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An analysis of marbled murrelet science in four habitat conservation plans

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AN ANALYSIS OF MARBLED MURRELET SCIENCE IN FOUR HABITAT CONSERVATION PLANS

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Mark Allen Jordan

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ABSTRACT

AN ANALYSIS OF MARBLED MURRELET SCIENCE IN FOUR HABITAT CONSERVATION PLANS

by Mark A. Jordan

Habitat Conservation Plans (HCPs) have been severely criticized for allowing take of species listed under the Endangered Species Act of 1973 (ESA) without sufficient scientific justification. This thesis evaluates four extant HCPs for the federally threatened marbled murrelet (*Brachyramphus marmoratus*). Adequacy results in five areas of analysis are examined for trends related to: land ownership, area covered, the number of species addressed, and the number of ESA species.

This research was conducted using a questionnaire to evaluate the extent to which scientific data and methods are used in each HCP as compared with availability of these tools and data. The results indicate that each of the four HCPs analyzed use inadequate scientific information and that use of adequate scientific information may decrease with size of area covered by a HCP and number of species listed under the ESA. Recommendations concerning HCP process/content and marbled murrelet policy are offered.

To all species.

In hopes of coexistence.

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INTRODUCTION

Taking of Endangered Species under Habitat Conservation Plans

The fossil record as well as current natural history indicates that earth is experiencing a massive biological extinction episode (Kohm 1991; Lawton and May 1995). In contrast to earlier episodes, the current extinction is affecting all major groups of organisms (especially terrestrial and freshwater), and the cause is a single biological species that has become so successful and so exploitive that it threatens to destroy the basis of its own long-term survival (Lawton and May 1995; National Research Council 1995).

The Endangered Species Act of 1973 (ESA) set forth guidelines that were conceived to protect species from becoming extinct in the United States (ESA 1973). In order to be considered for listing under this act, the status of a species is reviewed by the United States Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) to see if the species warrants listing under the ESA as "endangered", in danger of extinction throughout all or a significant portion of its range, or "threatened", likely to become "endangered" within the foreseeable future (U. S. Fish and Wildlife Service and National Marine Fisheries Service 1996).

Section 9 of the ESA prohibits the "take" of any fish or wildlife species listed under the ESA as endangered or threatened unless otherwise specifically authorized by regulation. The definition of "take" is "to harass, harm, pursue, hunt, shoot, wound, kill,

trap, capture, or collect or attempt to engage in any such conduct" (U. S. Fish and Wildlife Service and National Marine Fisheries Service 1996). The definition of "harm" extends take to include the effects of habitat loss and habitat modification (USFWS 1981).

In 1982 the ESA was amended to include a provision that allows for the "incidental take" of endangered and threatened species of wildlife by non-Federal entities (ESA 1982). Incidental take is a take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. In order to incidentally take a species listed under the ESA a land owner must go through the Incidental Take Permit (ITP) process. In order to obtain this permit an applicant must submit a Habitat Conservation Plan (HCP) for the land affected by plan activities (U. S. Fish and Wildlife Service and National Marine Fisheries Service 1996).

The following six criteria must be met for the USFWS and NMFS (herein "Services") to issue an ITP under 10(a)(2)(B) of the ESA in response to a HCP:

1) The take will be incidental to otherwise lawful activities and not the purpose of such activities;
2) The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking;
3) The applicant will ensure that adequate funding for the Habitat Conservation Plan and procedures to deal with unforeseen circumstances will be provided;
4) The taking will not appreciable reduce the likelihood of survival and recovery of the species in the wild;

5) The applicant will ensure that other measures that the Services may require as being necessary or appropriate will be provided; and

6) The Services must receive such other assurances as may be required that the HCP will be implemented.

In addition, under section 10(a)(2)(A) and Federal regulations 50 CFR 17.22 (b)(1)(iii)(C), the HCP submitted in support of an ITP must specify the following:

1) Impacts likely to result from the proposed taking of one or more federally listed wildlife species;

2) Measures the applicant will undertake to monitor, minimize, and mitigate such impacts; the funding that will be made available to undertake such measures; and the procedures to deal with unforeseen circumstances;

3) Alternative actions to the proposed taking that were considered but not selected, and the reasons why such alternatives are not being utilized; and

4) Additional measures the Services may require as necessary or appropriate for purposes of the HCP.

The section 10(a) permit process consists of following three phases:

1) Pre-application: The applicant consults with the Services and any other affected interests to ensure the HCP will minimize and mitigate effects of the project on listed species. The HCP is prepared to satisfy ESA requirements and an Implementing Agreement (IA) is prepared as the binding contract between the permittee and the government pursuant to which the HCP is implemented. The phase is completed when a complete application package

is submitted to the Office of the Regional Director of the USFWS, usually with a permit application (Form 3-200), a draft HCP, a draft National Environmental Protection Act (NEPA) document, and draft IA;

2) Formal application processing: The Services review the application package for biological and statutory completeness, announce in the Federal Register the availability of the draft HCP, IA, and NEPA documents for a 30-day public review and comment period, conducts an internal consultation as required under section 7 of the ESA. After the documents have been determined to be complete, and public comments are received and considered, the Services determine whether the section 10(a) permit issuance criteria have been satisfied, finalizes the NEPA documents, and makes a determination of permit issuance; and

3) Post-application phase: Notification of the outcome of the permit application to the public and for the administrative record. If a permit is issued the Services may publish notification in the Federal Register. Monitoring of implementation of the HCP, if required by the HCP or IA, occurs in this phase, as does any adaptive actions that may be stipulated (U. S. Fish and Wildlife Service and National Marine Fisheries Service 1996).

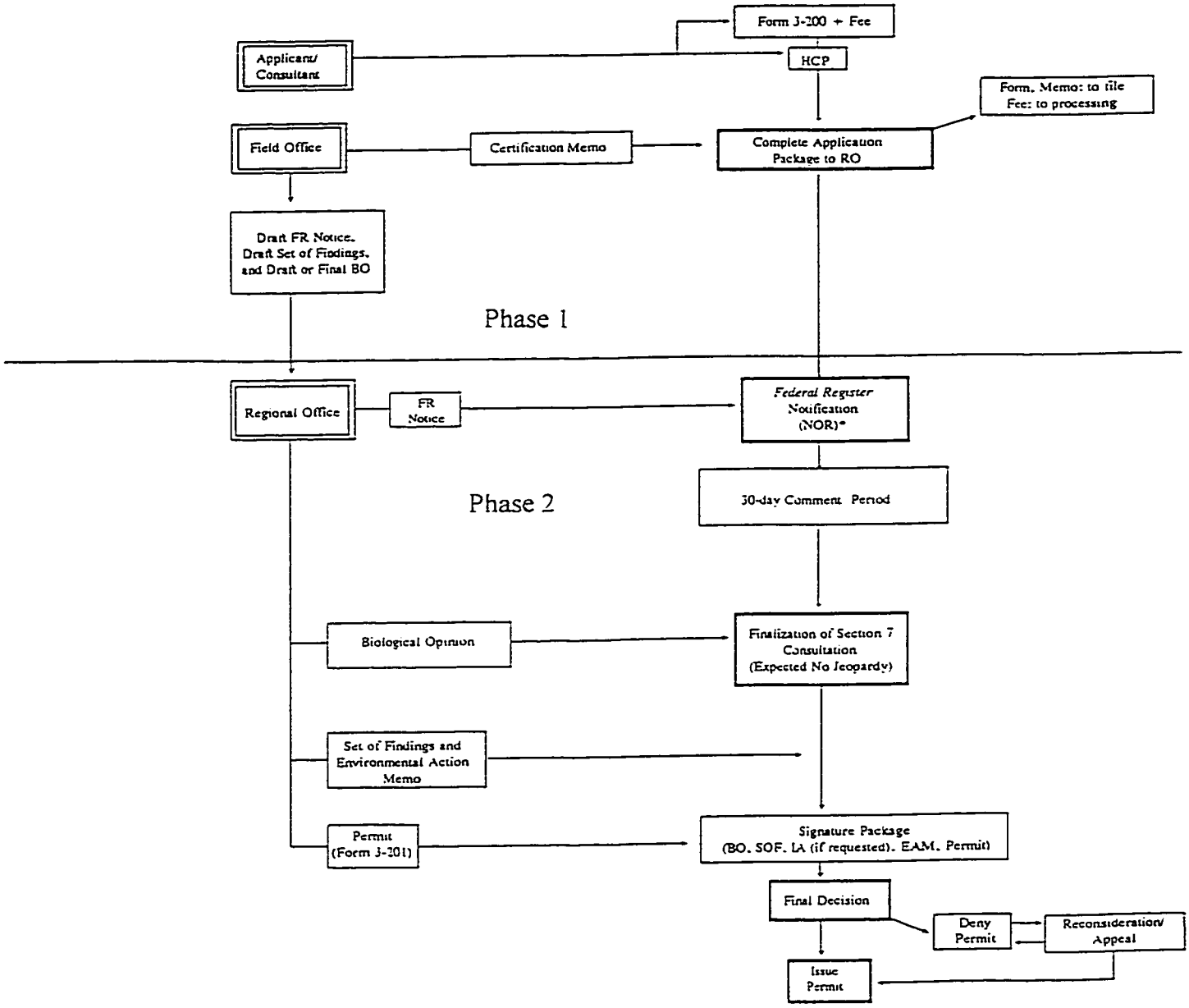
The NEPA requirements mentioned above mandate more documentation as the level of effect of a planned activity increases. Under NEPA, a categorical exclusion is given to a low-effect project and an Environmental Impact Statement (EIS) is required when the project or activity that would occur under the HCP is a major federal action

significantly affecting the quality of the human environment. An Environmental Assessment (EA) is prepared when the project does not appear to require an EIS but is not elgible for a categorical exclusion (U. S. Fish and Wildlife Service and National Marine Fisheries Service 1996). Phases 1 and 2 (above) of the section 10(a) permit process are outlined in Figures 1-3 for the different NEPA requirements.

Congress' intent in creating Habitat Conservation Plans (HCPs) was to provide a clear regulatory mechanism to permit the incidental take of species listed under the ESA, reduce conflicts between listed species and economic development activities, and provide a framework that would encourage creative partnerships between the public and private sectors and State, Municipal, and Federal agencies in the interests of listed species and habitat conservation (U. S. Fish and Wildlife Service and National Marine Fisheries Service 1996).

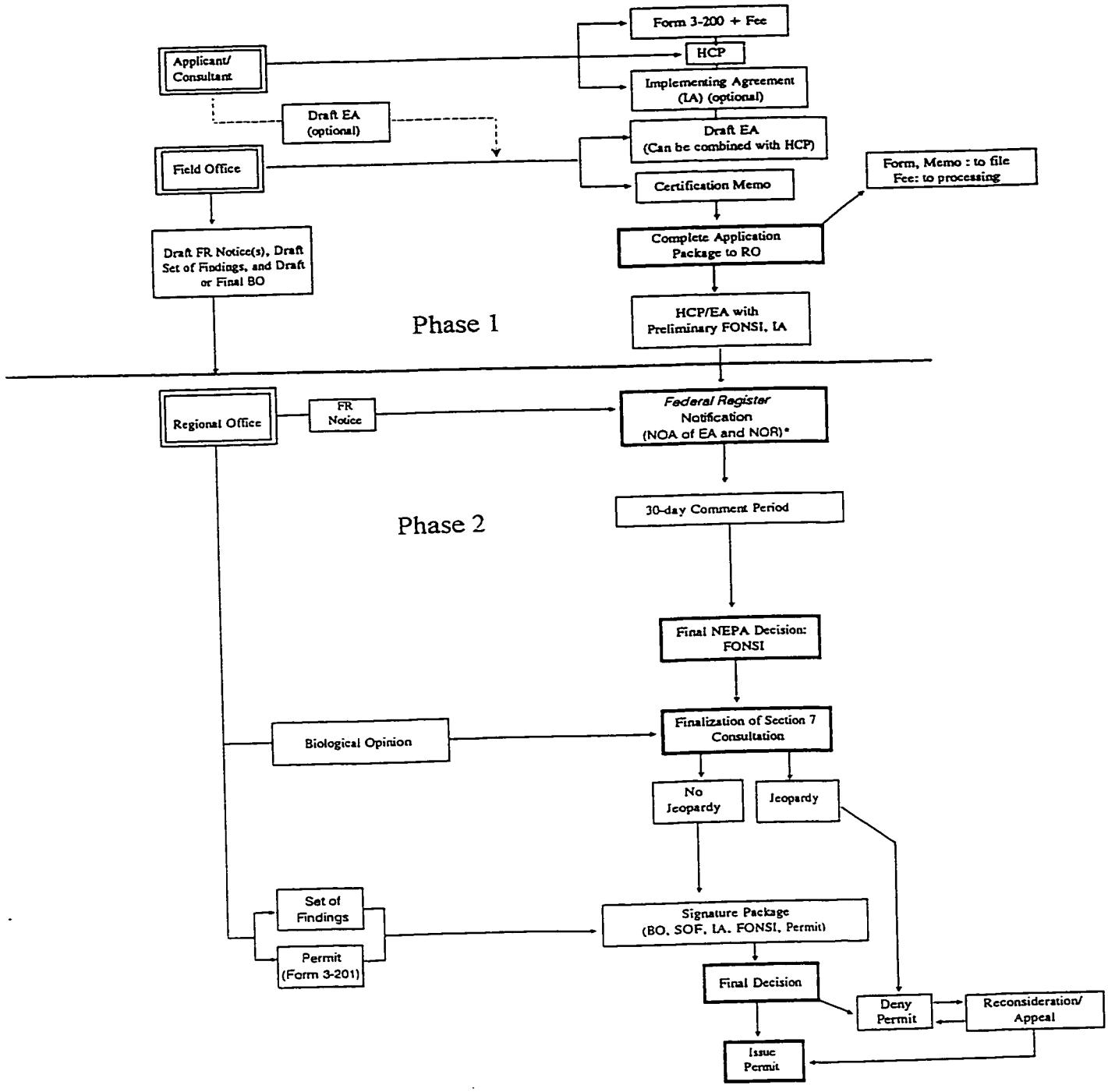
HCPs have begun to significantly affect the management of endangered species habitat due to the sudden increase in the number of plans being approved and the size of the plans. In 1992, ten years after their creation under an amendment to the ESA, only 11 HCPs had been approved by the United States Fish and Wildlife Service and the National Marine Fisheries Service. By 1997, however, over 200 HCPs had been approved for land totaling more than 7 million hectares (Kaiser 1997; Mann and Plummer 1997). HCPs have become the most prominent mechanism employed by the USFWS on private lands inhabited by species listed under the ESA (Kareiva *et al.* 1999).

Figure 1.-- Typical Processing for Low-Effect Section 10(a)(1)(B) Incidental Take Permit Applications.



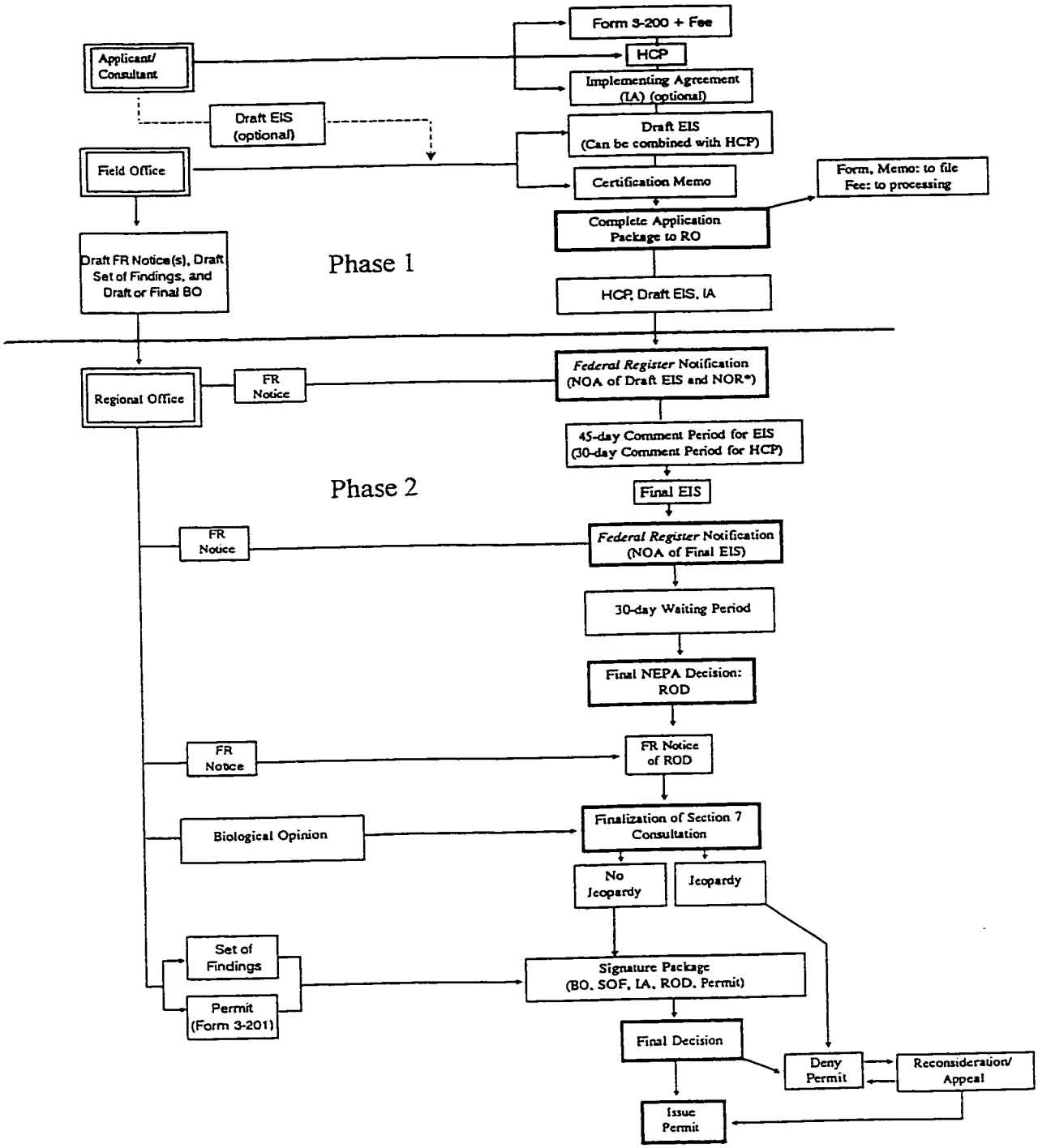
Source : United States Fish and Wildlife Service and National Marine Fisheries Service. 1996. Habitat conservation planning handbook. Washington D.C. : U.S. Government Printing Office.

Figure 2.– Typical Processing for Section 10(a)(1)(B) Incidental Take Permit Application Requiring an Environmental Assessment (EA).



Source : United States Fish and Wildlife Service and National Marine Fisheries Service. 1996. Habitat conservation planning handbook. Washington D.C. : U.S. Government Printing Office.

Figure 3.-- Typical Processing Steps for Section 10(a)(1)(B) Incidental Take Permit Application Requiring an Environmental Impact Statement (EIS)



Source : United States Fish and Wildlife Service and National Marine Fisheries Service. 1996. Habitat conservation planning handbook. Washington D.C. : U.S. Government Printing Office.

