC did not approve the Plan/Protocol for which all monitoring activities are to be based. Nevertheless, special and biodiversity studies were implemented.

Most of the special and biodiversity studies were not designed within an adaptive management framework. Some of the monitoring studies are designed to test hypotheses. Other studies are designed to answer questions concerning the current status of populations or to compare two or more invasive weed, grazing or burn areas for non-randomized treatments. Moreover, the studies have resulted in the collection of descriptive data based upon field measurements and observations.

Baseline data has been collected through the random sampling of target species, but control and replication sites were not used for statistical validation. Furthermore, since the NROC is refining its methodology to tease out natural variability and to establish trends, the research is not at the stage of evaluation to determine whether species declines are caused by management activities, environmental conditions or natural processes (Wilhere 2002).

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### 7.5.1 Institutional Learning and Next Steps

It is too soon to determine biological outcomes from NCCP-HCP implementation. Thus, process and institutional learning, e.g. the NROCs' reactions to baseline monitoring results and information gathered by Reserve managers, and subsequent changes in behavior and decision-making was the focus of this formative evaluation. Some of the key implementers of the NCCP-HCP have acknowledged the slow progress in implementing the NCCP-HCP and the challenge of coordination among multiple landowners and stakeholders. Interpreting the NCCP-HCP for on the ground implementation was also a learning process.

There are some indications that NROC is taking implementation more seriously. The Executive Director that has been with NROC over the last four years initiated a landowner and manager coordination meeting in 2003 and it appears that these meetings will continue on an annual basis. This may help address some of the problems of coordination previously addressed.

NROCs' participation in a formative evaluation may have inspired a review of the Implementation Agreement. In particular, NROC has realized that a Recreation Management Plan is not required. Nevertheless, NROC will compile existing Resource Management Plans from each park within the Reserve that will comprise a Recreation Management Plan. However, there are Parks within the Reserve that do not have Resource Management Plans. The establishment of these Plans will be necessary for incorporation into the Recreation Management Plan. The Annual Report failed to mention a timeline for the completion of Resource Management Plans.

NROC hired a full time ecologist in 2005. The ecologist will serve as NROCs' biological monitoring advisor and will lead the Technical Advisory Committee that met for the first time in June 2005 since 2002. Subsequent, priorities have been established for refining the target bird monitoring methodology, completing the vegetation monitoring protocol, and analyzing the special and biodiversity studies. The ecologist is working with the FWS and California Department of Fish and Game to revise the methodology for the target bird studies. The new methodology will be used to define inherent variability and to perform a power analysis to determine the best sample size to identify trends. Specifically, the methodology will estimate the detection probability based upon percent of coastal sage scrub area occupied. Methodology refinement is expected by 2006 (personal communication with FWS, July 18, 2005).

There will be no monitoring of gnatcatcher and cactus wren populations in 2005. Cactus wren populations may be monitored in 2006 and the NROC expects to begin gnatcatcher monitoring in 2007 (personal communication with FWS, July 18, 2005).

The second priority is to finalize the vegetation monitoring protocol and establish a pilot vegetation-monitoring project. The third priority is to initiate the analysis and integration of the target bird and biodiversity studies. The 2004 Annual Report reflects activities for 2005:

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- Retreat problem artichoke thistle and veldtgrass in Coastal Reserve and coordinate with The Nature Conservancy treatment of invasive species in the Central Reserve.
- Develop a mitigation matrix showing all mitigation areas established in the Reserve.
- Hold reserve owner/manager meetings to facilitate coordination.
- Initiate training sessions for field managers.
- Review the Habitat Restoration and Enhancement Plan for changes and updates.

The decision to identify a mitigation matrix to reflect all mitigation areas in the Reserve may have resulted from this formative evaluation. It also appears that NROC will focus on coordination and training of Reserve managers in the field.

Despite these next steps, some questions remain unanswered:

- ❖ Will NROC establish a timeline of prioritized activities and adhere to the schedule?
- ❖ Will NROC leverage resources to ensure completion of implementation commitments?
- ❖ How will the tension of recreational access demand and habitat/species protection be addressed? (The question is particularly important given the interest of Board members and Reserve managers to promote the Reserve and increase access.)
- ❖ How will NROC determine the achievement of long-term net habitat value?
- ❖ Will NROC establish measurable criteria to assess NCCP-HCP implementation progress and effectiveness?

## Chapter 8

### 8.1 Introduction

Adaptive management involves the process of learning how to improve management through iterative experimentation, hypothesis testing, and feedback that guides management redesign and implementation (Holling 1978, Walters 1986, Borman 1994, Nyberg and Taylor 1995). An HCP represents a policy decision with the assumption that proposed mitigation will not appreciably diminish the survival and recovery of species (Incidental Take Permit, 1996). Adaptive management for HCPs is intended to remove uncertainty caused by incomplete science about the effectiveness of mitigation strategies to protect species and habitat.

The purpose of this research was to: (1) evaluate the extent to which HCP permit holders have implemented adaptive management, (2) understand how adaptive management approaches influence early stage outcomes and (3) assess how ecosystem characteristics influence adaptive management approaches. This research involved synthesizing the adaptive management and HCP literature from which interview questions and evaluation criteria were derived. Also conducted was a review of supporting HCP implementation documentation. Research questions were explored within the context of two case studies, the Central Cascades HCP and the Orange Central-Coastal County NCCP-HCP. Both plans were approved in 1996. The case studies are distinguished by single versus multiple landowners and the type of land use permitted. Although both cases are intended to protect threatened species, the endpoint is habitat protection. For the Central Cascades HCP, the endpoint is habitat quantity and the strategy of protection is minimization and avoidance. The Orange Central-Coastal County NCCP-HCP is intended to focus on habitat quality and the strategy for protection is habitat restoration.

The Central Cascades HCP involves a single landowner, Plum Creek Timber which is implementing the HCP in two separate environments; the East Cascades is rural in character and the West Cascades is abutting urbanization. The company extracts and manages timber as it protects multiple species and associated habitat. However, the emphasis is on the protection of Northern Spotted Owl habitat and the primary strategy for protection is harvest minimization and avoidance. Plum Creek Timber is solely responsible for implementation, but works closely with the Services when making modifications to implementation and during progress reviews. Stakeholders, i.e., the Yakama Indian Nation and Washington Department of Fish and Wildlife, are involved to the extent that they provide suggestions for improved habitat protections during timber sale reviews and watershed analysis. Adaptive management is funded by profits gained from harvesting.

Eleven parties to include a private company, jurisdictions and utility and infrastructure agencies are implementing the Orange Central-Coastal NCCP-HCP in a Reserve. The Nature Reserve of Orange County, a non-profit entity, consists of an Executive Director who is responsible for coordinating NCCP-HCP implementation. The Executive Director works with a Board of Directors that is responsible for making strategic and operational decisions for the Reserve.

Most of the land in the Reserve is owned by The Irvine Company, the driver of the NCCP-HCP. This land is being restored in the interim before being transferred to the Orange County Harbors, Beaches and Parks, the second largest landowner.

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This case is also unique as it integrates both the federally regulated HCP that emphasizes species protection with the California Natural Communities Conservation Program that emphasizes the protection of natural communities, coastal sage scrub habitat, and native grasslands. The NCCP-HCP targets the gnatcatcher and cactus wren, indicator species for coastal sage scrub and cactus, while also protecting multiple species and habitat. The primary strategy for protection is habitat restoration. The NCCP-HCP recommends implementation of conservation biology principles and adaptive management to achieve the goal of long-term net habitat value. Adaptive management is funded through mitigation fees and interest gained from an endowment.

Since HCPs are place-specific, there are variations in HCP goals and objectives. There are also differences in the implementation setting, i.e. -- politics, social dynamics and stakeholders. These contextual factors influence adaptive management implementation and early outcomes. Although each case is unique, in some instances similar conclusions may be reached that provide corroborating evidence for reasons that can be explained through theory (Yin, 1994).

### 8.2 Case Formative Evaluation Outcomes

#### 8.2.1 Extent HCP Permit Holders Have Implemented Adaptive Management

Plum Creek Timber is further along in the adaptive management process than the Nature Reserve of Orange County. Plum Creek Timber reached the stage of making a decision about adapting its management strategies for greater Northern Spotted Owl habitat protection. Northern Spotted Owl populations have fallen below the threshold for triggering adaptive management. Plum Creek Timber identified mitigation actions in the HCP under “Changed Circumstances,” such as the rearrangement and redesign of deferral habitat that is distributed across the landscape. The company may also modify the harvest of forest age classes and structures. However, the company has not employed these strategies as they attribute external causal factors for population declines. Supported by the Services, Plum Creek Timber is proceeding with HCP prescriptions; the company’s rationale is that Northern Spotted Owl populations are declining because of the preponderance of barred owl populations.

The “No Surprises” assurances protect Plum Creek Timber from providing additional protection above and beyond the HCP agreement when changes in Northern Spotted Owl populations are related to external factors. The company believed regulatory certainty was “essential for making strategic decisions and future investments (Plum Creek Timber staff interview, February 2004).” In addition, since the Northern Spotted Owl has declined significantly throughout its range, Plum Creek Timber believes that the government, rather than the company, bears the responsibility for increased habitat protections. Moreover, the threshold that triggered corrective action was removed in 2001, when the company revised its resource selection probability function model equation. The 80% rate of expected owl site occupancy was replaced with an estimated number of available owl sites.