Problem Statement

The effectiveness of Habitat Conservation Plans (HCPs) as a management tool is controversial, and as HCPs are being used more and more, the national controversy over the process has heightened. The plans have recently come under scientific scrutiny for possibly undermining the success of the Endangered Species Act of 1973 (ESA) with varying and inconclusive results (Bingham and Noon 1997; Hall 1997; Kaiser 1997; Koystack 1997; Mann and Plummer 1997; Noss *et al.* 1997; Shilling 1997; Reichhardt 1998a; Kareiva *et al.* 1999). The intensity and awareness of the problem was recently demonstrated when members of the California State assembly threatened not to allocate California's $130 million share in the joint purchase of ancient redwood groves (U.S. Congress had already approved the federal share of $250 million), nullifying the entire historic purchase and years of high-level negotiations, if the landowner (Pacific Lumber Company) did not create a scientifically adequate HCP to accompany the transaction (Lochhead 1998).

Using a limited, case study approach, this study addresses the problem of whether the species protections contained in HCPs are supported by adequate science and if there is a difference in the scientific adequacy of HCPs based on factors such as: land ownership, plan area, the number of species specifically addressed in a plan, and the number of species listed under the ESA that inhabit a plan area. To achieve this goal, the study specifically examines four questions:

1) Is there a difference in the scientific quality of HCPs being created for private land and public land?
2) Does the physical area covered by an HCP affect the scientific quality of the HCP?
3) Does the number of species specifically addressed by a plan affect the scientific quality of the HCP?
4) Does the number of ESA listed species known to inhabit the HCP area affect the scientific quality of the HCP?

RELATED RESEARCH

Research on Scientific Adequacy of HCP-related Aspects of the ESA

Recently, the adequacy of science used in implementing the ESA has come under increased scrutiny. The listing process, the designation of critical habitat, and recovery plans have each been analyzed by researchers. Some researchers believe the act overprotects species due to use of questionable science (Mann 1991; Budiansky 1993); while others determine the act does not provide enough protection to species due to insufficient use of existing scientific knowledge (Yaffee 1994; Rohlf 1991; Franklin 1993; O'Connell 1992; Rohlf 1992; Tear et. al. 1995). Political and economic concerns are found to influence the application of science-based protections intended by the act (Rohlf 1991; O'Connell 1992; Rohlf 1992; Tear et. al. 1993; Yaffee 1994; and Shilling 1997).

History of science and the ESA. Yaffee (1994) finds governmental agencies began to use a more scientific approach to endangered species decisionmaking in the late 1970s when they shifted away from reliance on questionable "expert opinions" and began to include discussions of viable populations. He points out that the late 1970s and early 1980s were a period of intense growth for research and writing in the area of conservation biology. Yaffee's research follows the progression of scientific understanding of biological diversity as it expands into the mid-1980s where it begins to encompass genetic, species, and ecosystem levels. This expansion, the author finds,

moves biological diversity objectives into opposition with timber objectives for the first time in American history.

Rohlf (1991) determines the ESA to be biologically inadequate. He argues that this has greatly contributed to the failure of the act to achieve its stated goal of halting and reversing the trend toward species extinction. His research details the absence in the ESA and associated implementing regulations of important biological concepts such as ecosystem conservation, patch dynamics, and the probabilistic nature of stochastic threats to a species persistence. In response to Rohlf, O'Connell (1992) asserts that the ESA is scientifically adequate, but has been plagued by ineffective implementation and underfunding; a finding supported by the Office of Inspector General (1990).

The National Research Council (1995), in response to a request by Congress, conducted research on the level of science being used in the ESA. In contrast to many scientists, the authors find a good match between science and the ESA.

Listing of species. An investigation of the USFWS Endangered Species Program by the Office of the Inspector General (1990) determines the Service is not making timely progress on officially listing and protecting endangered and threatened plant and animal species. The investigation finds that approximately 600 domestic candidate species deemed by the Service to merit immediate protection under the ESA have not been listed and an additional 3,000 species suspected by the Service to be threatened or endangered have received no protective action. As a result of such inaction, the report finds, at least 34 animal and plant species have become extinct in the ten previous years without ever being listed under the Act.

The National Research Council (1995), in a study mandated by Congress, agrees with the Office of the Inspector General and others that the designation of endangered or threatened status is not timely enough to protect these species (Shilling 1997). Dobson *et al.* (1997) determine that the presence of a bird listed under the ESA is the best indication of overall endangered biodiversity within a region.

Designation of critical habitat. The National Research Council (1995) finds problems in protection of survival habitat but praises the language of the ESA for emphasizing habitat, claiming it is the central ingredient for recovery. Shilling (1997) recommends critical habitat be designated at the time of listing to better protect species.

Recovery plans. An important aspect of the ESA is a species recovery plan, required by law since 1978, for all species listed under the ESA. The plans are intended to "restore the listed species to where they are viable, self-sustaining components of their ecosystem" (USFWS 1990, v). In 1990, the Office of the Inspector General finds that the USFWS needs $4.6 billion for recovery of the species currently listed under the ESA, an impossible task as the annual budget of the Service is approximately $8.4 million (Office of Inspector General 1990). The same audit finds no uniform system in the Service for tracking recovery plan development or implementation of recovery plan tasks.

Tear *et al.* (1995) evaluate all the recovery plans approved by the regulatory agencies, USFWS and the National Marine Fisheries Service (NMFS), as of August 1991. All of the species contained in the plans are found to be at risk of extinction, yet no objective, measurable difference between recovery goals for threatened and endangered species is evident. The average time from listing under the ESA to the approval of a

recovery plan is 8.7 years for animals; among vertebrates the wait is longest for bird species, 11.2 years. The researchers find that there is an overall lack of detailed biological information presented in the plans and that if the population-based recovery goals were achieved it would not change the level of endangerment for 60-73% of vertebrate species. The researchers recommend the USFWS and NMFS begin to use more biologically defensible criteria for assessing extinction threats and create biologically sound plans by using measures such as population size and number of populations, and explicitly state the risks associated with these levels over a stated period. Shilling (1997) finds that approximately one-third of species listed under the ESA have a recovery plan, the majority of which are high-profile species.

Research on Scientific Adequacy of Habitat Conservation Plans

As Habitat Conservation Plans (HCPs) begin to significantly affect the management of endangered species habitat they have come under scientific scrutiny for possibly undermining the success of the ESA (Bean *et al.* 1991; Thornton 1991; Carpenter 1993; Beatley 1994; Bean and Wilcove 1997; Bingham and Noon 1997; Hall 1997; Kaiser 1997; Koystack 1997; Mann and Plummer 1997; Noss *et al.* 1997; Reichhardt 1997; Reichhardt 1998a, 1998b; Shilling 1997; Kareiva et. al. 1999). An examination into HCPs serves as a test of the ESA approach to conserving biodiversity (Beatley 1994).

Private versus public land. The National Research Council (1995) discusses the differences between public and private entities and states that the two do not always

respond in the same way to laws, regulations, and other incentives and disincentives. The Council encourages more research into this area.

Bean and Wilcove (1997) determine private land and state-owned land are extremely important to endangered species, as most species listed under the ESA have 80% or more of their known habitat on non-federal land, and over a third have all of their known habitat there.

Area covered by plan. Research by Bean *et al.* (1991) indicates larger HCPs provide greater benefits for targeted species. The National Research Council (1995) notes that wherever possible HCPs should be regional in scope and cover multiple species across multiple habitat types. Mann and Plummer (1995) note that larger, regional HCPs are better, biologically and politically.

Species covered by plan. Tear *et al.* (1995) support, as do several other scientists, a shift toward a habitat- or ecosystem-based method of protecting species under the ESA (Orians 1993; Franklin 1993; National Research Council 1995). Shilling (1997) concurs, finding HCPs designed around the needs of one or two species can leave the habitat requirements for other species in jeopardy due to inappropriate mitigation. Indeed, plans reviewed by Kaiser (1997) often relied on well-studied "indicator" species, ignoring quality habitat for other species. Eisner *et al.* (1995) disagree with this logic, stating that the traditional individual species approach is sound because species provide a more objective means of determining the location, size, and spacing of areas needed to conserve biodiversity, population declines of individual species may alert observers to a stressed ecosystem before it is obvious, individual species are useful to humans in a

variety of ways, and individuals often play pivotal roles in ecosystems. Koystack (1997) determines that the number and quality of HCPs in any region has little if any relation to the seriousness of endangerment of wildlife in that region.

No Surprises. Baur and Donovan (1997) research the "No Surprises" policy issued by the Department of Interior and Department of Commerce in August 1994 that apparently led to an increase in the number of landowners willing to prepare HCPs. The policy states that the USFWS and the NMFS will not require additional lands, additional funds, or additional restrictions on lands or other natural resources released for development or use, from any permittee who is implementing an approved HCP should "unforeseen circumstances" occur, such as the listing of a species under the ESA (U. S. Fish and Wildlife Service and National Marine Fisheries Service 1996). The authors find this policy to be controversial but sufficiently flexible to meet the needs of species and landowners. They state that the negotiations leading up to the final HCP and the use of guarantees in a specific plan through the negotiations are the most important aspects of a successful "No Surprises" policy. Several scientists disagree with the findings of Baur and Donovan, claiming the policy is locking in bad science or is contrary to the natural world, which is full of surprises (Kaiser 1997; Reichhardt 1997; Reichhardt 1998a, 1998b). Shilling (1997) finds the "No Surprises" clause to be one of the most troubling aspects of a troubling process (HCPs).

Status of species. Shilling (1997) finds most HCPs lack adequate baseline information about population size of target species. He recommends that regionally negotiated agreements conform to a common recovery plan, and recovery goals should be

driven by a standard that is several-fold higher than the minimal viable population. Kareiva *et al.* (1999) find that crucial, yet basic, information on species is often unavailable to the preparers of HCPs.

Analysis of take. The National Research Council (1995) recommends HCPs include population-viability analysis (or equivalent modeling effort) to assess likelihoods of persistence under alternative options. In a study involving species dependent on old-growth forest, Bingham and Noon (1997) point out that "harm" in the ESA definition of "take" includes the effects of habitat loss and modification.

In their extensive review of 43 HCPs, Kareiva *et al.* (1999) determine that of the instances in which a listed species might be "taken" by an HCP activity, the predicted take is quantitatively estimated for only 56%. Of the HCPs studied, only 25% of species treatments include both a quantitative estimate of take and an adequate assessment of the impact of that take.

Analysis of biological impact of take. Rohlf (1991) finds that the USFWS and the NMFS issue Incidental Tale Permits (ITPs) too quickly in response to HCPs, often giving species less protection than is necessary to ensure their continued existence. The lack of a recovery plan, or updated plan, is found by Beatley (1994) to be a common impedance to effective habitat conservation planning. After reviewing HCPs, Shilling (1997) concludes that the scientific community should draft conservation recommendations for endangered species and that these should include the disallowing of incidental take of listed and candidate species until the recovery of the species has been achieved.

Mitigation for anticipated take. Shilling (1997) finds most HCPs lack adequate baseline information on actual habitat use of species; when this information is available it is not necessarily used in the implementation and mitigation phases of the plan. Kaiser (1997) identifies the insufficient size and fragmentation of reserves set aside by HCPs as a problem. She also finds reliance on translocating animals to be a flaw occurring in numerous plans.

Hall (1997) finds that forestland HCPs fail to provide mitigation for old-growth, late successional, and other older and more diverse forest habitats. He also finds that many forestland HCPs' minimization and mitigation measures lack credibility.

Bingham and Noon (1997), also concentrating on forestland, find that the mitigation solutions used in HCPs are often arbitrary, lacking an empirical foundation in the species life history requirements. They recount an existing HCP mitigation technique for the Northern Spotted Owl (*Strix occidentalis*) that uses no data, analyses, or logical defense. Bingham and Noon explore the ongoing debate of species area requirements, attributes, and types of habitats within that area required for effective mitigation against the take of habitat for endangered species. The authors, using spotted owl data, illustrate a biologically based method for estimating the areal requirements necessary to mitigate against the take of essential habitats. This method, the authors believe, could serve as an alternative to the ad hoc methods being used to develop guidelines and could be used to comply with the intent of the ESA. Kareiva *et al.* (1999) finds absences of crucial data leading to a finding of "unproven" mitigation measures being relied on in several HCPs.

Plan monitoring. The National Research Council (1995) recommends HCPs include discussions of how ongoing research and monitoring activities will be used to adjust management in response to changes in population sizes and environmental variables. Only half of the HCPs studied by Kareiva *et al.* (1999) contain a clearly outlined monitoring program.

Case studies. A study by Bean *et al.* (1991) was one of the first to analyze HCPs. Based on a review of most of the HCP efforts undertaken at the time (4 detailed examinations and 7 case briefs) the authors give background information on how HCPs came to exist, put the process into perspective, and examine the key issues. The findings indicate that the best HCPs developed adequate biological information prior to the planning process. The study recommends that the independence of biological and other paid consultants be assured when funding comes from one or a few primary participants. The likelihood that an HCP will benefit a species is found to be questionable due to unproven biological assumptions and unproven conservation measures. The study makes excellent recommendations for the process, such as HCPs defining what constitutes "success" and how to measure it, including remedial measures if objectives are not being achieved, employing techniques such as population viability analysis (PVA) as an evaluation tool, and periodic evaluations by independent biologists. The authors warn that, if misused, HCPs could undermine the protection intended by the ESA for species listed under the act.

Beatley (1994) provides an excellent background of the HCP process and an extensive pre-1994 look at HCPs, their successes, and their failures. Beatley (1994)

states that while HCPs are in their infancy and it will take many years of monitoring and evaluation to reach meaningful conclusions on the plans, it is extremely useful to take stock of the process and strategies currently being pursued in the plans. He states that the HCP process is an example of how the environment versus development dichotomy has evolved and he maintains that HCPs teach an important lesson in how practical compromises have been reached which accommodate both interests. Relatively few HCPs had been approved while Beatley authored his study and some of his findings, such as the average length of plan being 30 years, reflect this. He finds several causes for concern in his review of extant HCPs. Of paramount importance is the scientific adequacy of the plans. All the HCPs he examines contain serious deficiencies in biological information. He concludes that the most complete and thorough biological and scientific information available should be included in an HCP. He adds USFWS should provide minimum conservation standards and ensure that the benefit of the doubt is given to the species.

In their 1995 book, Mann and Plummer (1995) examine the fourth HCP effort, the Balcones Canyonlands Conservation Plan (BCCP) process. This plan, located in Travis County, Texas, failed after six years of planning even though it was expected by Interior Secretary Bruce Babbitt and others to be a national model of the HCP process. This failure occurred even though the process seemingly had all the ingredients for success: sophisticated computer models from respected scientists; ideological opponents (developers and conservationists) committed to working together to make an acceptable plan; the common goal of being proactive; and the energetic support of the Interior

Secretary and his department. The size and scope of habitat reserves recommended by scientists to protect the black-capped vireo (*Vireo articapillus*), golden-cheeked warbler (*Dendroica chrysoparia*), several cave invertebrates, and other species were severely curtailed during the planning process. The authors conclude that the BCCP demonstrates that even though biology is the heart of the ESA, financial considerations are equally important. They recommend scaling back the definition of "take" under the ESA to exclude harm to habitat.

The National Research Council (1995) study mentioned above analyzes the HCP process and briefly mentions some of the efforts to date. The authors address criticisms by Mann and Plummer (1995) and others that HCPs demand inordinate amounts of time, human resources, and money, and should be avoided by stating HCPs have the potential to effectively protect ecosystems given more funding. The study praises California's Natural Communities Conservation Plans use of guidelines to assist planners in applying biological data and encourage HCPs to use similar methods. The research concludes by stating that while sound-science alone can not prevent species extinction's, conserve bodiversity, and reduce economic and social uncertainty and disruption, it is the essential starting point for innovative and workable policies that can help to solve these and perhaps other related problems.

In January 1999 the National Center for Ecological Analysis and Synthesis (NCEAS) published the first extensive academic study of HCPs (Kareiva *et al.* 1999). The study confirms many of the existing criticisms of the HCP process, including a lack of key data and the misuse of scientific methods and biological data. The study is the

cumulation of research done through eight major research universities, 106 students, and 13 faculty advisors. The publication contains the results of research into 208 approved HCPs, 43 of which receive extensive analysis. The authors state that the HCP process is new, complex, and difficult and their goal is to take the analysis of HCPs "away from the realm of unsubstantiated expert opinion and into an empirically based arena where arguments over methods and conclusions can be articulated, debated and revisited" (Kareiva *et al.* 1999, 12).

Forest Habitat Conservation Plans. Of primary concern to this study is HCPs completed for forest ecosystems. Hall (1997) published a detailed study on Pacific Coast forestland HCPs that contains important insight into the plans that are being created for this ecosystem. At the time of publication, HCPs covered over 1,012,145 hectares of forestland in Washington, Oregon, and California with an additional 3,075,677 hectares in HCP formation. The author finds that most forestland HCPs do not follow basic policy guidelines and are of debatable biological value. The plans do, however, minimize some of the impacts for industrial timber harvesting and other activities, provide some limited monitoring, and coordinate management with neighboring federal lands. His study shows that forestland HCPs tend to have a lifespan of 20 to 100 years. Hall concludes that landowners who are developing forestland HCPs appear to be doing as little as possible to contribute to species survival and recovery.

Other findings. Bean and Wilcove (1997) determine that HCPs do not help endangered species recover and the plans often allow a steady erosion of species and their habitats. They find that HCPs seek only to minimize and mitigate the detrimental

effects of new development on biological diversity instead of requiring that either the particular species affected or the survival prospects for endangered species be enhanced.

Kaiser (1997), through examination of specific issues such as the Alabama Beach Mouse (*Peromyscus polionotus ammobates*) and the Red-Cockaded Woodpecker (*Picoides borealis*), finds that the HCP process is quite controversial. Kaiser states numerous ecologists are unsure of the quality of science being used in HCPs. Studies of HCPs are important, the report finds, even it they do not influence the reauthorization of the ESA, as HCPs are a newly-arrived prominent component of the ESA.

From a legal perspective, Kostyack (1997) reviews the role HCPs are having in the ESA process and proposes ways to improve the process as a whole. He finds that HCPs are a matter of great debate among ESA policy experts and are highly criticized by conservationists and independent scientists because they allow substantial habitat destruction without appropriate consideration for species long-term survival needs. He suggests that the implementing agencies require all HCPs be monitored carefully, and that biological indicators should be established from the outset of the plans so that key assumptions of the HCP can be regularly tested. Kostyack also suggests that HCPs be required to put limits on duration and to take corrective action when goals are not being met.

Reichhardt (1997) reports that a small but influential group of conservation biologists concerned about HCPs, the "No Surprises" clause, and the reauthorization of the ESA by Congress have come together to call for scientifically-sound implementation of the ESA. The scientists state that many HCPs have been developed without adequate

scientific guidance. They call for the formation of a standing body of independent scientists to review large and complex HCPs. According to the group, for HCPs to be scientifically credible they must have clear, measurable biological goals and demonstrate how those goals will be achieved. Reichhardt (1998b) reports that this group disagrees with a second body of scientists that ran a full-page advertisement in *The New York Times* concerning their viewpoint. While the two groups have many of the same reservations, the group that ran the advertisement call for a complete ban on killing any endangered animal or plant, which would mean suspending "incidental takes" permitted under HCPs.

RESEARCH OBJECTIVES

The objective of this study is to investigate whether the case of the marbled murrelet supports or undermines the following hypotheses:

H1) Public entities are more likely than private entities to use adequate scientific information in a Habitat Conservation Plan.