Plum Creek Timber’s removal of the owl threshold allows the company to focus on protecting owl habitat rather than the number of owls within owl habitat. Plum Creek Timber however, occasionally negotiates additional protections based upon stakeholder suggestions.

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On the other hand, the Nature Reserve of Orange County has only reached the monitoring stage of the adaptive management cycle. Early implementation has focused on monitoring species and habitat trends. A 7-year target species baseline monitoring study (originally approved for 5 yrs.) reveals that gnatcatcher populations have declined in productivity by 95-99%. Cactus wren population declines have resulted in their status as “species of concern.” The Nature Reserve of Orange County attributes species declines to external factors, i.e. -- patterns of drought, rainfall and wildfires. Thresholds for triggering corrective action have not been established and the NCCP-HCP makes no mention of management modifications under “Changed Circumstances.” The establishment of the Reserve serves as mitigation and the Nature Reserve of Orange County is assured that additional land will not be required for incorporation into the Reserve.

The target bird study monitoring methodology will continue to undergo refinement. The Nature Reserve of Orange County will establish detection probabilities and begin estimating the percent area occupied by gnatcatchers. The baseline will be used to define inherent variability and then used to perform a power analysis (personal communication with Services official, July 18, 2005). This will facilitate the determination of the best sample size to identify population trends. Thus, species declines have not been evaluated to determine causal factors such as management activities, environmental conditions, or natural processes (Wilhere 2002).

Assessing the problem is the first step in the adaptive management cycle. Neither Plum Creek Timber, nor the Nature Reserve of Orange County, has attempted to assess the issue of species/habitat protections within the context of the landscape. While the landowners have baseline data on species and habitat of interest, they failed to create system models that identify key indicators, past, current, and future stressors, and management controls. These elements assist in the formation of initial hypotheses about cause and effect, followed by new hypotheses for testing based upon new information and enhanced understanding. The decision to adapt is then based upon habitat or species response to management actions within the landscape.

### Accountability

Both cases reveal that timelines for HCP implementation have not been followed. In the case of the Central Cascades HCP, Plum Creek Timber has been gradually withdrawing from or modifying its commitments. The company identified the HCP monitoring schedule as short-term objectives. The schedule has been modified to reduce or consolidate implementation commitments. Plum Creek Timber has a strong working relationship with the Services, such that all modifications in implementation are discussed and supported.

The Nature Reserve of Orange County has taken an incremental approach to implementing the NCCP-HCP that is contingent upon the availability of funds. The target bird study, weed eradication and grazing management appear to have been implemented according to schedule.

While target species monitoring and invasive weed eradication is responsive to the Implementation Agreement, the Nature Reserve of Orange County has not taken a strategic approach to implementation. Moreover, baseline monitoring of target species and special and biodiversity monitoring studies have not been statistically analyzed. Additionally, annual reports and management plans exceeded submission deadlines.

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The Nature Reserve of Orange County is responsible for implementing three management plans that include grazing, fire, and habitat enhancement and restoration. Management Plans are designed to guide adaptive management. These plans identify goals, objective and activities, but do not identify assumptions, indicators or thresholds that are based upon measurable criteria. In addition, the Plans are prescriptive and do not discuss the potential effects of alternative decisions on indicators.

The Grazing Management Plan was finalized within the first year of NCCP-HCP inception and implementation is meeting expectations. The Grazing Management Plan is the only plan that identifies performance criteria, i.e., amounts of residual dry matter, and cattle stocking rates to ensure compliance and effectiveness (Grazing Management Plan, 1996).

The completion of Habitat Restoration and Enhancement Plan and the short and long-term Fire Management Plans exceeded the deadlines established in the NCCP-HCP Implementation Agreement. The Habitat Restoration and Enhancement Plan was completed in June 2003.

The short-term and long-term strategic Fire Management Plans were combined and a research component was added to form a Wildland Fire Management Plan (The Nature Reserve of Orange County 2001 Annual Report). The Board approved this Plan in December 2003 with the understanding that there would be additional reviews and changes in 2004 (The Nature Reserve of Orange County 2003 Annual Report).

The Draft Wildlands Fire Management Plan is the only plan that acknowledges information gaps. The Plan recommends fire ecology research to address plant community and animal responses to prescribed burns and grassland and coastal sage scrub sampling. A fire management implementation schedule/timetable that identified regrowth, regeneration and plant succession analyses for burn areas, and burn site sampling was to be completed and updated depending upon fire recovery monitoring program results (NCCP/HCP Wildland Fire Management Plan, March 2002). There is no evidence that an implementation schedule has been completed.

While contemplated, there is not an explicit requirement for a written Recreation Plan. However, the Implementation Agreement recommends that the Nature Reserve of Orange County monitor and control recreation and public access within the Reserve. Up until March 2004, the Nature Reserve of Orange County was uncertain whether a Recreation Management Plan was required to be completed. It has since been decided that individual park Resource Management Plans will be consolidated to form a Recreation Management Plan. However, not all parks within the Reserve have completed Resource Management Plans.

The FWS and the California Department of Fish and Game are responsible for NCCP-HCP compliance monitoring. Both agencies are active on the Nature Reserve of Orange County Board. The Board minutes reveal a high turnover in resource agency representation on the Board, particular by the FWS.

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The Nature Reserve of Orange County has been slow to implement its commitments with the seemingly tacit agreement of the resource agencies. According to a Reserve manager, the FWS have sent “nice letters” to the Board. By contrast, Plum Creek Timber has been accountable to its obligations, although those commitments have undergone continual modifications with Services approval.

### 8.2.2 How Adaptive Management Approaches Influence Early Stage Outcomes

#### *Passive Adaptive Management versus Passive Management*

While adaptive management provisions are written in the Central Cascades HCP and Orange Central-Coastal NCCP-HCP, both cases are passively managing their respective landscapes. While preliminary interpretations of monitoring results are limited to trend analyses, ecological adjustments have not been subsequently made.

Adjustments to management strategies or objectives would demonstrate that the landowners are modifying their management practices based upon new information, passive adaptive management. Subsequently, over the last nine years, both cases have employed passive management. Passive management has resulted in the lack of short-term objectives and measurable criteria to assess implementation progress.

In the case of the Central Cascades HCP, historical data was used to initially construct their resource selection probability function model that predicted Northern Spotted Owl occupancy. The model underwent several refinements to incorporate new data from a revised and updated stand inventory and to improve the accuracy of the estimated carrying capacity. The end result was the replacement of the number of occupied owl sites as an output with the number of available owl sites. Unfortunately, the model focuses on habitat variables without considering causal factors.

In the case of the NCCP-HCP, the Nature Reserve of Orange County monitors the population trends of the gnatcatcher and cactus wren with the intent to determine the level of conservation success. The Nature Reserve of Orange County also monitors the natural recovery of wildfire burn areas to detect the regeneration of habitat, i.e., coastal sage scrub and cactus, and the return of the gnatcatcher and cactus wren. Baseline data has been collected through the random sampling of target species, but control and replication sites were not used for statistical validation.

Active management such as cowbird trapping and invasive weed eradication began as part of NCCP-HCP preparation and continues. Cowbirds have not been observed in the Reserve since 2003. Artichoke thistle and veldtgrass eradication, the thrust of the Nature Reserve of Orange County’s habitat restoration and enhancement strategy began immediately following the 1993 Laguna Canyon wildfires. Weed eradication has resulted in over 2,000 acres of treated invasive weeds (Nature Reserve of Orange County 2003 Annual Report).

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Habitat restoration involves the maintenance of ecosystem function or habitat quality, but the Nature Reserve of Orange County has not established measurable performance targets describing function and habitat quality. However, qualitative performance standards were designed for coastal sage scrub revegetation and native grassland salvage and translocation mitigation projects. Criteria included sites that: (1) support breeding pairs of gnatcatchers, and (2) contain the structure and composition of naturally occurring gnatcatcher habitat or fully functional coastal sage scrub. Criteria also included: (1) sites that are not statistically different from functional coastal sage scrub for cover and (2) sites that contain a diversity of coastal sage scrub species.

The Nature Reserve of Orange County also sponsors special and biodiversity studies involving small mammals, raptor, large carnivore, herpetofauna monitoring and vegetation monitoring. Most of the special and biodiversity studies were not designed within an adaptive management framework thus; interpretations of monitoring results were limited to the analyses of trends with little understanding of causal factors. The studies have resulted in the collection of descriptive data based upon field measurements and observations. The results of special and biodiversity studies will not be analyzed until 2006.

Pollak's (2001) assessment of Orange Central-Coastal NCCP- HCP identified aspects of adaptive management that required greater understanding to include: (1) selection of variables that provide good indicators of ecosystem health, (2) establishment of valid monitoring protocols, (3) statistically valid sampling to detect trends, and the natural variability of the parameters being measured, and (4) understanding of the inter-relationships and the cause and effect relationship in the Reserve (Pollak 2001). As of June 2005, a newly hired ecologist at the Nature Reserve of Orange began working with the FWS to establish a statistically valid sampling strategy. The 2000 umbrella monitoring plan/protocol remains in draft. The other issues identified above by Pollak (2001) remain unresolved.

### Experiments

Ideally, active adaptive management involves deliberate experimentation. Models, theory and field methods are also employed to estimate and infer ecosystem behavior. Biological and physical responses to management strategies are monitored and evaluated. Finally, evaluation results are provided to decision makers who modify management policy practices accordingly. This is an iterative process. There was no stated expectation for active adaptive management for which cost has been a deterrent in both cases. Moreover, formal experimentation is not always possible given political and social constraints, and duration (Peterman 2002, Doremus 2001). Hence, the degree of rigor is adjusted to the circumstance.

Plum Creek Timber and the Nature Reserve of Orange County Board have attempted to implement active adaptive management on a limited basis. Active adaptive management is weakened in both cases by the: (1) failure to use null and alternative hypotheses, (2) lack of replicates of treatment and control units, (3) lack of treatment and control units in time and space, to control for random variation; and (4) lack of treatment allocations in space and in time to control for bias and environmental gradients.

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Regarding the lack of replicated treatments and controls on the landscape, Taylor *et al.*, (1997), would argue that it may be impractical or impossible to employ replicates in forestry even under long time scale conditions. And while treatments may be replicable at a small scale, extrapolating results to the large scale at which many management actions occur can be controversial and uncertain (Taylor *et al.*, 1997).

Plum Creek Timber's experiments were not revisited after four years of implementation. These early experiments likely contributed to the approval of Plum Creek Timber's incidental take permit and served as examples for the foresters to implement. However, there were few on the ground examples of adaptive management. Adaptive management is subject to the intent of the forester and Plum Creek Timber's foresters' intentions and decisions did not lead to active adaptive management.

Plum Creek Timber's early experiments were employed at the stand rather than the landscape scale. According to a forester, silvicultural approaches vary based upon the type of forests, operational conditions and local opportunities at each stand. Modifications to forests occur at the stand scale where foresters have experience with and control over operations (Plum Creek Timber staff interview, April 2004). However, adaptive management involves more than modifying practices at the stand scale. At the stand level, silvicultural techniques can alter species composition and the physical structure of vegetation. At a landscape scale, changes in stand structure have significant cumulative impacts on animal habitat. Additionally, activities occurring at the same time in different parts of the landscape may have much greater total effects on wildlife than could be expected from looking at a single stand or activity (Nyberg and Taylor 1997). Moreover, there must be a feedback loop that incorporates new information and knowledge about management outcomes into decision—making. New information leads to the iterative changing of management practices based upon new learning.

Plum Creek Timber initiated early examples of active adaptive management on the east of the Cascades during NCCP-HCP preparation. The east of the Cascades, based upon its population would be considered a "human colonized" ecosystem rather than a "human dominated" ecosystem that is found on the west of the Cascades (Roe and Eeten 2001). In addition, U.S. Forest Service lands are predominately found in the eastern Cascades. Plum Creek Timber's decision to implement experiments on the eastern portion rather than the western portion of the Cascades, may support Roe and Eeten's (2001) claim that ecosystems with minimum domination by people, i.e., wilderness, mountain peaks and national parks are most conducive for deliberate experimentation.

In the case of the Orange Central-Coastal NCCP-HCP, the Nature Reserve of Orange County initiated a native grassland restoration project in 2003 that involves fertilization method experimentation. Results of fertilization treatments are not available given recent project implementation.

The common thread in both cases is the small scale of active adaptive management application. According to the adaptive management literature, learning is limited when management options are employed on a stand and project scale.

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### 8.2.3 The Influence of Ecosystem Characteristics on Adaptive Management Approaches

According to Roe and Eeten (2001), ecosystem characteristics influence adaptive management approaches. Characteristics include: (1) human population size, (2) the level of resource extraction from the ecosystem, (3) ecosystem reliability in providing resources for consumptive uses (single or multiple, i.e., recreation, agriculture, urban), (4) the availability of causal models to explain and predict relationships for management purposes and (5) the tension between ecosystem health and organizational health.

For HCPs, the level of resource extraction from the ecosystem is negotiated as “take” during the HCP approval process and therefore not the focus of adaptive management implementation. The availability of causal models to explain and predict relationships for management was not identified as an issue in either case. Although, Plum Creek Timber relied on a resource selection probability function model that does not consider external threats or factors. The Nature Reserve of Orange County has not chosen to employ causal models for the Reserve, despite the recommendation made by the Technical Advisory Committee.

Ecosystem reliability has indirectly affected Plum Creek Timber to the extent that their land is valuable to numerous stakeholders for conservation, acquisition or development. Subsequently, Plum Creek Timber is “exploring lands sales in an upcoming HCP and will be looking to amend the Central Cascades HCP in the future, to bring land sales into the HCP as an accepted practice (Plum Creek Timber staff interview, April 2004).”

Burgeoning human population and ecosystem reliability in providing resources for recreation is a big issue for the Nature Reserve of Orange County. Hence surrounding urbanization introduces pressures for the Nature Reserve of Orange County to provide public access to the Reserve. Public access has already resulted in the creation of illegal trails and the subsequent trampling of resources. In addition, according to a Board member, there has been an internal debate about prescribed burning in the Reserve for native plant regeneration. Urbanization may be contributing to this debate. These issues are further discussed in Section 8.4.

Finally, the tension between ecosystem health and organizational health is of particular concern to Plum Creek Timber foresters implementing the Central Cascades HCP. Plum Creek Timber is most interested in maintaining the viability of the company by maintaining a comfortable level of revenue from harvesting. Foresters must figure out how to accommodate regulations while also meeting harvesting goals in a cost-effective manner. This challenging endeavor presents barriers to the application of adaptive management. In fact, the ability to make a profit, meet legal requirements and customer needs while also implementing the Central Cascades HCP and Orange Central Coastal NCCP-HCP, are common goals of Plum Creek Timber and the Irvine Company, respectively.

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### *Conflicts and Trends*

While the creation of an HCP is intended to resolve conflicts between private interests and species/habitat conservation, conflicts do not necessarily dissipate once the plan is approved. Dependent upon the context in which HCPs are implemented, conflict may be driven by internal tensions about having to meet HCP and private goals or social and natural pressures that influence HCP implementation.

When asked about conflicting mandates in implementing adaptive management, Plum Creek Timber staff consistently identified “Adaptive Management versus No Surprises”. Plum Creek Timber staff admitted the tensions about adaptive management that may require additional protections. But regulatory assurances that the company will not be asked to provide additional mitigation was critical to their HCP agreement facilitated the ability to make decisions and strategically plan over the long-term. Plum Creek Timber only entertained additional protections if the company deemed them to be sound and credible.

In the case of the Orange Central-Coastal NCCP-HCP, social and natural pressures have influenced implementation. Passive recreation and wildfires were identified in annual reports and referenced by three board members and three Reserve managers as sources of conflict.

### Recreation

Orange County has 3 million people with a high demand for open space access with recreational users advocating for public access. Increased urbanization makes it challenging to maintain park access while also reducing recreational impacts. Since recreational impacts occur overtime, impacts are not immediately apparent. Thus, the control of public access has not been a priority for the Nature Reserve of Orange County.

However, the NCCP-HCP states that if Reserve function is impacted, then recreational use must be modified by either park closures or limited access. Annual reports consistently mention park violations to include: dogs off leashes, evening and rain closure trespass, and the unauthorized use of trails and trail development (The Nature Reserve of Orange County 1998-2004 Annual Reports).

County Regional Park management has a public works culture having operated its parks as public facilities prior to Reserve creation. Thus, some Regional Park managers have been slow to embrace park closures or limited access. Park rangers at one County Park were not aware that their land was apart of the Reserve.

The Nature Reserve of Orange County Board recommended the establishment of a Public Outreach Committee to promote access to the Reserve. The Irvine Company advocates public access and met with the public during the NCCP-HCP planning phase to learn about their interest and needs for community development (Nature Reserve of Orange County Board member interview, March 2004). The number of tours conducted by The Nature Conservancy on behalf of The Irvine Company has steadily increased, with 300 conducted in 2003.

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Locating housing near open lands and providing public access is an economic advantage for the company. Studies have shown that current and prospective homeowners consider open space an amenity. Thus, property values increase when homes are adjacent or in close proximity to vast open space. The Irvine Company's decision to set aside open space that would be in close proximity to their community development projects could potentially benefit species and associated habitat in the Reserve. Passive recreational users such as bird watchers and the nature educational programs conducted by the County Parks may sensitize nature enthusiasts about the value of species and habitat protections.

The process of educating the public about the sensitivity of species within the Reserve will take some time as recreational impacts within the Reserve continue to mount. Nevertheless, the Board chose not to endorse a proposal by its Recreation Ecology Committee to: (1) create uniform trail prescriptions for Reserve lands, (2) develop and implement a Recreation Impact Monitoring Plan and (3) identify critical thresholds and appropriate management responses to reduce or eliminate recreational impacts to habitat. Despite the dissolution of the Committee, a few concerned Reserve managers have voluntarily monitored trail conditions and the number of illegal trails.

### ***Fire Management***

Wildfires have been a continued source of disturbance in the Reserve with accidental fires reported annually. The causes of many the Nature Reserve of Orange County fires are due to arson or unknown circumstances (Nature Reserve of Orange County 1999-2003 Annual Reports). Although fire is recognized as a serious problem, the Nature Reserve of Orange County has responded reactively by focusing on fire suppression. There is no evidence of fire prevention efforts.

Failure to reach agreement on a comprehensive prescribed burn strategy in the Reserve may have contributed to not having a finalized Long-term (Strategic) Fire Management Plan. Annual Reports reflected only two instances of small scale prescribed burns within The Irvine Company's ownership and that of the Crystal Cove State Park.