Hypothesis #1 creates an important distinction between two categories of Habitat Conservation Plans (HCPs) being implemented. Public entities are likely to behave differently from private landowners because their incentives and disincentives are different. Private landowners tend to be driven by profit, whereas public entities are charged with stewardship of the common land and thus, perhaps more likely to use management techniques that prescribe protection and caution; techniques based on science (Beatley 1994; National Research Council 1995; Shilling 1997; Bean and Wilcove 1997). The biological and physical requirements of species do not vary due to land ownership, and many species are dependent on both public and private lands (Bean and Wilcove 1997). Together these factors provide an interesting and applicable realm of study.

H2) The larger the area covered by a Habitat Conservation Plan, the more likely the plan will be to use adequate scientific information.

Some researchers believe that larger, more wide-spread HCPs may increase protections for species in the plan area (Kohm 1991; Franklin 1993; Beatley 1994; Mann and Plummer 1995). Small HCPs are believed to produce fragmented habitat, and involve less coordination, resulting in a scientifically inadequate plan (Bean *et al.* 1991).

H3) The more species specifically addressed with biological information by a Habitat Conservation Plan (covered by the Incidental Take Permit), the more likely the plan will be to use adequate scientific information.

Hypothesis #3 stems from related research indicating that a comprehensive, multi-species approach is preferable (Bean et al. 1991; Rohlf 1991; Beatley 1994; National Research Council 1995). This may not be the case if the plan is designed around the needs of just a few species. Intuitively, it is argued that HCPs that cover more species should create a better plan and use of a more thorough process (Shilling 1997).

H4) Habitat Conservation Plans for areas that are known to contain more species listed as federally threatened or endangered are more likely to use adequate scientific information.

Areas where there are more species listed under the ESA are believed by some authors to receive more attention due to the associated indication of threatened biodiversity and increased conflicts over land use (Gibbons 1992; Beatley 1994; Dobson 1997). Due to this increased attention, Hypothesis #4 relates the increased presence of endangered species to a more scientifically sound HCP.

METHODS

Introduction

In order to address the four hypotheses, this study uses a focused case-study approach. In particular, it examines the quality of four extant Habitat Conservation Plans (HCPs) that contain habitat for the marbled murrelet (*Brachyramphus marmoratus*), a species listed as threatened under the Endangered Species Act of 1973 (ESA). Both quantitative and qualitative data are used to evaluate the scientific adequacy of five HCP components (current status, take, impact of the take, minimization/mitigation, and monitoring) for each plan as they relate to the marbled murrelet. The evaluation and subsequent comparisons based on ownership, amount of land covered by each plan, species specifically addressed by each plan (to obtain take permit), and species listed under the ESA known to inhabit the covered area help to support or weaken the study hypotheses. The results of the study provide specific insight into each HCP studied and general insight into the HCP process under the ESA .

Study System: The Marbled Murrelet

Taxonomy and description. The marbled murrelet is a small Pacific Coast seabird in the family Alcidae. Murres, dovekies, razorbills, puffins, guillemots, murrelets, auklets, and the extinct great auk complete this family of wing-propelled diving birds. There are two genera for the six species of murrelets. The genus *Synthliboramphus* includes the Japanese murrelet (*S. wumizusume*), ancient murrelet (*S. antiquus*), Craveri's murrelet (*S. craveri*); and Xantus' murrelet (*S. hypoleucus*). The

genus *Brachyramphus* includes the marbled murrelet (*B. marmoratus*) and the Kittlitz's murrelet (*B. brevirostris*).

The plumages of male and female marbled murrelets are identical. While breeding adults (spring and summer) have light mottled brown underparts and sooty-brown upperparts with dark bars, non-breeding (winter) adults have brownish-gray upperparts except for a white band below the nape that extends up from white underparts and white scapulars (Figure 4 and 5). Plumage of a fledged young is similar to adults in the winter (Carter and Stein 1995).

Distribution. Eighty-five percent of the estimated 300,000 marbled murrelets reside along the Gulf of Alaska and Prince William Sound (WADNR 1997). They are the only alcid known to nest in trees and most do so throughout the forested portion of their range, from Kodiak Island and the Kenai Peninsula to Santa Cruz County California (Figure 6). The Pacific Northwest population forages almost exclusively in the nearshore marine environment. At-sea distribution becomes discontinuous in California. Wintering marbled murrelets have been found as far south as northern Baja California, Mexico (USFWS 1997).

Life history. Marbled murrelets grow to approximately 25 centimeters in length and are estimated to live an average of ten years. Adults lay at most one egg per year (Beissinger 1995). Both sexes incubate the egg in 24–hour shifts for a period lasting approximately 30 days which is followed by 28 days of fledging. Adults feed on a variety of small fish and invertebrates and feed a chick up to eight times a day. Marbled

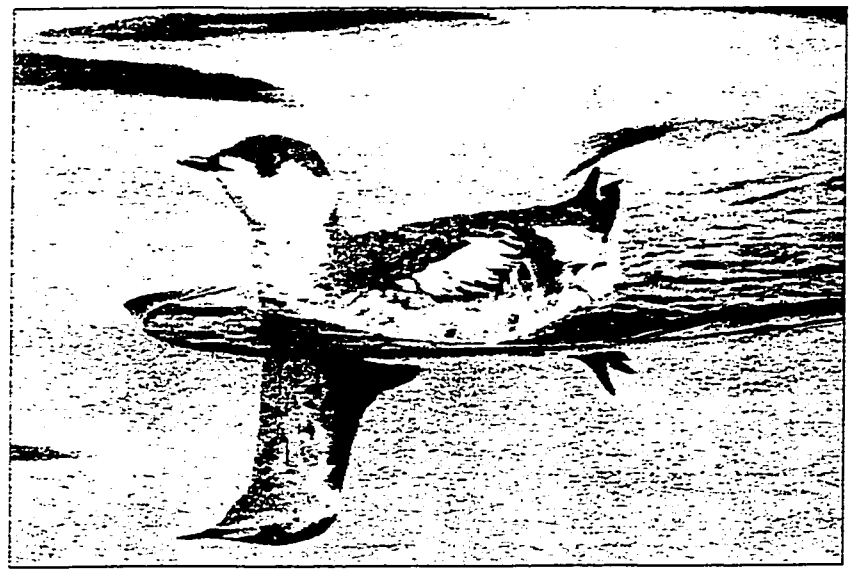


Figure 4. Marbled murrelet in winter plumage (photo by Gus van Vliet).

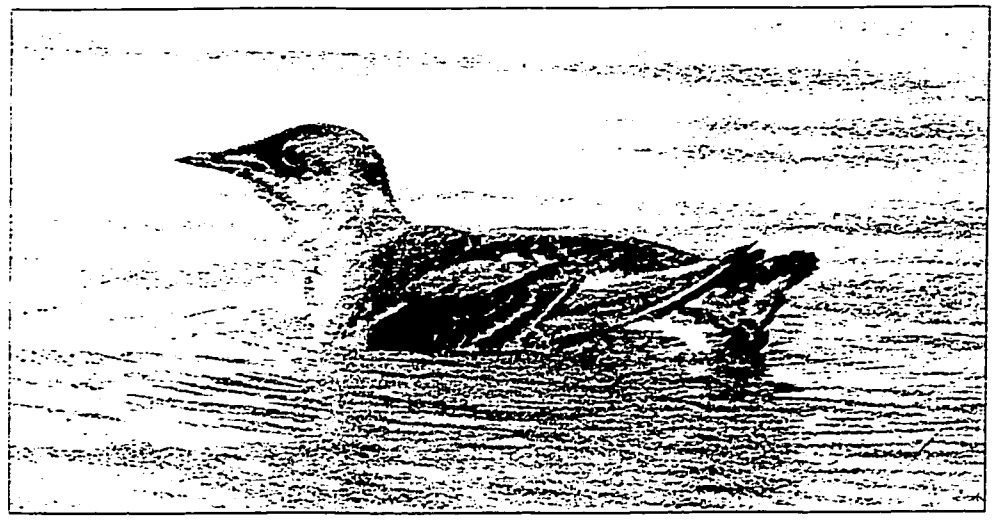
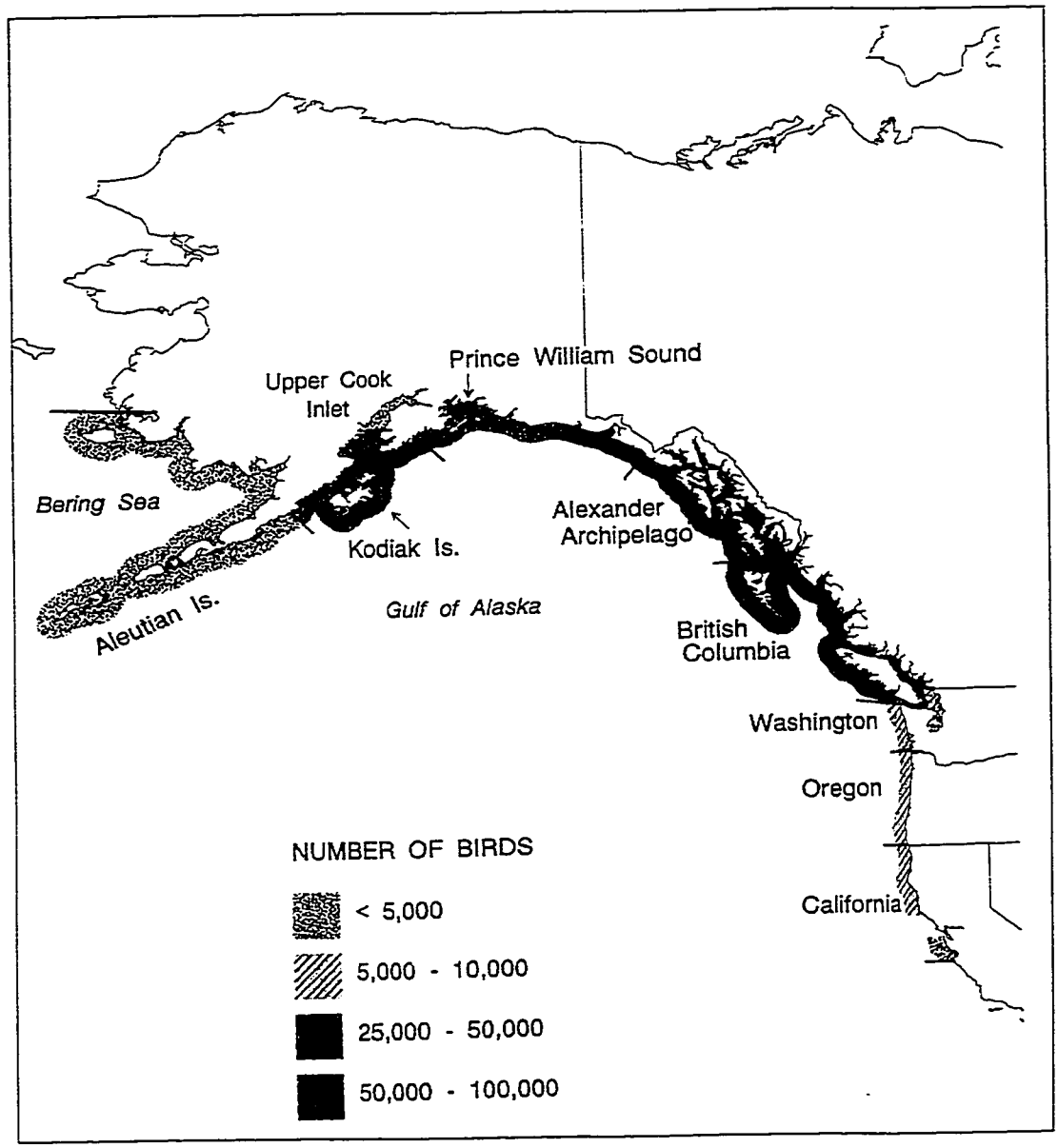


Figure 5. Marbled murrelet in breeding plumage (photo by Gus van Vliet).

Source : United States Fish and Wildlife Service. 1997. Recovery plan for the marbled murrelet (*Brachyramphus marmoratus marmoratus*) in Washington, Oregon, and California. Washington D.C. : U.S. Government Printing Office.

Figure 6. Range of the marbled murrelet and population sizes along the Pacific coast.



Source : WADNR. 1997. Final habitat conservation plan. Olympia, Washington : Washington State Department of Natural Resources.

murrelets are secretive birds that fly at high speeds (up to 158 km/hour), attend their breeding sites primarily during low light levels, and nest solitarily (USFWS 1997).

Habitat. The marbled murrelet primarily nests in old-growth forests (late-successional forests with trees 200 years or older) within 80 kilometers of shore from late March to late September. Old-growth forests are characterized by a range of tree ages and sizes (consisting of both rapid-growing and slow-growing individuals), a multilayered canopy, abundant shade-tolerant species, numerous large, standing snags and downed trees of various size and decay classes, and abundant tree cavities (Old-Growth Definition Task Group 1986, Cooperrider *et al.* 2000). Nesting areas for marbled murrelets usually contain at least the following components: large trees, multistoried stand, and moderate to high canopy closure. Marbled murrelets also have been found to use mature forests with one or more old-growth component, especially in trees with deformities that create suitable nesting platforms. No nests have been found in stands younger than 180 years old, with the average being much older (USFWS 1997).

Marbled murrelets exhibit nest fidelity for stands and even for specific trees. Research suggests the species is not well adapted to disperse to new nest stands once their natal stand has been destroyed (Divoky and Horton 1995). The most important traits of a nesting tree appear to be the occurrence of suitable platforms, usually made of large branches or tree deformities, and sufficient moss or debris to place the egg (USFWS 1997). Table 1 gives characteristics for nest trees located through 1996. The preference for large trees, especially in California, and large branches is evident in this table.

Table 1.– The mean standard deviation, range and sample size for platform and tree characteristics of marbled murrelet tree nests located in the Pacific Northwest through 1996. Pacific Northwest data include nests located in British Columbia, Washington, Oregon, and California. ( ) = Sample Size.

Characteristics	California N=14	Oregon N=45	Washington N=6	British Columbia N=51	Pacific Northwest N=116
Tree Species					
Douglas-fir	4	32	3	2	41
Alaska yellow cedar	0	0	0	37	37
Western hemlock	1	11	3	5	20
Sitka spruce	0	1	0	6	7
Mountain hemlock	0	0	0	1	1
Coast redwood	9	0	0	0	9
Western red cedar	0	1	0	0	1
Tree diameter (cm)	308.7 ± 41.7 139.0-533.0 (14)	164.7 ± 7.8 76.0-279.0 (45)	149.5 ± 18.5 88.5-220.0 (6)	119.4 ± 8.2 60.0-370.0 (51)	161.4 ± 8.7 60.0-533.0 (116)
Tree height (m)	73.1 ± 2.8 48.8-86.5 (14)	61.5 ± 2.0 36.0-85.1 (45)	57.4 ± 3.7 45.1-65.0 (5)	33.2 ± 2.0 16.5-79.4 (51)	50.2 ± 1.9 16.5-86.5 (115)
Tree diameter at nest height (m)	103.2 ± 19.7 70.0-199.0 (6)	67.6 ± 4.0 29.3-122.0 (39)	78.4 ± 10.8 40.5-110.0 (6)	58.1 ± 4.7 25.5-209.0 (45)	66.1 ± 3.2 25.5-209.0 (96)
Branch height (m)	46.9 ± 3.1 31.7-67.5 (14)	41.9 ± 2.2 13.6-74.8 (44)	33.9 ± 5.5 20.1-52.9 (6)	22.7 ± 1.0 12.5-42.0 (51)	33.6 ± 1.4 12.5-74.8 (115)
Branch diameter at trunk (cm)	44.0 ± 4.6 21.0-61.0 (8)	24.6 ± 1.6 11.6-56.0 (42)	38.3 ± 5.7 13.5-50.5 (6)	29.0 ± 1.7 8.0-62.0 (50)	28.9 ± 1.2 8.0-62.0 (106)
Branch diameter at nest (cm)	24.5 ± 3.1 16.0-37.0 (6)	33.7 ± 3.9 10.0-63.0 (12)	29.4 ± 7.6 10.7-46.0 (4)	17.5 ± 2.5 15.0-20.0 (2)	29.4 ± 2.6 10.0-63.0 (24)
Branch diameter proximal to nest (cm)	X	25.0 ± 1.8 10.0-50.0 (31)	X	29.0 ± 1.5 15.0-62.0 (47)	27.7 ± 1.2 10.0-62.0 (79)
Branch length (m)	4.2 ± 1.1 0.9-15.0 (13)	4.9 ± 0.4 1.0-12.2 (42)	4.1 ± 1.2 1.1-7.5 (5)	3.9 ± 0.3 0.6-9.7 (51)	4.3 ± 0.2 0.6-15.0 (111)
Branch crown position (%)	64.3 ± 3.3 50.0-91.0 (14)	67.8 ± 2.6 26.0-98.0 (44)	63.4 ± 7.7 41.0-82.0 (5)	71.0 ± 1.8 40.0-95.0 (51)	68.6 ± 1.4 26.0-98.0 (114)
Branch Orientation (°)	30-360 (14)	20-360 (43)	110-342 (5)	0-360 (49)	0-360 (111)
Distance of nest from trunk (cm)	23.1 ± 10.5 0-122.0 (14)	100.2 ± 19.7 0-762.0 (44)	22.0 ± 12.1 0-57.0 (5)	46.5 ± 11.1 0-340.0 (50)	63.4 ± 9.6 0-762.0 (113)

(continued)

Table 1 (continued).

Characteristics	California N=14	Oregon N=45	Washington N=6	British Columbia N=51	Pacific Northwest N=116
Nest platform length (cm)	24.3 ± 3.7 9.5-41.9 (10)	55.4 ± 7.2 7.5-250.0 (44)	30.7 ± 7.0 10.0-57.0 (6)	52.3 ± 4.8 8.0-128.0 (44)	49.7 ± 3.8 7.5-250.0 (104)
Nest platform width (cm)	19.7 ± 4.0 6.5-50.8 (10)	26.8 ± 1.7 7.0-51.0 (44)	25.0 ± 4.7 10.0-39.0 (6)	19.1 ± 1.2 7.0-41.0 (44)	22.8 ± 1.0 6.5-51.0 (104)
Nest cup length (cm)	11.0 ± 1.2 8.3-16.5 (6)	11.0 ± 0.6 5.0-26.0 (43)	12.4 ± 2.3 5.9-20.0 (6)	9.9 ± 0.4 6.0-20.0 (49)	10.6 ± 0.4 5.0-26.0 (104)
Nest cup width (cm)	9.3 ± 1.1 6.5-14.0 (6)	10.0 ± 0.5 3.3-18.4 (43)	11.7 ± 2.5 3.1-20.0 (6)	8.7 ± 0.3 4.0-14.5 (49)	9.4 ± 0.3 3.1-20.0 (104)
Nest cup depth (cm)	3.5 ± 0.8 2.0-8.0 (7)	3.5 ± 0.3 0.5-7.1 (38)	2.6 ± 0.3 1.8-3.6 (6)	3.9 ± 0.2 1.0-6.0 (46)	3.6 ± 0.2 0.5-8.0 (97)
Number of landing pads	0.6 ± 0.2 0-1 (8)	1.2 ± 0.1 0-3 (43)	2.0 ± 0.6 1-3 (3)	0.6 ± 0.1 0-3 (51)	0.9 ± 0.1 0-3 (105)
Percent moss on platform	42.2 ± 14.7 0-100 (12)	89.5 ± 2.7 50-100 (31)	58.0 ± 19.8 5-100 (5)	88.9 ± 3.8 2-100 (37)	80.7 ± 3.5 0-100 (85)
Moss depth on platform	1.2 ± 0.7 0-8.1 (12)	4.7 ± 0.4 0-12.0 (43)	1.4 ± 0.7 0-3.5 (5)	4.9 ± 0.3 1.0-10.0 (48)	4.2 ± 0.2 0-12.0 (108)
Duff and litter depth on platform/nest cup (cm)	4.2 ± 1.7 0-20.0 (11)	3.0 ± 0.6 0-12.0 (30)	2.5 ± 0.4 1.6-3.8 (5)	4.9 ± 1.0 0.8-10.0 (8)	3.5 ± 0.5 0-20.0 (54)
Cover above nest (%)	87.1 ± 7.9 5.0-100 (13)	78.1 ± 3.3 5.0-100 (41)	89.2 ± 4.4 70.0-100 (6)	77.7 ± 2.2 30.0-100 (47)	79.6 ± 1.9 5.0-100 (107)
Distance to cover above nest (cm)	210.7 ± 64.7 1.3-444.4 (10)	71.8 ± 12.6 2.5-300.0 (40)	104.8 ± 64.1 19.0-360.0 (5)	96.0 ± 11.9 10.0-350.0 (45)	98.2 ± 10.7 1.3-444.4 (100)

Source : United States Fish and Wildlife Service. 1997. Recovery plan for the marbled murrelet (*Brachyramphus marmoratus marmoratus*) in Washington, Oregon, and California. Washington D.C. : U.S. Government Printing Office.