### **8.3 Understanding Adaptive Management: Learning While Doing, Adding Mitigation or Applying Common Sense?**

To elucidate the extent of NCCP-HCP adaptive management implementation the definition of adaptive management must be understood. Both cases revealed that HCP implementers have different understandings of the concept. "Learning while doing" was commonly defined as adaptive management by Plum Creek Timber staff. However, subjects revealed nuances in their level of understanding. For example, Plum Creek Timber foresters viewed adaptive management from an operational perspective at the scale of a stand (timber sale). Their responses to my question "how do you define adaptive management" also insinuated the challenge of implementing the HCP and other regulatory requirements while also meeting economic objectives.

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On the other hand, Plum Creek Timber scientists were quite familiar with the adaptive management literature, yet when asked to provide examples of on the ground adaptive management implementation, Plum Creek Timber scientist responses were inconsistent with their definition of the concept. Most Plum Creek Timber staff, the Services and a state official identified “Prospector” as an example of adaptive management. “Prospector” was a timber sale or stand with known Northern Spotted Owl and goshawk nest sites that was originally allowed for “take”. Since the site was not in their plan to protect, Plum Creek Timber did not originally consider it for adaptive management.

While reviewing Plum Creek Timber’s harvest plans, representatives from the Yakama Indian Nation and the Department of Fish and Wildlife informed Plum Creek Timber and the Services about the site history. After ongoing negotiation, Plum Creek Timber modified their stand management by linking habitat and deferring a portion of the site based upon trades of equivalent conservation value in another area. The following year, goshawks were found occupying the timber sale (Plum Creek Timber staff interview, April 5, 2004; State and Tribal official interview, February 2004). As supported by a forester, the “Prospector” example was actually ad hoc negotiation. Plum Creek Timber was willing to negotiate added protections with stakeholders as long as the company could still achieve a return on its harvest. Negotiations resulted in additional mitigation above and beyond the HCP, rather than adaptive management.

“Adaptive management” for the Central Cascades HCP was used as a mechanism for making minor adjustments to management practices based upon stakeholder suggestions. Minor adjustments that were unanticipated during plan implementation included: (1) the establishment of channel migration zones throughout the HCP Planning Area, (2) harvest avoidance in a riparian habitat area and (3) the protection of a nest site within portions of a stand that was an outlier in the HCP Planning Area.

In the case of the Orange Central-Coastal NCCP-HCP, the Nature Reserve of Orange County Board members and researchers also shared different levels of adaptive management understanding. Most Board members were not familiar with the theoretical definition of adaptive management. Some referred to adaptive management as common sense that occurs naturally. These Reserve owners did not provide any evidence of a commitment to learning.

A Resource official acknowledged that the Nature Reserve of Orange County is applying a minimalist approach to adaptive management. He also alluded to the practicalities of implementing active adaptive management on the ground. The official never mentioned a strong commitment toward collecting new information beyond monitoring data.

### **8.4 Habitat Condition and Species Fate Unknown**

The objective of the HCP is to remove uncertainty of species fate in a positive direction. Plum Creek Timbers’ approach to HCP implementation has not removed uncertainty. The company primarily focused on meeting monitoring and reporting schedules and complying with state regulations rather than testing the effectiveness of management actions.

## Chapter 8

The terrestrial and aquatic resources monitoring and reporting schedule served multiple purposes. Besides serving as a vehicle to measure compliance, (Plum Creek Timber staff interview, April 2004) the monitoring schedule is used to determine the achievement of short-term objectives (Plum Creek Timber staff interview, April 2004). The schedule also serves as a “trigger point at which to consider adjusting mitigation strategies (Services interview, January 2004).” Additionally, the schedule outlines the frequency upon which terrestrial and aquatic monitoring is to occur. Although not explicitly stated, it is assumed that analysis and evaluation begins shortly after each monitoring activity. However analysis does not involve the testing of alternative hypotheses about species and habitat responses to mitigation. Moreover, cumulative effects that develop over time and across the landscape are not considered. Finally, the lack of formal performance standards/benchmarks made my determination of short-term objective achievement challenging. Thus, it is unclear how Plum Creek Timber will ultimately determine the effect of their management practices on the species and habitat conditions.

Decision analysis involves weighing the potential benefits and costs of alternative management actions. Plum Creek Timber purports to use “feedback” to influence decision-making yet costs and feasibility are the primary criteria for incorporating new information in their decision-making. Adjustments to mitigation are based upon political and economic constraints rather than empirical data on species’ ecology, life history and habitat requirements. If implemented in the theoretical sense active adaptive management would involve the adjustment of management strategies based upon management outcomes.

### *Northern Spotted Owl*

Plum Creek Timber’s decision to remove the occupancy rate of Northern Spotted Owl sites from the resource selection probability function model absolves the company from understanding why owls are not present. The Services endorsed Plum Creek Timber’s decision.

Instead, the company decided to estimate the number of available owl sites that does not inform the quality of the habitat on Plum Creek Timber land. Plum Creek has also used the presence of mature and old growth habitat on adjacent U.S. Forest Service land as justification for not investigating Northern Spotted Owl responses to HCP mitigation and management practices.

### *Watershed Analysis*

Plum Creek Timber relies heavily on best management practices to mitigate the impacts of forestry management on water quality. Sections 319 of the Clean Water Act, requires states to formulate programs to reduce water pollution from non-point sources, including forestry.

Strictly adhering to best management practices and regulations without testing their effectiveness limits Plum Creek Timber’s flexibility and willingness to learn about the structure and function of the ecosystem in the HCP Project Area. Thus active adaptive management is not employed for watershed analyses.

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The watershed analysis process has the potential for hypotheses testing and understanding cumulative effects, but Plum Creek Timber decided to extrapolate best management practices from completed watershed analysis to nearby watersheds. In addition, the company chose to identify products that provided “concrete information” from completed analysis to use in their daily decision-making.

The ability to profit from their earlier work and quickly implement forest management improvements was the motivation for extrapolation. At first glance, Plum Creek Timber’s decision would be supported by Hilborn *et al.*, (1995), who argue that the rate of learning about the ecological system must be rapid enough to provide useful information for subsequent decisions. However, it must be understood that adaptive management is an iterative process--the more that is learned about a system, the more is yet to be learned (Hilborn *et al.*, 1995). The value of long- term learning is reduced uncertainty that may lead to species survival and recovery.

Active adaptive management would seem to be the solution for understanding key processes and relationships in the watershed. Ironically, the lack of scientific certainty about processes and relationships was the very reason Plum Creek Timber decided to extrapolate (Plum Creek Timber 2001). While Plum Creek Timber acknowledged the value of information to be gained from channel, riparian, and habitat condition monitoring and restoration, the company believed the existing aquatic monitoring program to be sufficient (Plum Creek Timber 2001).

However, by applying replicates and a wide range of treatments throughout the HCP project area the company can understand the effectiveness of watershed analysis prescriptions. Unfortunately, adequate replication and measurement of replicate response are rare. In addition, watersheds must be similar and treatments must produce differential responses (Hilborn, *et al.*, 1995).

According to Walters (1986), there are challenges in implementing adaptive management for aquatic species. First, there are lag times for biological response to disturbance. Second, it is difficult to separate natural from anthropogenic influences. Third, the response and sensitivity of aquatic ecosystems to human disturbance differ due to varying site conditions (Walters 1986). This level of complexity may have precipitated Plum Creek Timber to extrapolate lessons learned from completed watershed to nearby watersheds. However, extrapolating lessons learned on a landscape scale may not be appropriate (Hilborn *et al.*, 1995) for the above reasons.

### ***Learning: Diminishing Returns on HCP Commitments***

As a regulated private company with a profit motive, Plum Creek Timber is willing to abide by their HCP obligations, but the level of implementation that may impact company profits will be kept to a minimum. While the Nature Reserve of Orange County has been slow to fully implement the NCCP-HCP, Plum Creek Timber has sought ways to consolidate their implementation requirements. These requirements will decrease throughout the duration of the Permit. Plum Creek Timber spent \$500,000 in developing the HCP and over \$1 million in HCP implementation (Plum Creek Timber staff interview, April 2004).

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Plum Creek Timber's HCP implementation is to continue for the next 41 years, yet revisions to the monitoring schedule indicate that learning will diminish as implementation proceeds and as the company finds quick solutions that provide cost-effective conservation. Thus, future implementation costs for monitoring and adaptive management are expected to decline as monitoring commitments are reduced overtime.

Similar to Plum Creek Timber, the Nature Reserve of Orange County is concerned about collecting information in a cost-effective manner. One Nature Reserve of Orange County Board member pondered the need to collect new information beyond monitoring. Thus, future investment in learning about the physical and biological dynamics within the Reserve is uncertain. For example, the opportunity to initiate studies to understand fire and species ecology has not been undertaken. Finally, the prospect of the Board establishing measurable biological objectives to assess progress toward long-term net habitat value remains unclear.

### 8.5 Summary of Cases

HCPs are negotiated agreements designed to resolve conflicts of interest over private land use and species/habitat protection. Landowners are authorized to pursue economic interests on the landscape in exchange for protecting habitat and species by preparing and implementing a HCP.

These cases reveal a variety of strategies employed to protect species. Plum Creek Timber's strategy for protecting species and habitat is to: (1) use best management practices, i.e., riparian buffers, road management prescriptions; (2) avoid harvesting in locations and distributions of habitats that are important for supporting natural processes and species diversity; and (3) reduce or minimize the impact of habitat alteration. The Nature Reserve of Orange County's strategy of protection is to: (1) eliminate threats to habitat by eradicating invasive plant species, (2) trap cowbirds, and (3) transfer and replant coastal sage scrub and native vegetation.

Plum Creek Timber is further along in its implementation, while the Nature Reserve of Orange County has been slow in fulfilling its obligations. Neither Plum Creek Timber nor Nature Reserve of Orange County was expected to employ active adaptive management. Both cases overwhelmingly use monitoring represented by surveys of existing ecological populations (species and habitat). Subsequently, only weak inferences can be made about the relationships between management intervention and system response (Taylor *et al.*, 1997).

The influence of ecosystem characteristics on the approach to adaptive management differs for Plum Creek Timber in comparison to the Nature Reserve of Orange County. While Plum Creek Timber struggled with the tension between ecosystem health and organizational health, (i.e., profit) the Nature Reserve of Orange County grappled with human population and the ability to provide recreational access.

Both cases viewed nature from a utilitarian perspective. Plum Creek Timber must produce revenue for its shareholders by providing goods and services from timber. However, short-term harvest gains may diminish the long-term protection of species and habitat. The Irvine Company demonstrated its stewardship in dedicating part of its land to the Reserve. In addition, the company dedicated another parcel for open space protection just outside of the Reserve.

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Nevertheless, land dedicated for the Reserve will be transferred to the ownership of the Orange County Harbors, Beaches and Parks (County Regional Parks system). This land was granted with the understanding that it would be publicly accessible.

Finally, neither case established performance measures to assess implementation progress toward short-term objective achievement. Thus, in both cases, the efficacy of management strategies for protecting endangered and threatened species and habitat remain untested.

## Chapter 9

### 9.1 Introduction

The described cases demonstrate that second generation HCPs are not implementing adaptive management according to theoretical adaptive management principles and ideas. The “No Surprises” policy constrains learning, and the political accommodation of the “No Surprises” policy may be sacrificing the protection of species and habitat.

Adaptive management opportunities were identified and negotiated during HCP preparation. While the HCP Policy Handbook (FWS/NMFS 1996) was a resource for HCP implementation, there was a paucity of information on adaptive management. Thus, permit holder had little guidance on adaptive management implementation. Furthermore, HCP permit holders did not aggressively implement active adaptive management principles because there were no such expectations from the Services.

In the case of the Central Cascades HCP, low adaptive management expectations translated to FWS approval of Plum Creek Timber’s withdrawal from implementation commitments that might lead to adaptive management. In the case of the NCCP-HCP, low adaptive management expectations translated to minimum FWS encouragement to complete short-term adaptive management commitments, i.e. -- management plans. However, institutional barriers also contribute to the lack of adaptive management implementation. This chapter discusses these barriers as well as the role of public lands for private mitigation, innovative strategies in HCP implementation, win-win prospects for private interests and species/habitat, and implementation promises of third generation HCPs. The chapter concludes with case study recommendations for improved HCP implementation.

### 9.2 Institutional Commitment to Adaptive Management is Limited

Institutional commitment toward habitat conservation plan implementation is often lax as it relates to testing ecological responses to management practices and changing management strategies based upon these responses. For adaptive management to flourish, landowners must be willing to commit to continuous improvement. In the case of the Central Cascades HCP, Plum Creek Timber is divesting lands under the HCP as they negotiate land sales. Nevertheless, Plum Creek Timber is convinced that they are adequately addressing the requirements of the HCP and that short-term objectives are being met. The company’s five-year review of HCP implementation showed qualitative improvements. Annual stand targets are being met, and watershed analysis and riparian management is performing as planned. With Services support, the company is confident that its management strategies are sound and modifications are not needed. However, watershed extrapolation and early small spatial and short temporal scale experiments (Hilborn *et al.*, 1995) do not provide a platform for adequate learning.

Additionally, the lack of sustained institutional commitment is evidenced by the turnover of resource agency participation on the Nature Reserve of Orange County Board. High turnover in compliance monitoring oversight does not set a good example for institutions responsible for policy implementation. On the other hand, while FWS staff changed on the Board, there was a continual FWS presence.

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### *Capacity Building and Funding is Insufficient for Effective Adaptive Management*

The availability of financial and human resources is another barrier to adaptive management implementation. Institutions must have the capacity to sustain implementation over the long-term for successful adaptive management. Capacity building often involves financial and human resources.

For the NCCP, a lack of funding was cited for the Nature Reserve of Orange County not meeting all of its implementation obligations. For example, NROC had not been able to secure adequate funding and to identify individuals capable of carrying out power analyses of its five-year baseline monitoring data (personal communication with Services official, November 13, 2004). One Board member expressed frustration about not having enough money and staff to implement everything the Nature Reserve of Orange County desired (Nature Reserve of Orange County Board member interview, March 2004). The loss of revenue from its endowment in 2002 caused the Nature Reserve of Orange County to become more cautious about expenditures.

For HCPs to be effective, landowners must be strategic in their investments to fill data and information gaps that will influence decisions. The ability to control external factors such as weather, fire, and predator species are outside the realm of HCP implementation. However, investing in research and experiments to understand these threats can reduce uncertainty.

The Nature Reserve of Orange County could have re-prioritized habitat and enhancement efforts and to reallocate resources. In 2001, the Nature Reserve of Orange County had \$4 million in non-participating landowner mitigation fees. Most of those funds were spent on weed eradication efforts. Until 2003, the Nature Reserve of Orange County received California Department of Fish and Game grants that were also dedicated to weed eradication (Nature Reserve of Orange County 1998 – 2004 Annual Reports; Nature Reserve of Orange County Board meeting, March 12, 2004). Prior to the NCCP-HCP's inception, Nature Reserve of Orange County began eradicating invasive species in the Coastal Reserve and has since extended these efforts to the Central sub area. Transect monitoring revealed the most effective herbicide and weeds have been significantly reduced.

Slow implementation progress is also attributed to the instability of the Nature Reserve of Orange County personnel. For the first five years, a part-time Executive Director coordinated Reserve activities. This individual was also working as a full-time County Planning Department employee. Subsequently, annual reports were not submitted to the Board in a timely manner and the 2000 and 2001 annual reports were uneven in substance. In addition, monitoring reports were not submitted on time.

The failure to have an Executive Director that could focus solely on Reserve activities resulted in poor coordination and a lack of communication with all relevant stakeholders. Some rangers were not aware that their park was a part of the Nature Reserve of Orange County. Others were unaware of their citation authority.

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Following the hiring of a full time Executive Director in the summer of 2001, the 2000 and 2001 annual reports were approved and the substantive 2003 annual report was submitted on time. In 2003, the Executive Director also held a Reserve owner and manager coordination meeting that is currently an annual practice.

Limited County Regional Park staff control public access and monitors recreational impacts. Yet, the County Regional Parks bare most of the Reserve's operating costs. The County Regional Parks and the Crystal Cove State Park have also sponsored invasive weed removals projects.

### ***Cost Effective HCP Implementation Translates to No Adaptive Management Implementation***

Plum Creek Timber is concerned about expending funds effectively and ensuring conservation efforts benefit the natural resources identified in the HCP. According to a Plum Creek Timber scientist, a decision to change management practices involves the weighing of “*economic feasibility, biological credibility, legal defensibility, and social responsibility* (Plum Creek Timber staff interviews, April 2004).” However, documentation and interviews do not show the weight of these criteria and the process of decision-making. Plum Creek Timber's decision not to employ active adaptive management implies that economic feasibility outweighs other criteria.

Plum Creek Timber has been effective in reducing implementation costs. The company engages and coordinates species and habitat monitoring with academic researchers, students and the Department of Fish and Wildlife. The company also cooperates with the Forest Service by conducting joint surveys and exchanging Northern Spotted Owl information. Furthermore, collaboration has benefited Plum Creek Timber by providing a means to showcase the performance of the HCP through its professional affiliations with organizations such as the, Wildlife Society, American Fisheries Society, and the American Forestry Association (Plum Creek Timber staff interview, April 2004).

The company is also active with the National Council of Air and Stream Improvement, an outreach and forestry and wildlife research organization representing the Timber industry. Finally, Plum Creek Timber published technical reports and Journal articles that reflect company research conducted prior to and during HCP Implementation.

### ***Do We Have Enough Information to Adapt?***

Since terrestrial ecosystems operate on a long timescale, this evaluation is too premature for gauging impacts on species and habitat. Both HCPs have been in existence for 9 years with permit durations of 75 years for the NCCP-HCP and 100 years for the Central Cascades HCP. Both plans focus on improvements to habitat with the assumption that habitat enhancement and or protection will lead to species recovery. The choice to only focus on habitat may hinder the success of the Plans. Knowledge of species' life history and ecology can help ascertain their response to habitat alterations, protections and improvements.

Specifically, research on the dynamics between Northern Spotted Owl and barred owl populations and habitat may enhance Plum Creek Timber's understanding the influence of habitat alteration and management practices. Thus, an investment in studies on species demographics is critical.

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Habitat loss and fragmentation may have eroded species' demographic potential such that halting population declines is limited more by demographic factors than available habitat (Schrott, With and King, 2005). The question is then raised whether the maintenance of species is within the context of reality. Plum Creek Timber needs to invest in species' demographic studies to address this question.

In the case of the Orange Central Coastal County NCCP-HCP, habitat restoration may not be sufficient for saving populations that are declining due to habitat loss (Schrott, With and King, 2005). The Nature Reserve of Orange County funded a gnatcatcher and cactus wren demographic study in 1997 and 1998, but there was no documentation available on the results of this study.