Throughout the Pacific Northwest 85 to 95 percent of old-growth forests have been removed, mainly due to timber removal and land conversion practices. The low elevation old-growth forests close to the coast, essential for marbled murrelet nesting, have been heavily cut throughout the bird's entire range, and the quality of habitat in remaining old-growth forests is severely degraded due to fragmentation and edge effects. Past and current forest management practices have resulted in a landscape heavily skewed toward young, even-aged stands. The earliest possible recovery of marbled murrelet nesting habitat, once lost, is estimated at 100-200 years, with the average being much longer (USFWS 1997).

Federal status. Due primarily to major loss of nesting habitat (old-growth forest) coupled with mortality from net fisheries and oil spills, the Washington, Oregon, and northern California (herein Pacific Northwest) population segment of the marbled murrelet (*Brachyramphus marmoratus*) was federally listed as "threatened" under the Endangered Species Act of 1973 (ESA) in September 1992 (USFWS 1992). Critical habitat, required for species listed under the ESA, was designated for the marbled murrelet May 24, 1996 (USFWS 1996). The recovery plan for the marbled murrelet was published in September 1997 and is based upon the best biological information available and required for all species listed under the ESA (USFWS 1997).

Information on historic distribution and numbers of marbled murrelets is limited, but it documents significant decrease in the range, distribution, and numbers of marbled murrelets. The dramatic decline, continuing at a rate of 4 to 7 percent per year (due primarily to loss of nesting habitat), should continue until approximately 2040, when

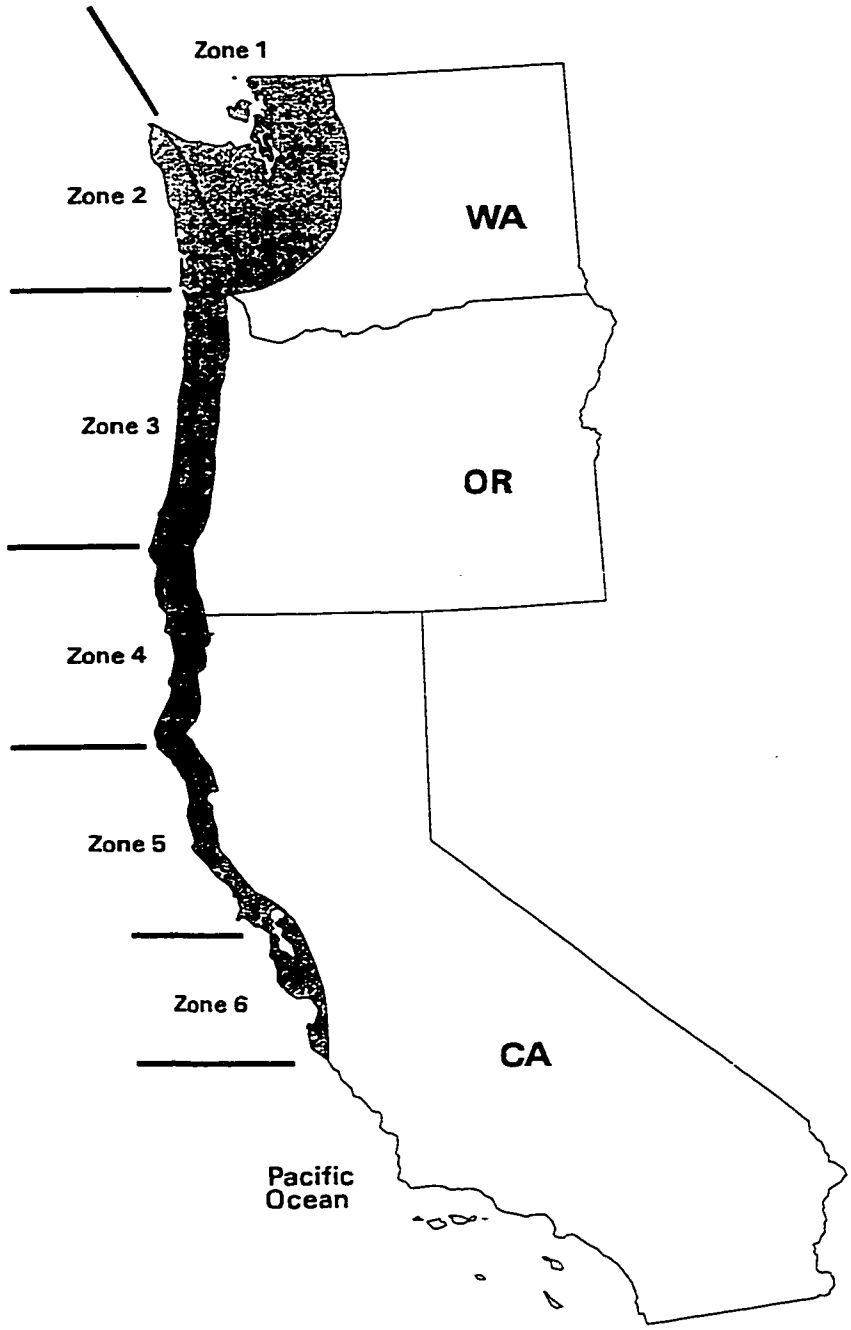
existing younger forests mature enough to become suitable for nesting (USFWS 1997). Limiting factors such as life-history strategy, a low reproductive rate, and low current breeding success and recruitment are predicted to facilitate this continued decline; a decline that creates a population that can not easily recover, especially if the species is impacted by catastrophic events such as oil spills and weather conditions.

The species has been given the recovery priority of 3 by USFWS on a scale ranging from a high of 1 to a low of 18, indicating a high degree of threat and high recovery potential. USFWS designated six Marbled Murrelet Conservation Zones to manage the species' recovery (Figure 7). Primarily due to absence of nesting habitat (old-growth forests and mature forests with sufficient old-growth components), USFWS has determined that the next 50 years is the most critical time for the marbled murrelet. Due to this critical time, USFWS has determined that short-term trade-offs, especially the loss of any occupied sites or unsurveyed suitable habitat, should be avoided (or impacts significant reduced) and weighed very carefully. USFWS was unable to project a date of recovery (delisting under the ESA) for the marbled murrelet in the species' recovery plan (USFWS 1997).

Interim delisting criteria for the marbled murrelet mandate that:

1) Trends in estimated population size have been stable or increasing in four of the six zones over a 10-year period (a period encompassing at least two El nino events and based upon recent frequency of occurrences); and

Figure 7.-- Marbled Murrelet Conservation Zones.



Source : United States Fish and Wildlife Service. 1997. Recovery plan for the marbled murrelet (*Brachyramphus marmoratus marmoratus*) in Washington, Oregon, and California. Washington D.C. : U.S. Government Printing Office.

2) Management commitments (terrestrial and marine) and monitoring have been implemented that provide for adequate protection of marbled murrelets in the six conservation zones for at least the near future (USFWS 1997).

More specific delisting criteria will be provided once the following is completed in each zone:

1) Marbled murrelet population size, population trends, and other demographic goals are adequate to ensure sustainable populations throughout its range;
2) The necessary quantity, quality, and distribution of marbled murrelet nesting habitat to sustain appropriate demographic goals are projected to be met in the near future (50 years). To determine the amount of habitat required to stabilize the population, information on the amount and quality of forest habitat required to support a specific number of marbled murrelets in each Conservation Zone is needed along with the current trend of population size, density, and productivity; and
3) The quantity, quality, and distribution of marine habitats and prey populations are sufficient to sustain marbled murrelet demographic goals, and that these requirements are projected to be met in the near future (next 50 years) at a minimum.

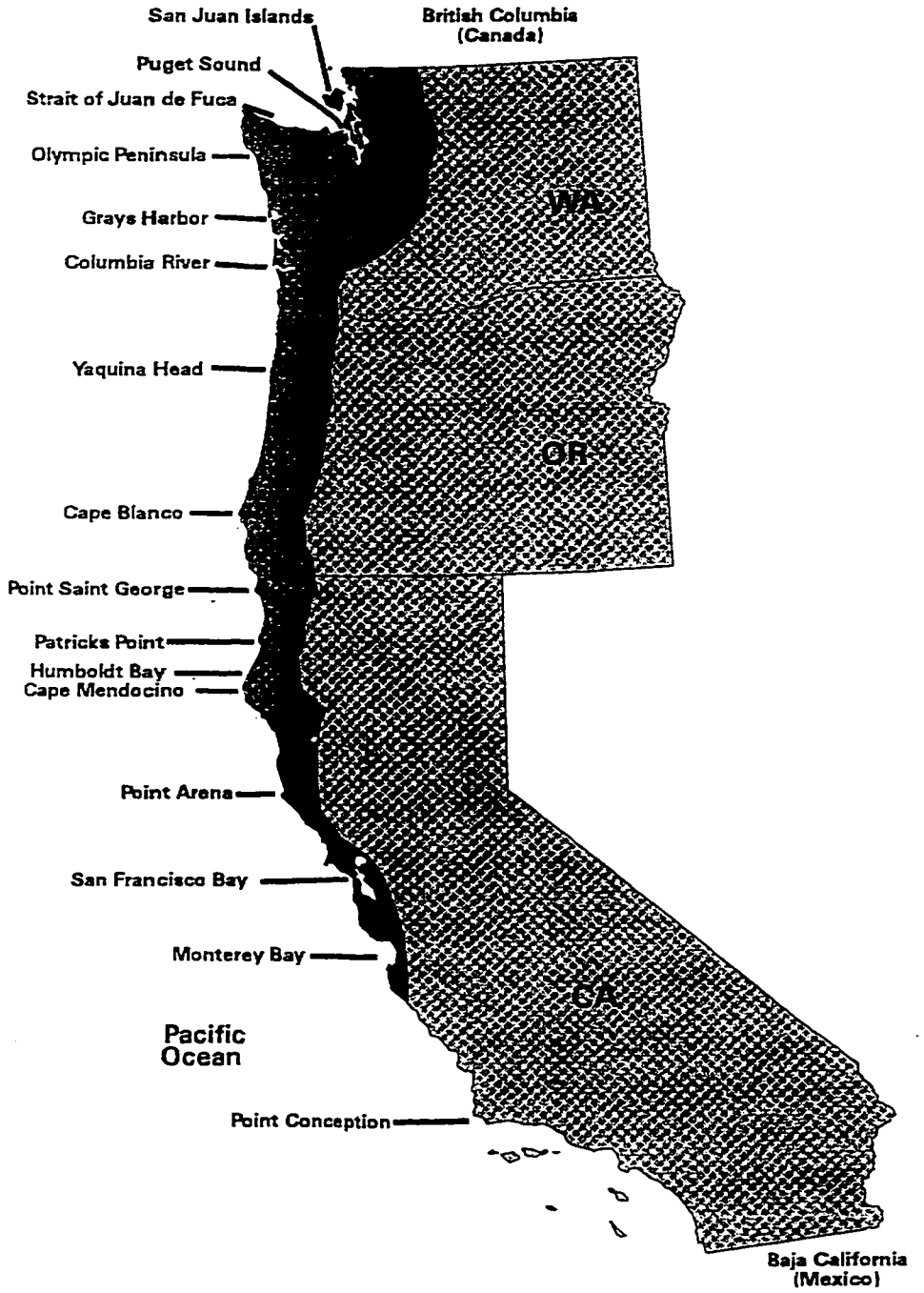
To achieve these goals, detailed studies of the survivorship and productivity of marbled murrelets must be completed (USFWS 1997). These criteria are considered realistic and adequate to maintain the species over the short (50 years) and long (more than 200 years) term by the federal regulatory agencies (USFWS 1997).

Loss of marbled murrelet habitat in the Pacific Northwest. The loss of old-growth forest and mature forest with old-growth characteristics is considered the greatest contribution to the threatened status of the marbled murrelet. In Washington, Oregon, and northern California (Pacific Northwest) the actual and potential habitat for the species was greatly reduced in the past 100 years through extensive logging. The earliest logging was concentrated in marbled murrelet habitat; low elevations near marine waters (Figure 8). The majority of suitable habitat on private lands has been eliminated (Thomas *et al.* 1990). In most cases, mature and older second-growth forests are logged before they attain the essential characteristics of marbled murrelet habitat. Unless a major shift in forest management occurs, the loss of suitable marbled murrelet habitat is permanent.

A mid-1930's comprehensive survey of forests indicated 1,314,700 hectares of old-growth Douglas-fir, Sitka spruce, and western hemlock in Washington State. During the 1940's and 1950's, the elimination of old-growth in Washington continued at a high rate. Two billion board feet, two-thirds of which was old-growth, were eliminated from private lands between the mid-1930's survey and 1958. By 1970, timber removal from private lands in Washington had reached 3.8 billion board feet annually, an estimated 80 percent of which was old-growth. Logging on public land in the state, most or all of which was old-growth, had reached 2 billion board feet annually by 1970 (USFWS 1997).

Prior to logging in Oregon, it is estimated that 800,000 to 1,200,000 hectares of forest suitable for the marbled murrelet existed. Currently, federal lands contain virtually

Figure 8.-- Estimated historical breeding/nesting range of the marbled murrelet in Washington, Oregon, and California (shown by darkly shaded area). Areas of special significance to the species are demarcated.



Source : United States Fish and Wildlife Service. 1997. Recovery plan for the marbled murrelet (*Brachyramphus marmoratus marmoratus*) in Washington, Oregon, and California. Washington D.C. : U.S. Government Printing Office.

all the remaining actual and potential habitat in the State, less than 200,000 hectares (USFWS 1997).

In contrast to Washington and Oregon, a large proportion of suitable habitat for the marbled murrelet in the state of California originally existed on private lands. In the early 1900's many coastal areas had already been depleted of old-growth forest. The rate and extent of logging throughout the 1900's, especially in Sonoma and Mendocino counties, led to the current isolation of the central California murrelet population from the population in the northern part of the State. Currently, marbled murrelets are known to occur in California primarily in old-growth redwood (coast redwood, *Sequoia sempervirens*) forests. Only a few observations and no nests have been located in Douglas-fir dominated forests. Old-growth redwood forests in the State have been eliminated to the extent that less than 4 percent of the original 770,000 hectares remain, most of which is preserved in State and Federal parks (Cooperrider *et al.* 2000, USFWS 1997).

Washington population. Marbled murrelets were once abundant in the Puget Sound, but today only about 5,000 breeding birds are found locally in the State during certain times of the year (Speich *et al.* 1992). The marbled murrelet was listed as threatened by the state of Washington in the fall of 1993.

During breeding season Puget Sound and the northern outer coast are heavily used, whereas the southern outer coast is believed to be important in winter (Varoujean and Williams 1995). Puget Sound is also believed to be used by wintering marbled murrelets from British Columbia (Speich *et al.* 1992).

The Washington Department of Natural Resources (WADNR) is the lead State agency regulating timber removal from private and WADNR (state-owned) lands. The WADNR is advised on proposed harvests within known marbled murrelet habitat by the Washington Department of Fish and Wildlife (WADFW). A Science Advisory Group (SAG) was created by the Forest Practices Board to review WADFW recommendations and answer any questions regarding marbled murrelet protection in the state. Based on a SAG report that addressed suitable marbled murrelet habitat, stand size, and protection of known occupied sites, the Forest Practices Board adopted a permanent rule for protecting marbled murrelets. This rule established (1) marbled murrelet detection areas where surveys are required, (2) shared survey responsibilities, (3) revision of platform criteria and definitions, (4) survey protocols, (5) disturbance avoidance criteria, and (6) small landowner exemptions (WADNR 1997, USFWS 1997).

Oregon population. The marbled murrelet population on the Oregon coast and inland (during breeding season) was once healthy and abundant (Gabrielson and Jewett 1940, Nelson *et al.* 1992). Estimates of the current number of individuals in the state range from 2,000 to 20,000. These estimates may be inaccurately high as they are based upon extrapolation (USFWS 1997). The marbled murrelet was listed as threatened by the state of Oregon on May 24, 1995.

Although no formal Oregon regulations protect marbled murrelets, the Oregon Department of Forestry (ODF), in consultation with the Oregon Department of Fish and Wildlife (ODFW) and the USFWS, has developed a Management Plan for the species on Oregon State Forests to (1) avoid Take of the species and (2) provide flexibility in future

forest management planning and Habitat Conservation Plan development (USFWS 1997).

California population. Marbled murrelets were once numerous and plentiful along the California coast from the Oregon border to Monterey County, with sporadic sightings south to Santa Barbara County (Grinnell and Miller 1944). At least 60,000 marbled murrelets likely inhabited the State (Larsen 1991). As of 1995, the highest current population estimate was 6,000 (Ralph and Miller 1995, USFWS 1997).

The three separate areas where murrelets are currently found in significant number correspond with the three largest remaining blocks of old-growth coastal conifer forests: (1) Humboldt, and (2) Del Norte counties in the north, and (3) San Mateo/Santa Cruz county in central (Cooperrider *et al.* 2000, USFWS 1997). The southernmost breeding area, San Mateo/Santa Cruz County, is 480 kilometers (300 miles) from the Humboldt population. Due to this isolation and its small size, the San Mateo/Santa Cruz County population is considered to be especially vulnerable (USFWS 1997).

Northern California contains large blocks of suitable habitat considered critical to the recovery of the entire Pacific Northwest population. The amount of nesting habitat provided by parks in this region, although large in comparison to other areas, is considered insufficient to ensure the long-term survival of marbled murrelets in the region. Private lands in southern Humboldt County are considered essential for the recovery of the Pacific Northwest population (USFWS 1997).

The marbled murrelet was listed as endangered under the California Endangered Species Act (CESA), requiring the state to conserve, protect, restore, and enhance such

listed species and their habitat. To meet this requirement the state is authorized by CESA to use all methods and procedures to make the CESA listing of the species unnecessary (USFWS 1997).