Both cases are attempting to protect species using conservation biology principles and/or best management practices. However, to what extent can these management approaches make up for past land use practices on the landscape? In the case of the Nature Reserve of Orange County, past grazing and fire history within the Reserve has fragmented and degraded coastal sage scrub. These past occurrences have contributed to gnatcatcher and cactus wren declines. The Nature Reserve of Orange County may be able to restore degraded habitat, as grazing is no longer occurring in the Reserve. However, restoration is dependent upon whether thresholds have been crossed for species recovery. Threshold development is needed.

Extensive past harvesting by Plum Creek Timber and the Forest Service has fragmented habitat and reduced habitat suitability for the Northern Spotted Owl. The HCP is not designed to restore habitat. Rather, Plum Creek Timber primarily protects foraging and dispersal habitat that the company classifies as marginal habitat. Elucidating natural environmental variation and the impacts of past, current and future land use and management practices can lead to better decisions for species and habitat improvements.

### **9.3 Should Public Lands and Investments Be Use for Private Mitigation?**

In both cases, subjects criticized the use of public land for mitigation by asserting that public lands bear the burden for species conservation. With Plum Creek Timber's adjacency to U.S. Forest Service land there was the expectation that cooperative experiments would be employed within the Snoqualmie Adaptive Management Area. Plum Creek Timber and the Services viewed company proximity to U.S. Forest Service land, to be "of marginal value for Northern Spotted Owls (personal communication with Services official, March 2004)." Thus, the leveraging of habitat conservation with the U.S. Forest Service was advantageous. However, according to Plum Creek Timber, the two organizations could not reach an agreement on their respective roles.

The FWS and environmental stakeholders suggested that Plum Creek Timber's proximity to public land provides the flexibility and latitude to fulfill company objectives. An environmental stakeholder cited "the agreement to allow Plum Creek Timber to harvest in owl habitat up to the 80% allowance of owl circles," as an example of flexibility (personal communication, environmental stakeholder, January 29, 2004).

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Several issues discussed in Chapter 5 were cited for the failure of cooperative experimentation implementation, including: (1) irreconcilable management objectives, (2) the resurrection of private property rights and deference to economic interests; (3) mistrust; (4) limited USFS funding and changes in priorities; and (5) differences in institutional cultures.

In the case of the NCCP-HCP, a Reserve manager expressed concern about the appropriateness of using public land for private development mitigation. He asserted, “*if The Irvine Company wants to develop its land, it needs to provide its own mitigation and not use existing county park land to offset it* (Reserve Manager interview, April 20, 2004).” An interesting observation is that the Irvine Company was able to use public parkland as mitigation without getting the buy in from park management. The County Planning Department was the lead County official for the NCCP-HCP. Some subjects alluded to the tension between the Planning Department and Harbors, Beaches and Parks. Had Regional Park management been involved in the NCCP-HCP negotiation and planning process rather than the County Planning Department, a different outcome may have resulted.

These cases reveal that there was limited buy-in between relevant landowners about sharing the responsibility of conservation. Thus, implementation failed. Public and private partnership was the intent of Congress in establishing the HCP Program. Collaborations must extend beyond political gestures. For true partnerships to exist relevant stakeholders must be involved in critical decisions. In addition, all involved must be committed to the same vision, and commitments (financial and implementation) must be honored. Mistrust, conflicts, and biases must be discussed upfront. If these issues are addressed, expectations are established and roles and responsibilities are assigned, public-private partnership can potentially be successful.

### 9.4 Some Innovative Strategies for HCP Implementation

Stakeholder involvement enhances adaptive management implementation. By incorporating the state watershed analysis process into the Central Cascades HCP, stakeholders were able to contribute to the success of the HCP by providing recommendations for improvements. Although water analysis provides a limited view of the HCP, it has facilitated site visits resulting in added protections. While Plum Creek Timber did not anticipate additional habitat protections, the company was willing to consider and implement them.

Another good practice is Plum Creek Timber’s Sustainable Forestry Initiative that engages a third party to verify the implementation of Sustainability principles. This independent assessment provides an objective assessment of forestry practices and continual improvement recommendations for wildlife, forestry health, and productivity. The addition of an adaptive management criterion would ensure the achievement of sustainability goals. Finally, Plum Creek Timber’s self-assessment as demonstrated by the company’s 5-year review is a practice that should be considered by all HCP permit holders.

In the case of the NCCP-HCP, stakeholder involvement has worked particularly well. The appointment of stakeholders to the Nature Reserve of Orange County Board has given stakeholders the opportunity to be involved in all decisions that direct Reserve activities. Thus, stakeholders external to Board view the Reserve concept positively.

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Moreover, multiple stakeholder involvement in the planning process has enabled Nature Reserve of Orange County to be viewed as a model. It is the first jurisdiction in California to implement the NCCP and is very sensitive about maintaining a positive image.

### 9.5 Can HCP Implementation Result in a Win-Win Situation?

It is assumed that HCPs create a win-win situation for landowners and natural resources. In questioning the appropriateness of public land for private mitigation, one Nature Reserve of Orange County Reserve manager argues, “*It seems that county parks serve purposes for recreation, habitat and wildlife preservation and watershed protection all to benefit a private developer, those three things are not all necessarily compatible. There hasn’t been an evaluatory effort to determine if those three goals can be managed together at all, its’ just been kind of assumed well that—that’s how it is* (Reserve manager interview, April 2004)”.

This statement alludes to the trade-offs and the political nature of the NCCP-HCP negotiation process. It also suggests that perhaps planners did not thoroughly consider whether multiple objections—recreation, habitat, and wildlife protections—can actually be achieved in an urbanized environment.

HCPs are based upon the principles of ecosystem management. The goals of ecosystem management according to Grumbine (1995) are to: (1) maintain viable populations of all native species; (2) represent, within protected areas, all native ecosystem types across their natural range of variation; (3) maintain evolutionary and ecological processes (i.e., disturbance regimes, hydrological processes, nutrient cycles, etc.); (4) manage over period of time long enough to maintain the evolutionary potential of species and ecosystems; and (5) accommodate human use and occupancy within these constraints.

Both cases are accommodating human use and occupancy and are implementing the other goals in varying degrees. It is too soon to tell whether species and habitat conditions will improve given the inherent complexity of ecosystems, incomplete science, unpredictable interactions between people and ecosystems, coupled with human error. However, if landowners are not fully honoring their commitments to implement adaptive management, even within the constraints of “No Surprises,” species and habitat will likely become losers.

### 9.6 HCP Implementation Evaluation: From Second Generation HCPs to Third Generation HCPs

Early HCPs did not have the benefit of the 5- Point Policy issued by the FWS in response to the Kareiva *et al.*, (1999) study that assessed the scientific adequacy of HCPs. Specifically, the HCP Handbook (FWS/NMFS 2000) was amended in 2000 to give HCP permit holders guidance on biological monitoring and adaptive management. The prospect of species recovery for HCPs approved before 2000 is unlikely, unless landowners are willing to align their HCPs and implementation with the 2000 guidance.

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Plum Creek Timber's Native Fish Habitat Plan approved in 2000 and implemented in Montana shows evidence of the 2000 guidance and the company's experience with the Central Cascades HCP. According to a Services official, "*approximately 98% of the Plan relies on adaptive management (Services interview, January 2004).*"

A review of the Native Fish Habitat Plan reveals a more explicit statement of biological goals compared to the Central Cascades HCP. The Plan also includes a monitoring protocol, hypothesis testing, and clear and measurable triggers for corrective action.

A formative evaluation of adaptive management implementation of third generation HCPs (those approved since 2000) would provide insight as to whether these HCPs with improved adaptive management guidance are reducing uncertainty. Such an evaluation would also determine whether these landowners are advancing the HCP goal of species recovery.

### **9.7 Some Recommendations for Plum Creek Timber, the Nature Reserve of Orange County and the Services**

HCP implementers must view the HCP as an experimental policy that is not designed to be rigid or to maintain the status quo. Rather, HCPs with adaptive management are designed to fill information gaps and uncertainties by implementing a range of strategies to achieve HCP goals. If adaptive management is really the goal of HCPs, those responsible for implementation (reserve owners, reserve managers, academic researchers, company and agency scientists, rangers, and foresters) must have a common understanding of the concept. In addition, learning must be embraced over the long term. Moreover, the FWS must be equipped with the resources to provide consistent oversight and enforcement. This would ensure HCP compliance and lead to the potential achievement of HCP site-specific goals and HCP Program Goals. The following recommendations are provided for implementers of the Central Cascades HCP and the Orange Central Coastal County NCCP-HCPs and the "Services":

#### **Plum Creek Timber**

Adaptive management must be integrated into forestry management such that the rapid return in timber revenue is balanced with achieving HCP adaptive management objectives. One way to demonstrate company commitment to adaptive management is for Plum Creek Timber to incorporate it into the company's Sustainable Forestry Initiative. This Initiative involves a third party auditor who assesses company performance. The recognition of foresters who employ active adaptive management would provide the necessary incentive for adaptive management implementation. Without corporate commitment and incentives, individuals within organizations cannot build the capacity for learning alone.

#### ***Reduction of Partial Observability--the Uncertainty of Northern Spotted Owl Monitoring***

Given the precipitous decline of Northern Spotted Owl populations, Plum Creek Timber might consider increasing the frequency of its Northern Spotted Owl surveys. Surveys are currently conducted for two consecutive years every seven years of the HCP Planning period.

Additionally, Plum Creek Timber might consider elucidating Northern Spotted Owl habitat preference in addition to or instead of owl presence and absence that emphasizes habitat use.

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By exclusively focusing on habitat use, Plum Creek Timber is observing species within habitats without an understanding of habitat use context. If Plum Creek Timber were to also investigate habitat preference, the company could begin to discern for example, spotted owl habitat selection between nesting, roosting, and foraging habitat versus foraging dispersal habitat or foraging dispersal corridors versus riparian habitat corridors. An experiment may involve linking nesting, roosting and foraging habitat with foraging/dispersal habitat to assess species response.

Finally, Northern Spotted Owls are not responding to calls when barred owls are present, thus Plum Creek Timber might consider changing its assessment tool. Current protocols appear to no longer be valid for determining whether Northern Spotted Owl sites are occupied since barred owls compromise the company's ability to detect Northern Spotted Owls (State official, February 2004).

### ***Expansion of Early Plum Creek Timber Experiments***

At the landscape level, maintaining forest animal diversity depends on maintaining an adequate range of habitats, from early-successional forest to mature and old growth stands (White Paper, 1995). First, Plum Creek Timber may consider extending beyond the annual reporting of forest class quantities to design experiments that assess the effectiveness of forest classes for species diversity. For example, information obtained from a 2000 bird breeding survey thesis (Manuwal and Gergen 2001) could be used to design an experiment to further understand avian response to habitat types.

Second, experiments implemented to understand and compare species response to various harvesting activities (e.g. -- clear cutting, shelterwood, seed tree, selective harvesting) is another way to determine the most effective mitigation strategy. Designing harvesting activities as experiments may result in better outcomes for species and habitat.

### ***Reduction of structural uncertainty--the lack of understanding or agreement about the structure of biological relationships driving population dynamics***

It is suggested that both Plum Creek Timber and the Nature Reserve of Orange County invest in species' demographic studies that address how habitat alteration influences species demographics. In addition, neither Plum Creek Timber nor the Nature Reserve of Orange County has invested in elucidating causal factors for species status and habitat conditions. In both cases HCP land has been extensively altered and past land practices have impacted current species status. There is also a need to understand how natural processes, current and future management activities, and environmental conditions influence species interactions and status and habitat conditions. According to Taylor *et al.*, (1997) increased understanding about system response can lead to more effective and efficient management and better species and habitat outcomes.

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### **Nature Reserve of Orange County**

The Nature Reserve of Orange County may be missing opportunities to contribute toward its goal of long-term net habitat value. The Board may consider engaging in a systematic process of identifying and prioritizing management activities based upon current and future pressures (i.e. -- recreational and fire) within the Reserve. In addition, conducting a cumulative assessment of all habitat restoration activities (i.e. -- translocation and salvage projects) may also advance the goal of long-term net coastal sage scrub habitat value.

#### ***Strategic Investments***

The Nature Reserve of Orange County has been investing in invasive weed eradication since 1998. It is now time to address other threats to the Reserve, i.e., fire and recreation. Moreover, extending coordination efforts, such as the private-public cooperative study that monitors avian productivity, to leverage funding and reduce implementation costs would introduce the efficiency needed to implement all HCP commitments.

The Board may consider reallocating resources to address other disturbances within the Reserve, e.g., the trampling of vegetation and illegal trails. Weed eradication could be reduced and attention could be directed to the use of prescribed burns to maintain landscape function and ensure persistence of native vegetation. Additionally, the Transportation Corridor Agency's financial contribution toward cowbird-trapping studies could also be redirected. These studies have been conducted since NCCP-HCP inception resulting in no cowbird sightings within the Reserve since 2003 (Nature Reserve of Orange County 2003 Annual Report).

#### ***Amendments to Nature Reserve of Orange County Management Plans***

Current Management Plans do not address uncertainties or information gaps about: (1) the ecology of the species and its habitat, (2) management techniques, or (3) the effects of management on species/habitat for best management determination. The Management Plans could be improved by considering the potential effects of alternative decisions on key response indicators. The identification of management assumptions and thresholds that are based upon measurable criteria would particularly strengthen the Plans. In addition, it is necessary that criteria be linked to monitoring and that monitoring results are fed into management decisions. The use of scenarios in exploring options might be useful. Finally, Plans that recommend research to address remaining uncertainties would embrace the notion of continuous improvement.

#### **Greater "Services" Oversight/Enforcement, Leveraging and Sustained Protection**

The Fish and Wildlife Service and National Marine Fisheries Service ("The Services") need greater human and financial resources dedicated to HCP implementation oversight and enforcement. A potential role of the Services Regional, Field and State Office point of contacts could be to facilitate state, local, and private networks of landowners implementing HCPs within the same region.

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These HCP landowners could leverage resources dedicated to: (1) experiments that uncover cause and effect, and (2) research that addresses species demographics, external threats to species and habitat, and the resilience of habitat and species. In addition, resources dedicated to the creation of a centralized database could facilitate an assessment of cumulative impacts and information exchange on species status. Lessons learned among landowners could also be shared. The database could be the catalyst to sustained partnership and innovation.

The Services may consider negotiating the establishment of reserves and/or conservation easements with future forestry HCP applicants. This would allow for habitat protections in perpetuity for which experimentation may take place, rather than habitat deferrals for future harvesting.

The Services may also consider independent peer reviews and public reviews of HCP Implementation. However, success of HCPs can only be evaluated with appropriate monitoring. In particular, criteria must be established for each HCP to evaluate success of mitigation measures and the consequent effect on protected species and status. Future HCPs must clearly articulate adaptive management provisions that link effectiveness monitoring with biological and habitat goals. Provisions should also include adaptive management triggers, measurable criteria, as well as the responses to and responsibilities for implementation.

Finally, landowners need guidance to implement adaptive management. Enhancements made to the HCP Handbook (FWS/NMFS 2000) provides hope that third generation HCP permit holders are better informed about the approach to adaptive management. The HCP Handbook was designed as guidance for the Services in providing Incidental Take Permits to HCP applicants. HCP landowners use the Handbook at their discretion. Converting the HCP Handbook from a guidance document into a policy document may enforce adaptive management implementation.

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APPENDIX A

CENTRAL CASCADES HABITAT CONSERVATION PLAN

## **Riparian Habitat Areas: Interim Guidelines for Fish Bearing Streams and Road Management**

1. Fish bearing streams: This riparian habitat area will be retained as spotted owl habitat or if not currently functioning as spotted owl habitat, the area will be managed to provide forest conditions equal to or greater than foraging dispersal habitat for spotted owls.
  - a. Establish 200-foot riparian habitat areas (measured as horizontal distance from the edge of the stream) as determined by the normal high water mark, or if applicable, channel disturbance zone, on each side of all fish-bearing streams.
  - b. A 30 foot horizontal distance, no commercial harvest area (of conifer trees) will be situated in the riparian habitat area adjacent to fish bearing streams to maintain bank integrity, provide nutrients, and contribute large woody debris to the stream.
  - c. Limited silvicultural prescriptions for conifers and harvest of deciduous trees will be allowed to address watershed and wildlife concerns (excessively high tree density or undesirable coarse woody debris species).
  - d. Beyond the 30 foot no harvest zone, management objectives will be to meet large woody debris goals, maintain a late-successional forest structure, accommodate channel migration, slope stability, and/or additional wildlife considerations, and to implement a “feathering treatment” whereby more “large trees” will be left at the inner portion (i.e., closest to the stream) of the riparian habitat area.
  - e. One time selective or partial harvest during the permit period is allowable if Plum Creek can ensure that post harvest conditions in the riparian habitat area will provide at a minimum the equivalent of spotted owl habitat.

2. Road management: The objective of road management is to minimize disturbance of riparian habitat areas and to prevent sedimentation delivery to streams. The following measures will be employed to reduce the potential effects of road construction and use on streams and riparian habitat areas:
  - a. Minimization of road building activity;
  - b. Minimization of natural hydrological flow pattern disruption;
  - c. Restriction of side-casting during construction to prevent the introduction of sediment into streams and riparian habitat areas
  - d. Minimization of erosion at road sites using advanced techniques;
  - e. Identification of roads and associated drainage features that pose a potential risk;
  - f. Closing or stabilizing of roads based on short-term and long term transportation needs in each watershed;
  - g. Limited right-of-way clearing that allows for safe construction and passage on roads will be used; and
  - h. Roads will cross all streams at right angles.

**Table A-1. Stream Temperature Monitoring**

Year	Goal/Objective	Method	Location	Data analysis	Results	Next steps
99'  Most sites initiated in 00' and 01'.	Goal: Protect perennial stream temperatures.  Objective: Verify effectiveness of HCP riparian prescriptions.	Measure status and changes between upstream and downstream temperatures using before-after/control impact design.  Canopy: Measure pre and post harvest riparian stand conditions.  Stream temperature: StowAway TidBit digital temperature loggers.  Graphical and regression analyses.  Multiple linear regression	Total of 37 sites on East and Westside of crest.	Canopy closure and stream temperature  * Variables Climate data: (Air, precip & drought) Canopy, elevation  Temp data obtained from: Plum Creek Timber, U.S. Forest Service & Native Tribes. NOAA climate data.	Sites only evaluated 100' and 200' riparian habitat area buffer prescriptions.  Difficult to find and establish Riparian Leave Tree Areas and Inner Gorges sites.  No sites found for 300 ft. aquatic conservation buffers on federal lands.  Data from 9 sites: small differences in upstream and downstream temperatures after harvest. Increased cooling. Avg. difference (0.1 C), statistically insignificant.	Locate sites for RLTA's and Inner gorges Increase BACI replicates.  Install additional water and air temperature data loggers & widen distribution to improve accuracy of canopy elevation models.  Acquire covariate data (e.g., elevation, gradient).