The marbled murrelet is classified as a sensitive species by the California Board of Forestry. California Forest Practice rules require surveys for marbled murrelets and consultation with the California Department of Fish and Game (CDFG) before timber operations. The CDFG recommends annual training for marbled murrelet surveyors and an evaluation procedure must be passed prior to conducting surveys. Survey station layout and survey results are reviewed by CDFG personnel prior to submission of Timber Harvest Plans (THPs) submitted for private and state forest lands. The CDFG reviews the assessments of marbled murrelet presence in THPs. Pre-operation inspections are also performed by CDFG to determine whether or not proposed sites contain marbled murrelets (USFWS 1997).

Recovery of the marbled murrelet. Short-term actions identified by the U. S. Fish and Wildlife Service (USFWS) as critical to the recovery of the marbled murrelet include:

1) Maintaining occupied habitat;
2) Maintaining large blocks of suitable habitat;
3) Maintaining and enhancing buffer habitat; and
4) Decreasing risk of loss of nesting habitat due to fire and windthrow (USFWS 1997).

Long-term actions identified by the USFWS as being necessary for the marbled murrelet to recover include:

1) Increasing the amount of suitable nesting habitat;
2) Increasing the quality of suitable nesting habitat;
3) Increasing the distribution of suitable nesting habitat;
4) Increasing stand size of suitable habitat to provide more interior forest conditions; and
5) Increasing the number of stands of suitable nesting habitat (USFWS 1997).

In May 1996, USFWS designated 32 critical habitat units (CHUs) for the Pacific Northwest population of the marbled murrelet (Table 2, Figures 9-11, Figure 15). These lands in Washington, Oregon, and California, encompassing approximately 1,573,340 hectares of federal and non-federal lands, are considered essential to the conservation and recovery of the species. This designation accounted for 86 percent of the known occupied sites on Federal lands. The major foundation of this designation was the Late-Successional Reserves of the Northwest Forest Plan created in January, 1992 for the Northern Spotted Owl (*Strix occidentalis caurina*). The Northwest Forest Plan does not preclude cutting of older forests or other project activities from occurring within areas designated as critical habitat (Thomas *et al.* 1990, USFWS 1997).

Designation of CHUs serves to focus conservation activities by identifying areas that contain habitat qualities essential to the species survival that may require special management consideration. The Endangered Species Act (ESA) does not provide any

Table 2.– Designated marbled murrelet Critical Habitat by State, Ownership, and Land Allocation (1 Hectare = 2.471 Acres).

WASHINGTON	Hectares	Acres
Federal Lands		
Congressionally Withdrawn Lands	740	1,800
Late-Successional Reserves	485,680	1,200,200
Non-Federal Lands		
State Lands	172,720	426,800
Private Lands	1,020	2,500

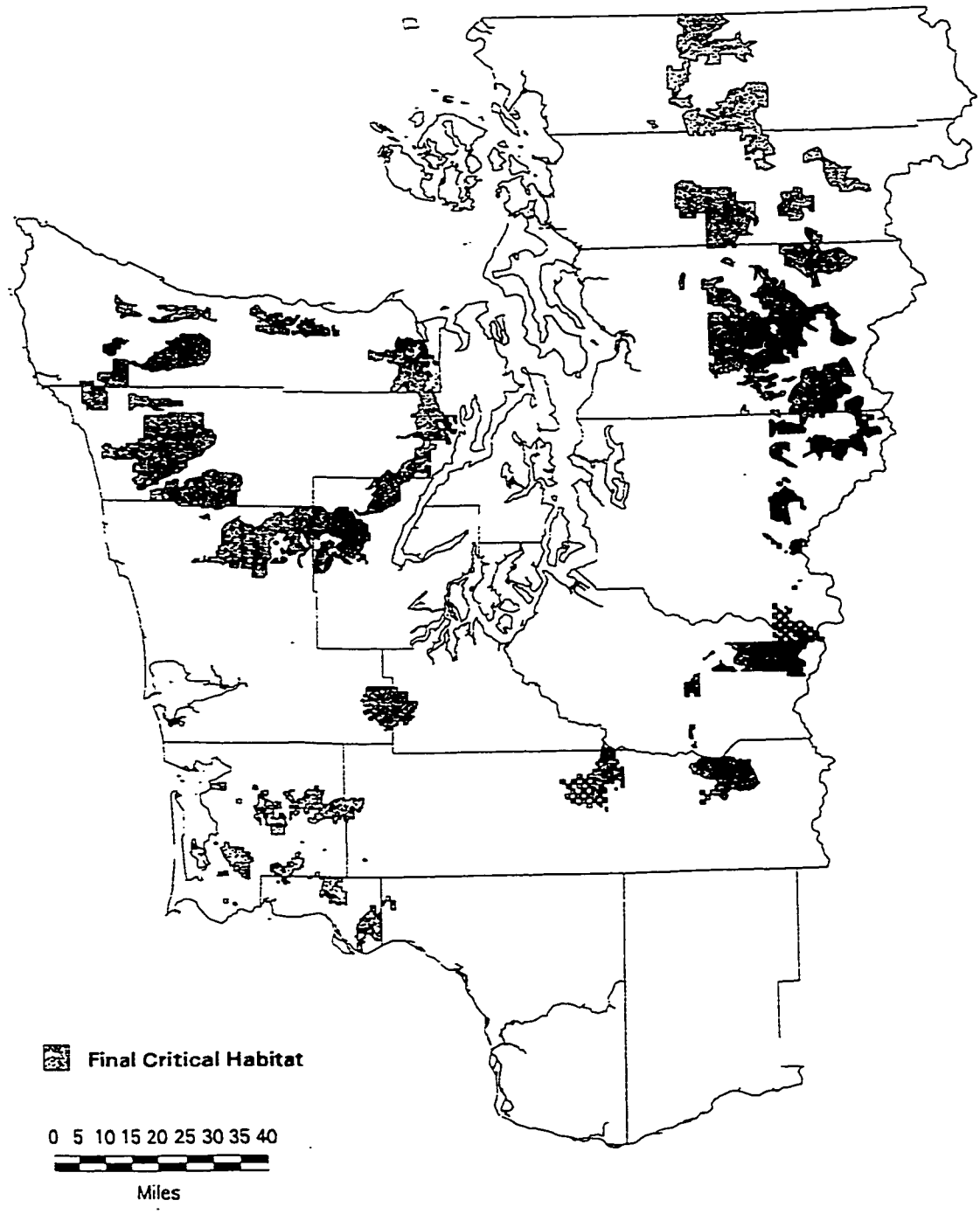
OREGON	Hectares	Acres
Federal Lands		
Late-Successional Reserves	541,530	1,338,200
Non-Federal Lands		
State Lands	70,880	175,100
County Lands	440	1,100
Private Lands	350	900

CALIFORNIA (Northern)	Hectares	Acres
Federal Lands		
Late-Successional Reserves	193,150	477,300
Non-Federal Lands		
State Lands	71,040	175,500
Private Lands	16,360	40,400

CALIFORNIA (Central)	Hectares	Acres
Non-Federal Lands		
State Lands	14,080	34,800
County Lands	3,230	8,000
City Lands	400	1,000
Private Lands	1,720	4,200

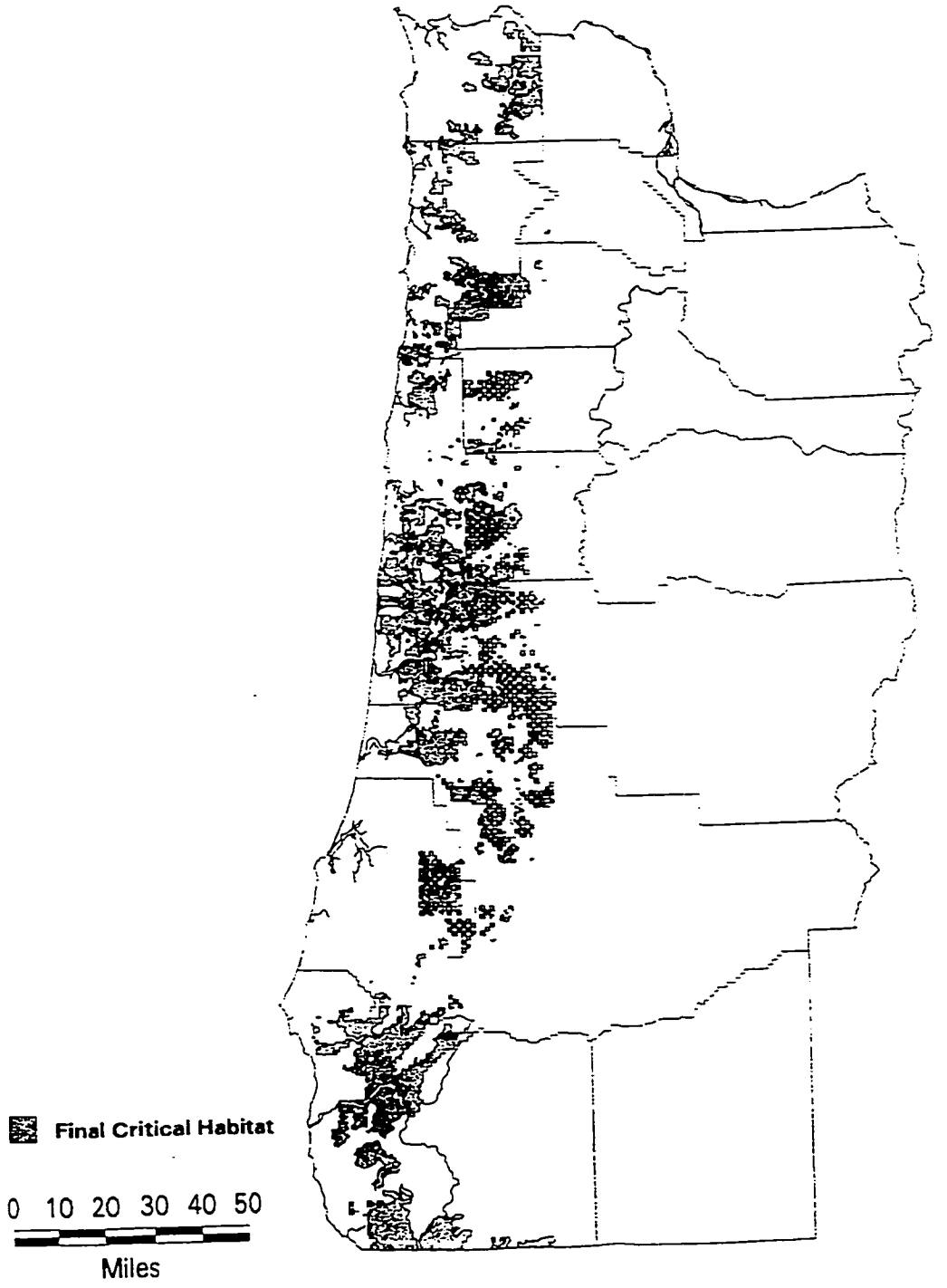
Source : United States Fish and Wildlife Service. 1997. Recovery plan for the marbled murrelet (*Brachyramphus marmoratus marmoratus*) in Washington, Oregon, and California. Washington D.C. : U.S. Government Printing Office.

Figure 9.– Map of marbled murrelet Critical Habitat Units in Washington.



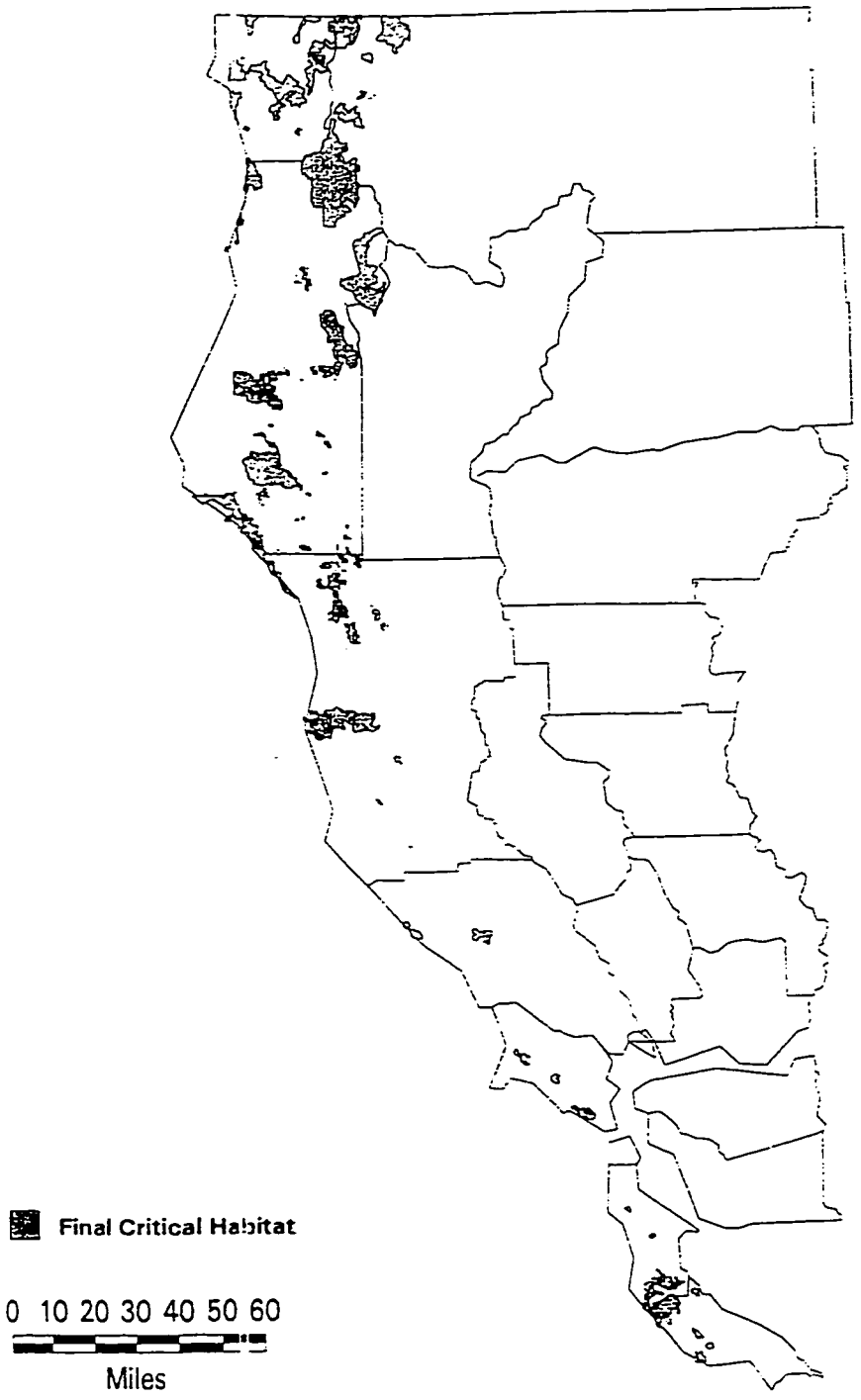
Source : United States Fish and Wildlife Service. 1997. Recovery plan for the marbled murrelet (*Brachyramphus marmoratus marmoratus*) in Washington, Oregon, and California. Washington D.C. : U.S. Government Printing Office.

Figure 10.-- Map of Critical Habitat Units in Oregon.



Source : United States Fish and Wildlife Service. 1997. Recovery plan for the marbled murrelet (*Brachyramphus marmoratus marmoratus*) in Washington, Oregon, and California. Washington D.C. : U.S. Government Printing Office.

Figure 11.-- Map of Critical Habitat Units in California.



Source : United States Fish and Wildlife Service. 1997. Recovery plan for the marbled murrelet (*Brachyramphus marmoratus marmoratus*) in Washington, Oregon, and California. Washington D.C. : U.S. Government Printing Office.

protection to lands designated as critical habitat other than requiring consultation on federal actions affecting the area. The majority (78 percent) of marbled murrelet CHUs are located on federal lands. Any privately-owned lands that are within critical habitat designation and are covered by a legally-operative Habitat Conservation Plan and associated incidental take permit for marbled murrelets are excluded from critical habitat designation while the permit remains active (USFWS 1997).

Critical habitat was not designated for the marbled murrelet in the marine environment. This was due to the fact that several existing laws such as the Oil Pollution Act of 1990, the Clean Water Act, the Coastal Zone Management Act, the Marine Protection, Research and Sanctuaries Act, and the Outer Continental Shelf Act provide varying degrees of protection to the murrelet and no additional management considerations or protections were deemed necessary (USFWS 1997).

The development of HCPs under the ESA that contribute to the conservation of the marbled murrelet is considered by the USFWS to be necessary for the species to survive. The USFWS believes that adequately designed and implemented HCPs will be the most effective and acceptable means of protecting occupied sites on private and state lands. The recovery plan for the marbled murrelet calls for the development and implementation of HCPs that incorporate the needs of the marbled murrelet for protected areas on non-Federal lands (USFWS 1997).

Monitoring. Due to the small body size, plumage, secretive behavior, and high flight-speed of the marbled murrelet, the species' nests have been difficult to locate; the first was discovered in 1974. Since that time, even with increasing knowledge of habits

and improved technology, only approximately 170 nests have been located (Hamer and Nelson 1995; Cooperrider *et al.* 2000). The variability present in current population estimates for the marbled murrelet underscores the need for development of consistent, reliable survey methods.

Detections of marbled murrelets at inland sites can occur during most months of the year. The species demonstrates a distinctive flight behavior near nest trees and in nest stands. Subcanopy behaviors associated with nesting includes single or paired birds flying into, through, and out of the canopy and landing in trees. Researchers have also observed single birds and flocks circling above the forest canopy of nesting sites (Ralph *et al.* 1994). Detections are higher during breeding season, reaching a peak level of activity in midsummer, and most often at dawn and dusk. It is hypothesized that the birds also visit nesting areas in non-breeding season (winter) to attend previous nest sites, prospect for future nesting sites, and maintain or form pair bonds (USFWS 1997).

USFWS and other agencies involved in monitoring tend to rely on the Pacific Seabird Group's marbled murrelet survey protocol to determine if potential habitat is likely to be occupied by nesting marbled murrelets. USFWS recommends surveys be carried out according to this protocol on all projects that may adversely affect suitable habitat prior to implementation. This is considered the best available method, though it is not error-free (USFWS 1997).

Many of the forest characteristics described above (under Habitat and elsewhere) predict occupancy by marbled murrelets. Characteristic-based models for estimation of

forest occupancy have been developed in Oregon by Hamer and Meekins (1996) and in Washington by Hamer and Cummins (1991).

Estimating take. A take of marbled murrelets in the terrestrial environment is likely due to activities that:

1) Kill or injure the bird; or
2) Impair essential behaviors by adversely affecting occupied or unsurveyed suitable habitat; or
3) Significantly disturb breeding birds, leading to reduced reproductive success (USFWS 1997).