**Table A-2 Landscape wide Monitoring of Aquatic Habitat Trends**

Yr.	Goal/Objective	Method	Location	Data analysis	Results	Results (continued)
Groundwork for site selection during Quartz, Upper Green River Sunday and Lester Water Analyses.	To examine responses of fish habitat and fish abundance to a 200 ft RHA buffer prescription.	<p>Trend monitoring: Physical characteristics &amp; fish populations.</p> <p>Effectiveness monitoring: (pre harvest) using before/after, control/ impact (BACI) design.</p> <p>Fish estimates from multiple pass electrofishing surveys with block nets.</p> <p>28 treatment and 20 control sites on low and mid order tributary channels.</p>	Upper Yakima and Green Rivers (Plum Creek and Forest Service ownership).	<p>*Variables</p> <p>Stream temperature, woody debris loading, channel and habitat conditions for fish and aquatic insects, fish abundance, and riparian vegetation.</p>	<p>49 long -term survey reaches installed throughout HCP area.</p> <p>Pre harvest sampling revealed that mean values of the variables describing channel, habitat, and LWD characteristics were not significantly different between treatment and control groups (@ = 0.10).</p>	Trout densities were not found to differ between treatments and controls within the east and west zones. Trout biomass was significantly higher in the Westside treatment reaches as compared to the Westside control reaches.

**Table A-3 Biotic Integrity of Stream Assessments**

Yr.	Activity	Goal/Objective	Method	Location	Data analysis	Results	Next step
1985-2000	Biotic Integrity of Streams.	Measure trends in stream benthic invertebrate community structure across a spatially dispersed array of sites over the Permit period.	<p>Compare sites where 200 ft. riparian habitat areas will be implemented with unharvested controls.</p> <p>*No attempt to stratify sites by amount and type of forest mgmt activity upstream.</p> <p>Assumption: if riparian habitat area harvest causes adjacent stream environment to change significantly, a commensurate change in aquatic insect community is expected.</p> <p>A 15 year aquatic insect monitoring program in Little Naches River System as reference.</p>	18 sites on east and west side of crest. (10 treatments and 8 controls).	<p>Benthic Index of Biotic Integrity and Fine Sediment Bioassessment Index.</p> <p>Data: Information on functional feedings groups, tolerance ratings, voltinism and habitat obtained from EPA taxa list and Oregon Dept. of Envir Quality Aquatic Insect Taxa list, respectively.</p>	Biotic integrity of sampled streams are good to excellent.	<p>Complete network of aquatic insect monitoring sites in 2001.</p> <p>Determine a final number of study sites.</p> <p>Collect data where evidence of significant disturbance of aquatic environment to explore sensitivity of aquatic insect community to habitat change.</p> <p>Integrate aquatic insect data with physical and biological data from landscape wide trends monitoring.</p>

**Table A-4 Stream Type Survey**

Yr.	Goal/Objective	Method	Location	Data analysis	Results	Results (continued)
96' - 01'.	<p>Goal: Ensure proper implementation of riparian prescriptions by establishing fish distributions and to inspect perennial flow.</p> <p>Objective: To locate upstream limit of fish distribution for perennial non- fish bearing and fish bearing streams.</p>	Electrofishing surveys.	East and west side of Cascades.	153 stream miles in the HCP area.	<p>Most surveyed streams were upgraded to fish bearing status. The net effect is increased riparian protection for more stream miles than originally estimated.</p> <p>Discovered areas unoccupied by bull trout allowed for more flexible management (Services interview, March 2004).</p>	<p>Fewer cutthroat trout in post-harvest than in pre-harvest period.</p> <p>No federally listed fish species have been encountered during those surveys (2003 Annual Report).</p>

**Table A-5 Prey Density Study (verification)**

Yr.	Goal/Objective	Method	Location	Data collection/ Analyses	Results
94'- 95'	<p>Assess effects of timber harvest on prey of NSO in East Cascades.</p> <p>Establish cause and effect relationship between logging and small mammal populations.</p>	<p>Treatment— within 71 variable size plots, harvested 180 acres via selective harvesting with tractor and cable yarding and small patch clearcut. Left standing representative large trees and snags.</p> <p>Control—26 acres left in the non-harvested patches and corridors.</p>	<p>Mole Mountain Harvest Unit S. Fork of Taneum Creek (Wenatchee National Forest).</p>	<p>Inventoried control plot and immediate post harvest (6 yr.). Collected data on snags, coarse woody debris and shrubs.</p>	<p>Biological objective achieved but silvicultural implications severe.</p> <p>Northern flying squirrels increase slightly during pre-harvest and immediate post harvest &amp; then decreased considerably at the 5th yr. on control unit.</p> <p>Treatment unit Pop increased sharply during immediate post harvest and stabilized 5 years later.</p> <p>Little change for green trees and snags over 5yrs. Large increase in shrub cover, slight decrease in coarse woody debris.</p> <p>Conclusion—population responses to timber harvest are site specific.</p> <p>Flying squirrels showed less of an effect from harvest than other species.</p> <p>Conclusion: Timber harvest can proceed without detrimental effects to prey base.</p> <p>The unit was given to USFS in the 1999 Land Exchange.</p>

**Table A-6 Dispersal corridor (verification)**

Yr.	Goal/Objective	Method	Location	Data collection/ Analyses	Results
97'	<p>Goal: Meet the HCP spotted owl foraging/dispersal (FD) habitat requirements.</p> <p>Objective: Maintain habitat conditions within the stand to facilitate movement and dispersal of owls from this site to other areas within the landscape.</p>	<p>150 ft width corridors arranged at various angles within 145 acre deferral (Frost Creek owl site).</p> <p>Placed a 100 ft. riparian habitat area on each side of a perennial stream.</p>	Big Frosty Harvest Unit within Late Successional Reserve of Northwest Forest Plan.	<p>Post harvesting of timber cruising showed the quadratic mean diameter of 13.7 inches unchanged from pre harvest inspection.</p> <p>The relative density decreased from 59 (pre-harvest) to 44 (post harvest).</p>	<p>Corridors within the stand were created where trees were removed.</p> <p>Areas outside the corridors were left unmanaged.</p> <p>Temporary road was constructed to access most corridors.</p> <p>After tree planting in Spring 98' the road was abandoned and the road prism returned to the natural slope.</p> <p>An inspection two years later showed that regeneration is underway.</p>

**Table A-7 Wildlife Reserve (WRT) & Green Retention Tree (GRT) Monitoring (verification)**

Yr.	Goal/Objective	Method	Location	Data analysis	Results
1999 & 2001	Compare post harvest results with HCP guidelines and WA State Forest Practice Rules and Regulations.	<p>Random sample of harvest units stratified by timber type (even or uneven aged) and harvest method (cable, tractor or helicopter).</p> <p>A combination of fixed area plots of various sizes, strip transects (long narrow riparian leave tree areas), and 100% census of leave trees in an area were established.</p> <p>Units segregated by pre harvest types (51 Douglas fir, 18 mixed conifer (whitewoods) and 3 ponderosa pines.</p>	<p>Eastside: Yakima</p> <p>72 harvest units</p> <p>Westside: Puget Sound</p> <p>36 harvest units</p>		<p><u>Yakima Unit</u> Down logs sampled in 8 harvest units covering 1,118 acres or 81% of area for WRTs and GRTs.</p> <p>Avg. of 8.2 logs per acre were present post harvest (met State criteria for size and volume).</p> <p><u>Puget Sound</u> Down logs sampled in 6 harvest units covering 288 acres or 52 % of the area sampled for WRTs and GRTs.</p> <p>Plum Creek is meeting or exceeding targets for retaining WRT and GRT post harvest.</p> <p>Tree retention in HCP Riparian Habitat Areas was not counted.</p>

APPENDIX B  
METHODOLOGY

## Interview Guide

1. What organizations makeup the HCP partnership?
2. Who are the key partners and decision makers?
3. What is your role within and financial contribution toward the partnership?
4. When and how often do the partners meet?
5. What is the internal process for communication and decision- making?
6. What are the HCP biological goals?
7. How were mitigation and management strategies determined?
8. How are information gaps and uncertainties addressed in HCP implementation?
9. How do you define adaptive management?
10. What are the parameters for implementing adaptive management in the HCP?
11. At what spatial scale is adaptive management applied?
12. How does adaptive management influence HCP goals, objectives, criteria and mitigation strategies?
13. How does new knowledge and understanding of the planning area and species (system) from monitoring influence decision-making?
14. What are your methods for monitoring species status and habitat quality?
15. How are monitoring efforts coordinated and shared?
16. What are the current environmental conditions and trends in the planning area?
17. What strategies are in place to deal with changing conditions within the ecosystem?
18. How is the acquisition of new information on species status obtained? (modeling, research, hypothesis testing, field experimentation)
19. How are biological responses to mitigation and minimization strategies monitored and evaluated?
20. What is the timetable for analyzing and interpreting biological responses to mitigation and minimization strategies?
21. Has the HCP been modified based upon biological responses to mitigation and minimization strategies?
22. What long-term funding mechanisms are in place for monitoring and adaptive management?
23. Have substantial changes occurred in extrinsic factors that were not anticipated?
24. If so, did implementation for the plan change to adequately account for these problems?
25. Has the “extraordinary circumstances” caveat ever been invoked?
26. How often is performance of the HCP and implementation agreement monitored?
27. How are conflicting mandates, policies and priorities factored into decision making?
28. What is your process for determining early outcomes? (performance standards, benchmarks, milestones, etc.)