Based on current knowledge of marbled murrelet habitat, a take is most likely to occur in low elevation mature forests within 80 kilometers of a marine environment characterized by large trees, a multistoried stand, and moderate to high canopy closure with 35 percent or more old-growth (Raphael *et al.* 1995, USFWS 1997). The presence of marbled murrelets peaking during nesting season, late March to late September, makes these months particularly susceptible to an actual bird/nest take. The likelihood of take occurring decreases as percentage of old-growth in a forest decreases and distance from a marine environment becomes greater than 80 kilometers; take may still occur in these areas and out of nesting season, however, as:

1) Nests have been discovered in forests with less than 35 percent old-growth (Raphael *et al.* 1995),
2) Nests have been discovered in residual old-growth stands next to large old-growth stands (USFWS 1997),

3) Nest have been detected further than 80 kilometers from a marine environment (Ralph *et al.* 1994),

4) Marbled murrelets have been detected inland in all months of the year (Carter and Erikson 1988), and

5) Habitat disturbance is independent of nesting season (USFWS 1997).

Any activity that creates large amounts of noise or visual disruption can result in a take under the ESA clause of "harm" and "harass." Loud sounds such as chainsaws and heavy equipment, within one-quarter mile, one mile for explosives, of occupied or unsurveyed suitable habitat would likely disturb nesting and/or breeding, a take under the ESA (see p.51 #3).

A take under the ESA may be as quantifiable as mortality due to an oil spill and fish net drowning or as difficult to observe and quantify as a failed breeding attempt due to chainsaws and heavy equipment. The estimation of take due to loss and fragmentation of occupied and suitable habitat, considered two of the highest risks to marbled murrelets, is relatively difficult to calculate, although this can be measured in hectares and even trees. The difficulty of quantifying various takes of the marbled murrelet is exacerbated due to:

1) The fact that the adverse impact is often removed from time and place of occurrence (egg or chick mortality, loss of breeding opportunity, etc.), and

2) The secretive nature of the species (nests difficult to locate, etc.).

Impact of take on species. The negative effects of take due to loss and fragmentation of occupied and suitable habitat can last centuries depending on the extent

and location of the disturbance. The exhibition of nest fidelity coupled with poor dispersal to new nest stands makes the removal of nesting habitat and nest trees especially detrimental to the species. The increase in forest "edges" (the boundary or transition zone between interior forest conditions and other forest conditions) produced by fragmentation and tree removal contributes to the problem of high nest failure due to the associated increase in predation; half of the nest failures documented by an Oregon study (failure was 70 percent) were due to predation (Oregon Department of Forestry 1995). Fragmentation on a larger scale poses the risk of isolation of small sub-populations of murrelets, increasing their susceptibility to extirpation through a variety of mechanisms (inbreeding depression, demographic fluctuations, catastrophes, etc.). These facts, combined with research finding recruitment of juvenile marbled murrelets into the adult breeding population to be dangerously low has made the maintenance of known and potential nesting habitat a primary goal of the USFWS marbled murrelet recovery plan (USFWS 1997).

The effect of take involving bird mortality can be put into relationship with population estimates. A quantification is more difficult with less tangible takes (habitat loss, increased predation, failed breeding, etc.). Loss of suitable habitat can be put in relation to total remaining habitat, protected and unprotected, to derive an estimate in number of species taken.

Minimization and mitigation of take. Because the next 50 years are considered the most critical for the marbled murrelet, immediate conservation efforts that increase adult survival chances and minimize and mitigate the loss of actual and potential nesting

habitat are extremely important (USFWS 1997). Knowledge of areas with a high chance of marbled murrelet nesting (see Habitat and Estimating Take above) is essential to properly minimize and mitigate take.

Mitigation measures that are often undertaken by forest HCPs are:

1) Preservation via acquisition or conservation easement of existing habitat;

2) Enhancement or restoration of degraded or former habitat;

3) Creation of new habitat;

4) Establishment of buffer areas around existing habitat (avoidance); and

5) Habitat management plans (Oregon Department of Forestry 1995).

If marbled murrelet habitat needs are not factored into timber removal strategies for areas containing suitable habitat for the species, the elimination of the habitat, a take under the ESA, will occur in most cases. Timber removal practices that retain marbled murrelet habitat characteristics (e.g. stand size, canopy closure and horizontal structure) may minimize impacts on nesting birds (USFWS 1997).

Disturbing activities leading to take of marbled murrelets (i.e. loud noises and visual disruption) may be minimized by seasonal restrictions and daily-timing within one quarter-mile of occupied or unsurveyed suitable habitat. Marbled murrelets tend to their nests most often at dawn and dusk, although diurnal adult nest visitations are believed to increase as chicks develop (USFWS 1997).

Study Design

Table 3.--Case Study Framework of Analysis

HCP	Ownership	Area of Plan (hectares)	# of Species Addressed	ESA Species	ITP (years)	NCEAS Study
WADNR	Public	647,528	99	9	100	Yes
Plum Creek	Private	68,465	285	4	100	Yes
Elliott S.F.	Public	37,865	2	3	6	No
Pacific Lumber	Private	85,673	17	6	50	No

To investigate the study hypotheses, careful analysis was carried out to examine the adequacy of science used for the marbled murrelet in four extant Habitat Conservation Plans. The analysis of the four case studies was designed to evaluate the extent to which scientific data and methods are used in the plans and to describe the availability of these tools and data.

The four case studies all contain habitat for the federally threatened marbled murrelet, namely old-growth coniferous trees, and were chosen for their richness in making the applicable comparisons. The 1999 Pacific Lumber Company (Pacific Lumber) and 1996 Plum Creek Timber Company (Plum Creek) HCPs apply to privately-owned forestland, whereas the 1995 Elliott State Forest and 1997 Washington

Department of Natural Resources (WADNR) HCPs cover public forestland. The physical area covered by these HCPs range from Elliott State Forest at 37,865 hectares, Plum Creek at 68,465 hectares, Pacific Lumber at 85,673 hectares, to WADNR at 647,528 hectares. The number of species specifically addressed with biological information in the HCP (in order to be covered by the associated Incidental Take Permit) ranges from only 2 for the Elliot State Forest to an unprecedented 285 in the Plum Creek plan; Pacific Lumber and WADNR are intermediate with 17 and 99, respectively. The number of species listed under the ESA known to exist in the HCP area ranges from three in the Elliot State Forest, Plum Creek land contains four, Pacific Lumber has six, to WADNR land with nine (United States Fish and Wildlife Service and California Department of Forestry and Fire Protection 1999; Plum Creek Timber Company 1996; Oregon Department of Forestry 1995; Washington State Department of Natural Resources 1997). Although the design does not statistically test hypotheses, the existing cross-section of plans in each area of analysis helps to reinforce or undermine hypotheses derived from the literature. While the insights provided by the analysis of these hypotheses are not conclusive to the entire HCP process, much less the ESA, they provide a degree of insight into both.

In addition, this study independently evaluates two HCPs (Washington Department of Natural Resources and Plum Creek Timber Company) previously analyzed by Kareiva *et al.* (1999) using the same methods. This independent evaluation helps control the research (one researcher evaluating all five areas of all four case-studies

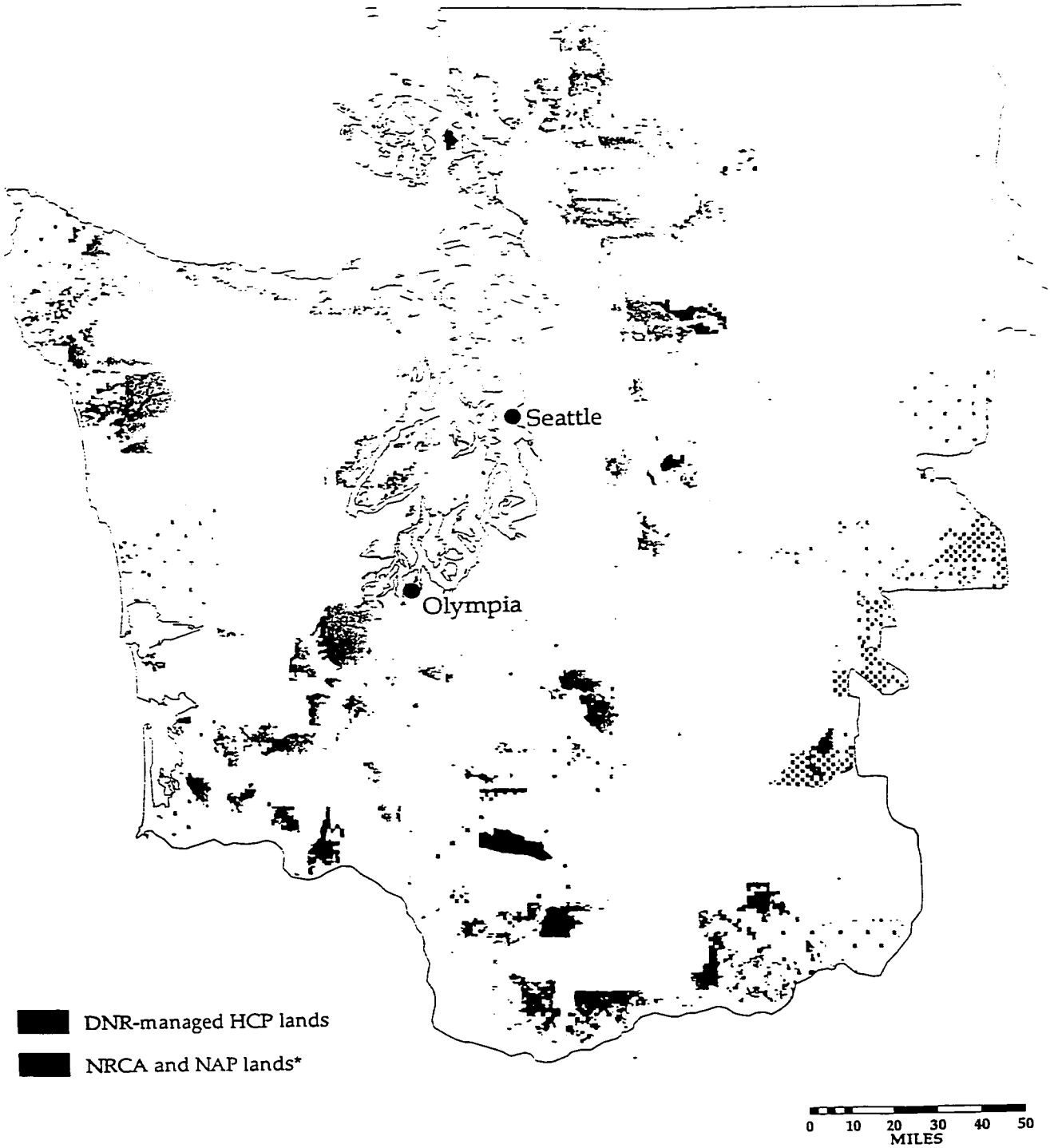
creates results that are sound for comparison as individual variability is nonexistent) and also led to insight into the Kareiva *et al.* (1999) study.

Case studies

I. Washington Department of Natural Resources 1997 Habitat Conservation Plan. The Washington Department of Natural Resources (WADNR) manages 1,214,083 hectares of state-owned lands, of which approximately 849,858 hectares is forested. They manage these lands in trust for common schools, state universities, other public institutions, and county services (WADNR 1997).

The WADNR Habitat Conservation Plan (HCP) covers approximately 647,511 hectares of state-owned forestland in western Washington State. The lands covered range from scattered isolated parcels under 17 hectares to a large contiguous block measuring more than 44,500 hectares (Figure 12), and are managed for maximum timber output. This habitat-based plan addresses 99 species, of which 9 were listed as endangered or threatened under the ESA when the plan was approved (Table 4). In January 1997 the Incidental Take Permit (ITP) was issued for the HCP by the USFWS and the National Marine Fisheries Service (NMFS) for the effects of logging. The ITP covers all species found on HCP lands currently listed under the ESA and all species included in the plan that become listed under the Act during the entire time span of the plan (a "No Surprises" clause). The ITP was issued for the 70 years, after which WADNR can renew the permit 3 times for 10 years each, for a total of 100 years (WADNR 1997).

Figure 12.--Washington State Department of Natural Resources lands covered by 1997 Habitat Conservation Plan



Source : Washington State Department of Natural Resources. 1997. Final habitat conservation plan. Olympia, Washington : Washington State Department of Natural Resources.

Table 4.--WADNR 1997 HCP Species Listed Under the ESA

Species	Federal Status under ESA
Gray Wolf (*Canis Lupus*)	Endangered
Columbian White-tailed Deer (*Odocoileus virginianus leucurus*)	Endangered
Peregrine Falcon (*Falco peregrinus*)	Endangered
Aleutian Canada Goose (*Branta canadensis leucopareia*)	Threatened
Bald Eagle (*Haliaeeutus leucocephalus*)	Threatened
Grizzly Bear (*Ursus arctos*)	Threatened
Marbled Murrelet (*Brachyramphus marmoratus*)	Threatened
Northern Spotted Owl (*Strix occidentalis caurina*)	Threatened
Oregon Silverspot Butterfly (*Speyeria zerene hippolyta*)	Threatened

II. Plum Creek Timber Company Cascades Multi-Species 1996 Habitat Conservation Plan. The Plum Creek Timber Company (Plum Creek) HCP covers 68,465 hectares of forestland on both sides of Interstate-90 in Washington State. Due to the fact that Plum Creek HCP land is intermingled in a checkerboard pattern with approximately 100,977 hectares of lands managed by the U.S. Forest Service and other private

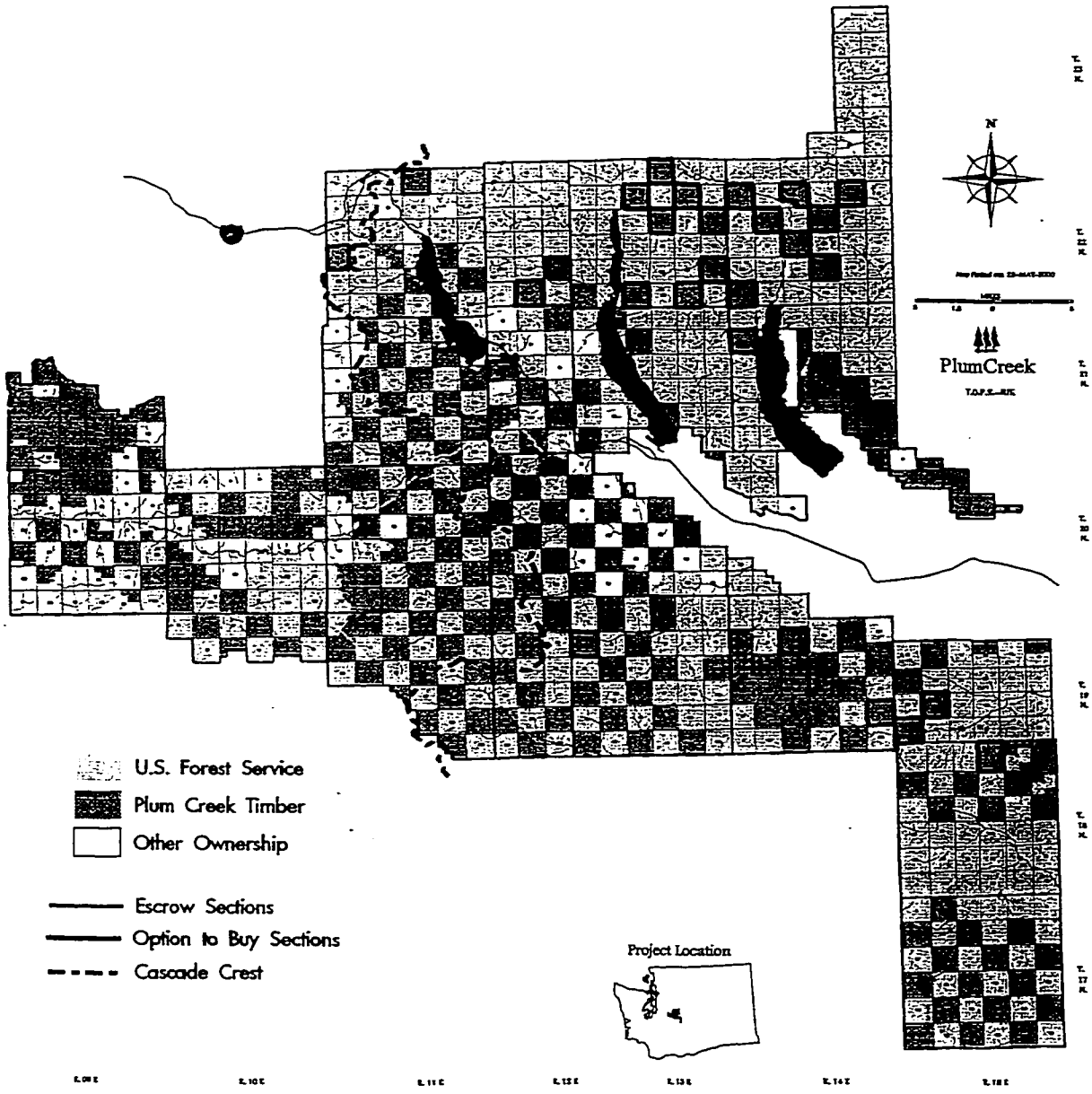
landowners, the area used for planning purposes actually extends to approximately 169,442 hectares (Figure 13). The relatively complicated plan includes 13 Technical Reports (#2 of which is "Marbled Murrelet Surveys and Occurrence in the HCP Area") and took two years to prepare at a cost of approximately $2 million. The plan is habitat-based and covers 285 vertebrate species of fish and wildlife, including 4 species listed under the ESA (Table 5). The ITP for the HCP was issued in June 1996 and contains a "No Surprises" clause for all species that might become listed in the 100 year duration (two 50-year phases) of the plan (Plum Creek Timber Company 1996).

Table 5.--Plum Creek 1996 HCP Species Listed Under the ESA

Species	Federal Status under ESA
Gray Wolf (*Canis Lupus*)	Endangered
Grizzly Bear (*Ursus arctos*)	Threatened
Marbled Murrelet (*Brachyramphus marmoratus*)	Threatened
Northern Spotted Owl (*Strix occidentalis caurina*)	Threatened

III. Elliott State Forest 1995 Habitat Conservation Plan. Elliott State Forest, managed by the Oregon Department of Forestry (ODF), contains some of the only habitat suitable for the marbled murrelet found on non-federal land in the State of Oregon (USFWS 1997). Over 90 percent of Elliott State Forest is Common School

Figure 13.--Plum Creek Timber Company lands covered by 1996 Habitat Conservation Plan



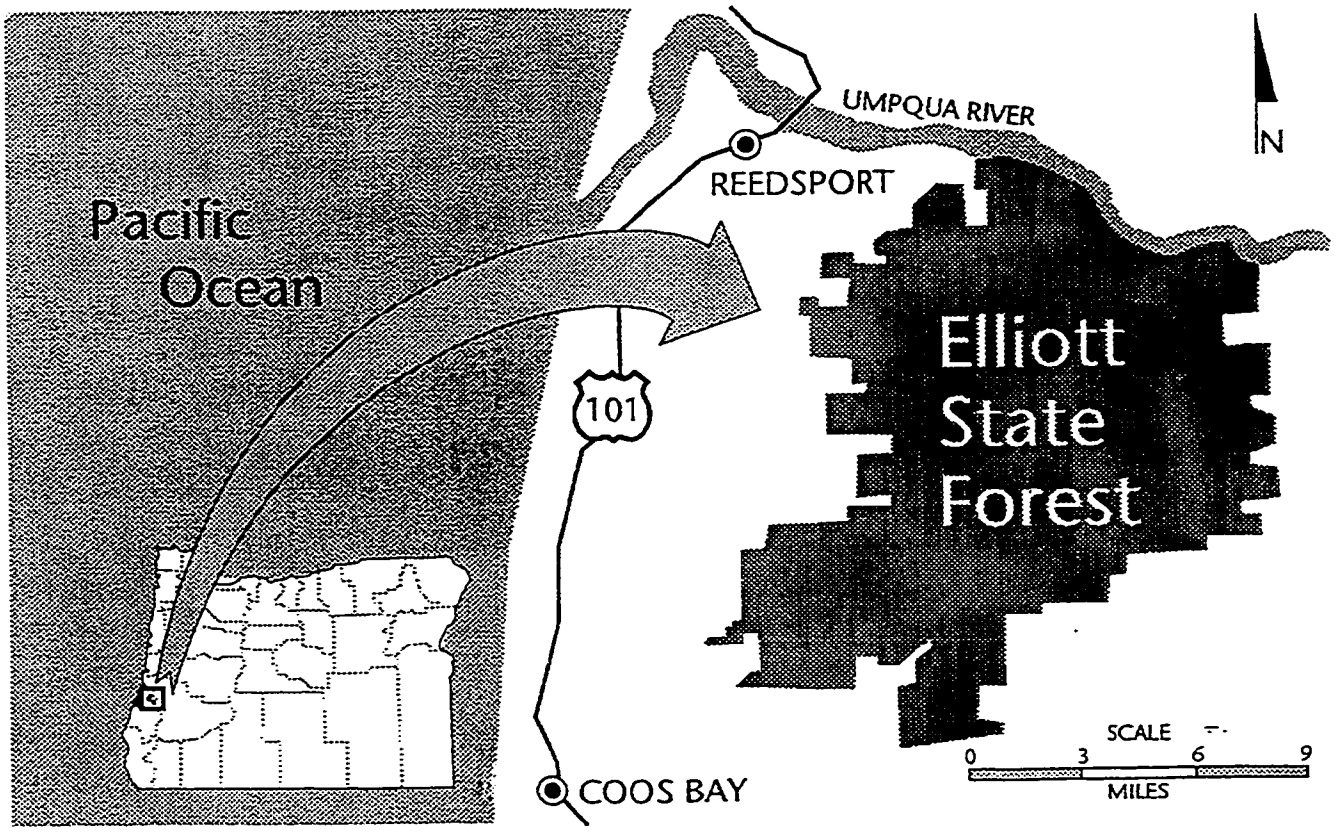
Source : Plum Creek Timber Company. 1996. Cascades multi-species habitat conservation plan. Seattle, Washington: Plum Creek Timber Company, L.P.

Forest Land which is managed for the maximization of long-term revenues for the Common School Fund. The remaining land is Board of Forestry land which is managed to provide income for counties and local taxing districts.

The Elliott State Forest HCP, approved by the USFWS and the NMFS in October 1995, covers approximately 37,865 hectares of forestland (Figure 14). The plan only covers two federally threatened species in detail, the northern spotted owl (*Strix occidentalis caurina*) and the marbled murrelet (*Brachyramphus marmoratus*). A 60-year Incidental Take Permit (ITP) was issued for the northern spotted owl along with a 6-year ITP for the marbled murrelet. The plan area also contains habitat for the federally endangered American peregrine falcon (*Falco peregrinus anatum*) although no nests have been found in the State Forest. The Federally threatened bald eagle (*Haliaeetus leucocephalus*) is known to inhabit the area as a nest was active up to 1993 in the HCP area. The ODF did not foresee any incidental take of American peregrine falcons or bald eagles and therefore did not provide detailed biological information for the species in the plan and did not request an ITP to cover these species (Oregon Department of Forestry 1995).

IV. Pacific Lumber Company 1999 Habitat Conservation Plan. Old-growth redwood, used almost exclusively by the marbled murrelet for nesting in California, has had approximately 96 percent of its original 647,500-770,000 hectares destroyed by logging (Noss 2000, USFWS 1997). A majority (75 percent) of the 18,080 hectares of private land designated as critical habitat for the marbled murrelet in the

Figure 14.--Location of Elliott State Forest

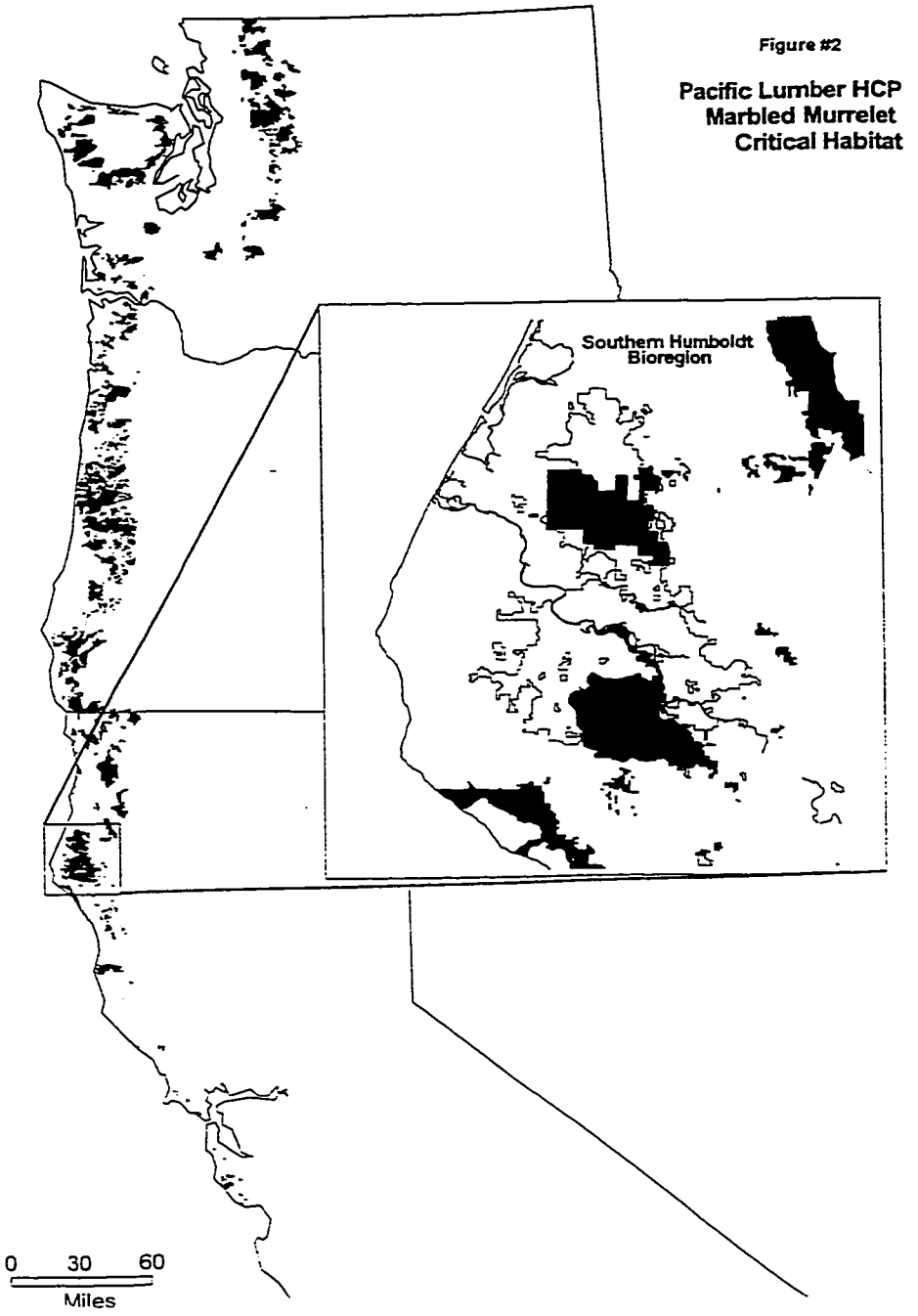


Source : Oregon Department of Forestry. 1995. Elliott State Forest habitat conservation plan. Portland, Oregon : Oregon Department of Forestry.

Pacific Northwest is located on Pacific Lumber property (Figure 15) (Sawyer *et al.* 2000, U. S. Fish and Wildlife Service and California Department of Forestry and Fire Protection. 1999).

The Pacific Lumber Company HCP is a high-profile plan that was worked out between the landowner, the Federal government, and the State of California (maps and pertinent HCP information included as Appendix J). The plan guides Pacific Lumber's logging operations on their 85,673 hectares of forestland, which includes the last significant groves of unprotected old-growth coastal redwoods (*Sequoia sempervirens*) in the world. The HCP was required of Pacific Lumber by the United States and the State of California as part of a $495 million acquisition deal for the largest remaining unprotected ancient redwood grove, known as Headwaters, and some buffer land (U. S. Fish and Wildlife Service and California Department of Forestry and Fire Protection 1999). The associated Incidental Take Permit was issued in 1999 and covers 17 species, six of which were listed under the ESA at the time of approval, for the 50 year life of the plan (Table 6). A "No Surprises" clause is attached for all species covered by the plan for the duration of the plan (U. S. Fish & Wildlife Service and the California Department of Forestry and Fire Protection 1999).

Figure 15.—Pacific Northwest Critical Habitat and Pacific Lumber land



United States Fish and Wildlife Service and California Department of Forestry and Fire Protection. 1999. Final environmental impact statement/environmental impact report and habitat conservation plan/sustained yield plan for the Headwaters Forest project. Washington D.C. : U.S. Government Printing Office.

Table 6.--Pacific Lumber Company 1999 HCP Species Listed Under the ESA

Species	Federal Status under ESA
American Peregrine Falcon (*Falco peregrinus anatum*)	Endangered
Bald Eagle (*Haliaeeutus leucocephalus*)	Threatened
Coho Salmon (*Oncorhynchus kisutch*)	Threatened
Marbled Murrelet (*Brachyramphus marmoratus*)	Threatened
Northern Spotted Owl (*Strix occidentalis caurina*)	Threatened
Western Snowy Plover (*Charadrius alexandrinus nivosus*)	Threatened

Data Collection

To assess the quality of science used in each HCP, a series of steps was taken. The governmental agencies (i.e. United States Fish and Wildlife Service, National Marine Fisheries Service) that regulate HCPs were contacted and visited to obtain relevant information including, but not limited to: HCPs, Environmental Impact Statements (EISs), Environmental Impact Reports (EIRs), Environmental Assessments (EAs), HCP guidelines, marbled murrelet literature, recovery plans, relevant laws, and handbooks. The Habitat Conservation Plans, Incidental Take Permits, Implementing

Agreements, EAs, EIRs, EAs and any other official document explicitly referenced to by the HCP, all of which are considered "part" of the HCP for analysis purposes, were obtained from authorized sources only. In addition, groups and agencies with pertinent information to the project were also contacted and visited as needed.

For each HCP, the researcher asked 789 questions/subquestions per HCP regarding the marbled murrelet (*Brachyramphus marmoratus*) (Appendix A). Relying on one species confined the qualitative assessment to a small, recognizable realm of analysis. The number of questions remained large enough to minimize the chance of missing information. The questionnaire was designed to characterize the extent to which scientific data and methods were used in developing and justifying a HCP. It includes information about what scientific data were available for use in formulating the HCP, how available information was used, and the rigor of analysis used in each stage of the plan process. The questionnaire was previously used in an extensive study of HCPs sponsored by the National Center for Ecological Analysis and Synthesis (NCEAS) and the American Institute of Biological Sciences (AIBS). The questions were formulated by a team of 119 scientists from eight major research universities.

The questionnaire focuses on different stages of the planning process. In particular, the following data was obtained from each case study and analyzed:

1) The information used to determine the *current status* of the marbled murrelet;
2) The information used in analysis of *take* of the marbled murrelet under the plan activities;

3) The information used in analysis of the biological *impact* of the anticipated take on the marbled murrelet;

4) The information used in analysis and planning of *minimization and mitigation* of the anticipated take of the marbled murrelet; and

5) The information used in analysis of *monitoring* activities to follow the future status, the actual take, and the effectiveness of minimization and mitigation procedures for the marbled murrelet.

For each of the stages above the following set of four parallel questions were asked:

A) whether information of this type was used in the HCP;

B) the source of the information;

C) the quality of how this information was used; and

D) whether any important information of this type was missing from the HCP.

Questions regarding the importance of these parameters (A-D above) for application to the marbled murrelet and the proposed land use were also asked.

The quantitative data assesses the extent of each plan's usage of marbled murrelet science. Numeric values representing the use and availability of scientific data were assigned to questionnaire responses (e.g. a score of 2 representing 'Significant information was missing that would have changed some quantitative conclusions'). The numeric values were reviewed by the researcher at the end of each section of analysis to help translate the sections use of available science to an overall qualitative assessment of scientific adequacy. The numeric values for adequacy are based on a scale of 1-6, with 1

indicating Excellent and 6 indicating Extremely Poor (Table 7). The basis of this qualitative assessment is specified by the series of background questions. This method of evaluation allows the dissection of the plans so that judgments can be made about their merits and faults.

Table 7.--Study Adequacy Ratings

RATING	LEVEL OF ASSESSMENT
1	Excellent
2	Above Average
3	Sufficient
4	Significantly Lacking in Data or Analysis to Reach Conclusion
5	Inadequate
6	Extremely Poor

Data Analysis

The qualitative assessments of scientific adequacy obtained through this quantitative case-study approach study led to comparisons of the HCPs based on land ownership, area, the number of species specifically addressed for incidental take in a plan, and the number of federally threatened and endangered species that are known to

inhabit a plan area. This analysis strengthens or weakens the validity of hypotheses evaluated, but does not purport to rigorously test them in a statistical sense.

Due to the small sample size of this study, the error resulting from a statistical test of results would be unrepresentative; therefore, this study does not involve statistical analysis. Instead, during project data collection the researcher created "Justification Notes" to accompany the data sheet. These notes support and give reasoning to the numerical value assigned to particular questions. Justification Notes are used to document the amount and quality of information used or not used with references to accepted theories, HCP page numbers, and other sources of pertinent and important information. These notes permit understanding of why and/or how the researcher arrived at certain key assessments. In order to facilitate insight into the NCEAS research, the research results from the two common HCPs (WADNR and Plum Creek) are compared and Justification Notes were required for important differences in plan analysis (Appendix E). Justification Comments for the five large qualitative assessments made of each HCP follow the data sheet for the HCP. These comments are more extensive and insightful than are the Justification Notes, and they include references to specific questions that directed the analysis. As shown above, the results are also justified by the detail-driven method of evaluation which allowed the dissection of plans so that judgments could be made about their merits and faults.

RESULTS

Case study adequacy ratings for each area of analysis and a summary of the extent to which scientific data and methods were used in these areas are found below. A Total Adequacy Score (TAS) is obtained for each case study by taking the mean of the 5 subscores. Results are compared to those of the National Center for Ecological Analysis and Synthesis study by Kareiva *et al.* (1999) for the two common plans following the four plan summaries and more extensively in Appendix E (findings different from Kareiva *et al.* (1999)(NCEAS) demarcated). A summary of case study adequacy scores, ranked case study Total Adequacy Scores, and adequacy scores grouped by basis of comparison follow the plan summaries.

Case Studies

I. Washington Department of Natural Resources 1997 Habitat Conservation Plan.

This study indicates the Washington Department of Natural Resources 1997 Habitat Conservation Plan to be "Inadequate," score of 5, in all areas of analysis except for the assessment of current status which received an evaluation of "Significantly Lacking in Data or Analysis to Reach Conclusions," score of 4 (Table 8, Appendixes B and C in detail).

A flaw found throughout the plan is a general failure to use information on the marbled murrelet that was available during HCP formation. In all sections the plan uses qualitative 'data' instead of more scientific quantitative data that existed in the literature.

Throughout the HCP, in the most important areas of assessment for the marbled murrelet, (terrestrial habitat, habitat affiliation, habitat quality, habitat amounts, fragmentation of habitat, and habitat trends) WADNR inadequately analyzes the insufficient information that is discussed (See A-E below). The HCP claims that insufficient information on the species terrestrial habitat exists to institute structured scientifically-sound minimization and mitigation measures. This assertion is unfounded, as evidenced by existing literature and it leaves a major requirement of HCPs unfulfilled. The threats to the continued survival and recovery of the marbled murrelet tend to be underestimated in the plan, especially in relationship to plan activities. In particular: fragmentation, edge, and loss of habitat will result from logging.

Table 8.-- Washington Department of Natural Resources 1997 Habitat Conservation Plan Study Assessment

Area of Analysis	Status	Take	Impact of Take	Minimization/ Mitigation	Monitoring	TAS
Score	4	5	5	5	5	4.8

A. Assessment of Current Status. The Washington Department of Natural Resources (WADNR) does not use sufficient quantitative data for the assessment of the marbled murrelet's current status. The plan uses large amounts of qualitative data, but it does not present pertinent existing quantitative information, especially for the important areas of breeding habitat, habitat quality, habitat amounts, and fragmentation of habitat.

Population and habitat trends also remain unaccounted for. This information existed and was not used. Score: 4.

B. Assessment of Take. Absence of data is the largest problem in WADNR's assessment of take. Data used to assess and draw conclusions about take are qualitative and inconclusive, especially in plan accounting for edge, fragmentation, and reduced canopy cover. Insufficient data are presented on the amount of existing suitable habitat in the plan area and scale of projects that will occur under the plan. Score: 5.

C. Assessment of Impact of Take on Population and Species. Due in part to the general lack of information provided for take (regarding habitat affiliations, quantitative data on breeding habitat, and community ecology), the assessments for impact of take are also found by this study to be insufficient in the WADNR plan. The information that is used for this stage suffers from inadequate assessments, especially in the important areas of movement ability of species and loss of breeding habitat (i.e. the impact of reduced nesting habitat is not addressed). The WADNR underestimates the seriousness of most factors, including loss of habitat, total individuals killed, and habitat degradation. Sufficient literature to guide this stage was available to planners and was not used, creating a serious plan flaw. Score: 5.

D. Assessment of Minimization and Mitigation Measures. Minimization and mitigation for the marbled murrelet are not covered in sufficient depth by this HCP. WADNR states that its objective to develop a long-term conservation strategy for the habitat of the marbled murrelet that will provide minimization and mitigation for the species is currently unsuccessful due to lack of knowledge about the bird's habitat needs

(WADNR 1997). This statement is not supported by research that was available to the planners (USFWS 1997, Oregon Department of Forestry 1995). In the interim, only minor minimization and mitigation strategies, most of which are unproven, guide the plan. No assurances are given on key points, and plan connection to information presented is often inadequate and insufficient to support plan assessments. Research findings, such as nest fidelity and poor dispersion to new nesting stands, are not discussed sufficiently in relation to the measures planned. Score: 5.

E. Assessment of Monitoring. Numerous problems exist in WADNR's monitoring plan. No monitoring is planned for several important aspects of take. Trends in population and habitat quality will not be monitored. Serious deficiencies also exist in the monitoring of habitat quantity and murrelet behavior. Rather than using outside monitoring to reduce inherent bias, WADNR employees conduct such monitoring. Score: 5.

II. Plum Creek Timber Company 1996 Multi-Species Habitat Conservation Plan. The total planning area for the Plum Creek Timber Company (Plum Creek) 1996 Cascades Multi-Species HCP is much larger (169,442 hectares) than is the Plum Creek ownership covered in the HCP (68,465 hectares). This difference occurs because Plum Creek land is intermingled in checkerboard fashion with federal and other privately-owned forestland (Figure 13). The Plum Creek HCP gives only secondary attention to the marbled murrelet, focusing on the northern spotted owl and relying on the other ownerships (especially federal) to provide habitat and mitigation for the murrelet. The

HCP is found by the study to be "Significantly Lacking in Data or Analysis to Reach Conclusions" in four of the five areas of analysis and "Inadequate" in the fifth area, plan assessment of monitoring (Summary Table 9, Appendixes B and D for detail).

The Plum Creek plan lacks analysis of available significant biological information for the marbled murrelet. In several areas of assessment, Plum Creek's lack of data concerning the characteristics of Plum Creek property and the current and potential habitat it contains for the marbled murrelet is a major plan flaw. Most factors measuring the impact of the take on the marbled murrelet are underestimated. Plum Creek provides no data that the prescribed minimization and mitigation methods, which do not sufficiently address primary threats to the marbled murrelet, such as loss of nest tree/nest stand, are done to the maximum extent possible. The company will not monitor take and the monitoring prescribed for "no net harm" does not use the primary indicators of population, habitat trends, survival information, or rates of reproduction. Combined, these shortcomings reflect negatively on the quality of the plan.

Table 9.-- Plum Creek Timber Company 1996 Multi-Species Habitat Conservation Plan Study Assessment

Area of Analysis	Status	Take	Impact of Take	Minimization/ Mitigation	Monitoring		TAS
Score	4	4	4	4	5		4.2

A. Assessment of Current Status. The Plum Creek Timber Company (Plum Creek) plan omits significant available biological information in the assessment of current status. Specifically, the plan does not use important existing information for

breeding habitat, an area of marbled murrelet science where sufficient information indicates this is of paramount importance to the survival and recovery of the species. Inclusion of this critical information would change quantitative conclusions of the plan. The seriousness of such an omission makes an assessment of "Sufficient" (Score 3) inappropriate, while the inclusion of some essential data, such as population decline makes a score of 5 "Inadequate" inappropriate , leading to an overall score of: 4.

B. Assessment of Take. The information that was available to Plum Creek Timber Company during HCP formation is used relatively well, however, available pertinent information is lacking. This deficit is partially due to the company's insufficient survey and knowledge of plan land. Plum Creek also omits available information on edge and fragmentation, both of which can have serious repercussions for the take of marbled murrelets. Score: 4.

C. Assessment of Impact of Take on Population and Species. This plan includes numerous inadequate assessments and lack of information in this area of analysis. The important impacts associated with loss of breeding habitat, trends in habitat quality, and habitat fragmentation negatively affect the plan's adequacy rating, as these are not sufficiently covered. The role of predator species is also overlooked. Most factors measuring the impact of the take on the marbled murrelet are underestimated in the plan. Global and local data assessing the movement ability of the species is used (with limited connection between the data and plan analysis), however, as is quantitative data for loss of habitat that includes relatively good modeling that extrapolates into the future, helping the plan narrowly avoid a score of "Inadequate" (Score 5). Score: 4.

D. Assessment of Minimization and Mitigation Measures. Plum Creek's plan does not sufficiently address the primary threats to the marbled murrelet in its minimization and mitigation measures. There is no data detailing the extent to which the company could minimize and mitigate for the extensive plan activities. A serious lack of information, both external (success of accepted methodologies) and internal (success/ failure of company techniques), impairs this aspect of the plan, as do inadequate assessments and unreliable measures for minimization and mitigation while conducting extensive logging. Data to be collected is insufficient to determine mitigation success ecologically, especially using a survey range of 40 miles inland that, according to literature, will likely miss valuable information. Existing information on community ecology, fragmentation, and edge is also lacking. The assessment of marbled murrelet preferred forest characteristics is adequate in relation to the scope of the plan. The inclusion of a previous extensive monitoring report on the marbled murrelet in the plan area (Technical Report #2), in addition to the use of population ecology and general ecosystem ideas in this assessment area, prevent a lower score. Score: 4.

E. Assessment of Monitoring. Numerous problems exist in this area, foremost of which is the fact that in the Plum Creek HCP no monitoring of take will occur. While the company will monitor for "no net harm," it will be performed by Plum Creek employees without using trends in population or amount and quality of habitat; survival information and rates of reproduction are also not used for this assessment. Mitigation data will be collected, however the extent is insufficient to determine if the measures are actually succeeding. The fact that monitoring data will be conducted,

including information which may add to the baseline knowledge of the species prevents a lower score. Score: 5.

III. Elliott State Forest 1995 Habitat Conservation Plan. The Elliott State Forest 1995 Habitat Conservation Plan, prepared by the land-manager Oregon Department of Forestry, is the most scientifically sound case study. The plan is well-organized, easy to read and evaluate scientifically, and often uses quality quantitative data with good modeling of processes to extrapolate into the future. The plan is "Above Average," Score 2, in two areas analyzed by this study, Assessment of Take and Assessment of Impact of Take on Population and Species. It is "Sufficient," score 3, in two areas, Assessment of Current Status and Assessment of Minimization and Mitigation Measures, owing largely to the above average use of science and information being offset by a few significant flaws. The Elliott State Forest HCP is "Significantly Lacking in Data or Analysis to Reach Conclusions," score 4, in one area, Assessment of Monitoring, due to its over-reliance on habitat monitoring, which is important, and lack of other types of monitoring (i.e. surveying for presence before tree removal, etc.) that would benefit the marbled murrelet (Table 10, Appendix F and G in detail). By looking at the Summary of Case Study Adequacy Scores and the Ranked Total Adequacy Score (Table 12) the superior quality of science used in this plan, as compared with the other three case studies, is evident. It is instructive to note, however that this superior Total Adequacy Score lies close to "Sufficient."

Table 10.-- Elliott State Forest 1995 Habitat Conservation Plan Study Assessment

Area of Analysis	Status	Take	Impact of Take	Minimization/ Mitigation	Monitoring	TAS
Score	3	2	2	3	4	2.8

A. Assessment of Current Status. Most available information is utilized in the Oregon Department of Forestry's (ODF's) HCP for this State Forest regarding the current status of the marbled murrelet. Clear documentation of old-growth loss and the amount of old-growth remaining would help the section, however. The ODF's assessment would also be improved by more data on fragmentation and a more complete discussion of threats to the marbled murrelet. Score: 3.

B. Assessment of Take. Considering the removal of each tree over 100 feet in height as take, along with the well-projected minimal loss of the marbled murrelet's suitable habitat over the life of the permit, is well documented in the plan. Studies supporting the movement abilities of individuals would help as would more discussion on the effects of fragmentation and edge. Score: 2.

C. Assessment of Impact of Take on Population and Species. ODF analyzes most pertinent information in this section clearly. The fragmentation and edge (along with the associated increased predation) produced by removing habitat is an important issue, discussion of such would help the assessment. Quantitative data is often used with clear and relevant modeling of processes that extrapolate into the future. HCP conclusions on the impacts of take are done well when the information is used. Score: 2.

D. Assessment of Minimization and Mitigation Measures. In this section population ecology, behavior, community ecology, ecosystem ideas, and amount and quality of habitat are used well. Packing and inbreeding issues and surveying for presence of marbled murrelets are the areas that could have been more thorough. Score: 3.

E. Assessment of Monitoring. ODF will protect the marbled murrelet through marbled murrelet management areas (MMMAs), but it does not propose to monitor important aspects such as: behavior, presence outside MMMAs, population trends, and survival. The plan instead monitors habitat by a ranking procedure. The emphasis in this section on the MMMAs and habitat-ranking is perhaps excessive considering lack of other monitoring. Score: 4.

IV. Pacific Lumber Company 1999 Habitat Conservation Plan. This study determines the Pacific Lumber Company 1999 HCP to be "Inadequate," Score 5, in three of the five areas examined (Assessment of Impact of Take on Population and Species, Assessment of Minimization and Mitigation Measures, and Assessment of Monitoring) and "Significantly Lacking in Data or Analysis to Reach Conclusions," Score 4, in two areas (Assessment of Current Status and Assessment of Take)(Table 11, Appendixes F and H in detail).

Table 11.--Pacific Lumber Company 1999 Habitat Conservation Plan Study Assessment

Area of Analysis	Status	Take	Impact of Take	Minimization/ Mitigation	Monitoring	TAS
Score	4	4	5	5	5	4.6

The Pacific Lumber Company 1999 Habitat Conservation Plan is included in the voluminous "Final Environmental Impact Statement/Environmental Impact Report and Habitat Conservation Plan/Sustained Yield Plan for the Headwaters Forest Project." This document is difficult to read and understand as large amounts of information are cross-referenced to different appendixes, tables, charts, and chapters. Important documents from this HCP are included as Appendix J.

This document indicates that Pacific Lumber Company plans to take a large proportion of a unique and important population of marbled murrelets: 246 murrelets. This number represents 24 percent of the bioregion population (3.1 percent of Marbled Murrelet Conservation Zone 4 (MMCZ4), 0.6 percent of Pacific Northwest). This take is considered a "reasonable" estimate in light of plan activities, although it contradicts the existing species' 1997 Recovery Plan, scientific understanding, and the background literature provided by the document itself. The "reasonable" estimate of take is based on a 1:1 ratio (tree loss : species loss) of known occupied habitat lost. This number climbs much higher if all the best habitat is included (old-growth and residual, assumed to be occupied at currently accepted rates) to 621 murrelets. This estimate is 42 percent of the bioregion population (7 percent of MMCZ, 1.3 percent of Pacific Northwest). This

estimate, referred to as a "worst case scenario" by Pacific Lumber, does not include other suitable habitat, such as large trees in somewhat canopied areas, and assumes neither Owl Creek or Grizzly Creek Groves will be cut, not a guaranteed assumption.

The majority, 75 percent, of Critical Habitat designated on private property for the marbled murrelet is included in this HCP. This habitat (and associated population) is considered critical to the survival and recovery of the species, as it encompasses a significant, relatively isolated portion of the species' habitat. The protected areas in the region are not sufficient to guarantee survival of the marbled murrelet in this MMCZ which is an important link to the main population for the extremely isolated population in Zone 6 (San Mateo/Santa Cruz County). The majority of this important information is acknowledged by Pacific Lumber in the HCP background literature, but not in the planned (and approved) activities and associated levels of take.

This HCP could likely set a precedent for high profile controversies involving sensitive habitat, as the area has received international attention and has been the focus of high-level negotiations for several years. Nonetheless, the HCP does not sufficiently acknowledge trends in old-growth quantity and quality or the global perspective of the bioregion population. The plan does not account sufficiently for the large amounts of fragmentation, edge and cumulative effects that will result from plan activities. It further assumes that the groves that will be set aside for the life of the 50-year plan (Marbled Murrelet Conservation Areas (MMCAs)) will adequately reduce the impacts of the extensive plan activities. No surveys will be conducted to determine presence of marbled murrelets outside of MMCAs, however, even though suitable habitat does exist. These

omissions result in an inadequate plan that could have a large impact on the threatened marbled murrelet and its ability to survive and recover.

A. Assessment of Current Status. The Pacific Lumber Company (Pacific Lumber) HCP does not sufficiently address pertinent information that was available to planners. Specifically, the plan does not sufficiently acknowledge trends in old-growth quantity and quality. The population of marbled murrelets is not placed in global population perspective. The unique value of the population using Pacific Lumber land, although well documented by biologists, is mentioned in the plan but does not receive sufficient analysis. The plan mentions that the marbled murrelet recovery plan has stated that the bioregion population is essential to the recovery of the species, yet does not use adequate global perspective. The amount of old-growth coast redwood globally and species fecundity are not analyzed, nor is the species susceptibility to natural and anthropogenic catastrophes. The inclusion of basic data concerning population numbers and decline of species avoids a rating of "Inadequate" (Score 5). Score: 4.

B. Assessment of Take. Pacific Lumber's assessment of take has several flaws. A 1:1 ratio (tree loss : species loss) to determine take (estimated at 24% of the bioregion population) is derived from habitat known to be occupied instead of suitable habitat. Only the best habitat (old-growth and residual) is considered important to the marbled murrelet; research demonstrates this to be an underestimation (USFWS 1997). There is also a lack of accounting for fragmentation, edge, and cumulative effects. Score: 4.

C. Assessment of Impact of Take on Population and Species. The impact of the plan activities is poorly analyzed. Pacific Lumber downplays several serious factors such as: nest fidelity, poor dispersion to other stands, fragmentation, edge, and predation. Only using occupied stands and best habitat to draw 1:1 (tree loss : species loss) take conclusions is unfounded and most likely underestimates the impact the plan has on the important population. As stated in the plan background information, extensive takings of marbled murrelets in the short term will have a large impact; Pacific Lumber's assessment does not accurately reflect this. The plan relies heavily on the set-asides to reduce the impact of take. Score: 5.

D. Assessment of Minimization and Mitigation Measures. The minimization and mitigation measures proposed by this plan contain several deficiencies. No surveys will be conducted to determine presence of marbled murrelets outside of marbled murrelet conservation areas (MMCAs). The MMCAs are used as mitigation and are the focus of measures such as small seasonal buffers and a habitat prioritization system. Large amounts of unminimized take for the marbled murrelet will occur under the plan outside of the MMCAs. By not accounting for nest fidelity and poor dispersal to new stands, the plan does not incorporate knowledge and analysis of suitable habitat and island biogeography. Score: 5.

E. Assessment of Monitoring. The HCP monitoring procedures are insufficient. Monitoring of suitable habitat levels is neglected as only the best habitat is considered for monitoring and will only be conducted in marbled murrelet conservation areas (MMCAs), with the exception of old-growth and residual old-growth redwood

authorized for removal which will be prioritized and tracked. The at-sea population monitoring is helpful, although it will not directly reflect minimization and mitigation success or plan impact. The lack of terrestrial monitoring outside prime habitat is a serious plan flaw. Score: 5.

Summary of case study adequacy scores. The case study adequacy scores and Total Adequacy Scores (TASs) for all four HCPs analyzed are summarized in Table 12. Although there was some variability in quality of HCPs among the cases analyzed, overall the science used was poor (Table 12). As can be seen from ranking of Total Adequacy Scores, Elliott State Forest was the strongest document, while WADNR was the weakest.

Table 12.--Summary of Case Study Adequacy Scores and Ranked Total Adequacy Scores

	Status	Take	Impact of Take	Min./Mit.	Monitoring	TAS	Rank
WADNR	4	5	5	5	5	4.8	4
Plum Creek	4	4	4	4	5	4.2	2
Elliott S. F.	3	2	2	3	4	2.8	1
Pacific Lumber	4	4	5	5	5	4.6	3

1=Excellent, 2=Above Average, 3=Sufficient, 4=Significantly Lacking in Data or Analysis to reach conclusions, 5=Inadequate, 6=Extremely Poor

Comparison of results with NCEAS study.

I. Washington State Department of Natural Resources 1997 HCP. This study and National Center for Ecological Analysis and Synthesis (NCEAS) study by Kareiva *et al.* (1999) vary on a total of 85 questionnaire responses (10.8%; 85/789) for the WADNR HCP (Appendix E, findings different from NCEAS demarcated). Despite the numerous differences, only one of the five major scores for adequacy varied. This study gives the WADNR HCP a score of 4 (Significantly lacking in data or analysis to reach conclusions) on Assessment of Current Status, whereas the Kareiva *et al.* (1999) study gave the plan a score of 5 (Inadequate) in the same area (Table 13).

The majority of the differing results are due to slight differences in plan assessment; the current study identified some information used in plan assessments that

were apparently overlooked by Kareiva *et al.* (1999) (16 of the 85 differences; 18.8 %). Specifically, this study found that information on basic genetics, pollution, environmental stochasticity was included in the plan and marked as absent by Kareiva *et al.* (1999). Also overlooked by Kareiva *et al.* (1999) is the fact that quantitative data was used for trends in habitat amounts and that both global and local information was used for trends in population size. The lower Kareiva *et al.* (1999) score for Current Status is thus largely attributable to information that was somehow overlooked by the study.

II. Plum Creek Timber Company Cascades Multi-Species 1996 HCP.

This study and the NCEAS study by Kareiva *et al.* (1999) are at odds on a total of 212 questionnaire responses (26.9%) for the Plum Creek HCP. Over 50% of the differences (112; 52.8%), however, are due to coding error in the Kareiva *et al.* (1999) study. Section C (Assessment of Take), half of Section D (Assessment of Impact of Take on Population and Species, through the A-D questions, D1-D31), and two-thirds of Section F (Assessment of Monitoring, F33-F80) have a coding error throughout. In these sections -1 (Data/info. does not exist) is used when -2 (Not Applicable) is appropriate. This same error is not found in Section A/B (Assessment of Current Status), the second portion of Section D (Assessment of Impact of Take on Population and Species, D32-47), Section E (Assessment of Minimization an Mitigation Measures) or questions 1-26 in Section F (Assessment of Monitoring). This error, if analyzed by a different individual, could undermine the study as a false absence of data could be extrapolated to analysis that leads to an adequacy score. This false extrapolation is less likely for the individual making the error, therefore most likely this error did not affect results in the section. It is

unlikely that one researcher would change coding technique from section to section in similar situations and less likely s/he would do so within one section. As a result, it appears that more than one Kareiva *et al.* (1999) researcher examined this HCP and contributed to the analysis, and at least one was somewhat ill-trained for the study. This also increases the likelihood of the extrapolation error discussed above.

The most unusual difference, independent of coding error, was that the Kareiva *et al.* (1999) study rated the marbled murrelet as endemic to Washington State. This error may also have been data entry error on the part of Kareiva *et al.* (1999). The lack of ranking by the Kareiva *et al.* (1999) study in C19-C24 (Assessment of Take), immediately preceding the qualitative conclusion, is yet an additional study flaw, as this is an important step in the assessment process.

This study and the Kareiva *et al.* (1999) study thus arrive at different conclusions of adequacy in four of the five areas (Table 13). The Kareiva *et al.* (1999) adequacy rating in the analysis of Assessment of Current Status, "Sufficient" (Score 3), does not seem to correlate with the scores given in the series of background questions. Only minor differences in questionnaire responses between the two studies exist yet the current study finds adequacy to be "Significantly Lacking in Data or Analysis to Reach Conclusions" (Score 4). Furthermore, the Kareiva *et al.* (1999) adequacy score does not correspond with the language used in the unpublished plan summary written by the researchers. They state, "The assessment of current status of the marbled murrelet on Plum Creek Timber Company lands is reasonable, but incomplete." In addition, the Kareiva *et al.* (1999) rating for minimization and mitigation measures, "Sufficient"

(Score 3), is inconsistent with analysis in light of the fact that the HCP does not address the primary threats to the marbled murrelet in this area, and delineation of measures that would be practicable for Plum Creek Timber Company to implement is absent.

The differing ratings of adequacy in the sections of Assessment of Impact of Take on Population and Species and Assessment of Monitoring result from truly different assessments given throughout the sections (Appendix E, findings different from NCEAS demarcated). The current study finds the omission of data concerning population ecology and cumulative effects cause for concern in the Assessment of Impact of Take, whereas this is not mentioned by Kareiva *et al.* (1999). The current study scores the lack of data concerning predator interaction and habitat fragmentation to be more serious of a problem than Kareiva *et al.* (1999) in the Assessment of Impact of Take. In this same area of assessment, Kareiva *et al.* (1999) score that total acreage of habitat lost is not of any consequence and that habitat degradation , fragmentation, edge, and reduced movement rates will not be noticeable effects on the marbled murrelet; findings contested by the current study and extant literature.

Concerning the Assessment of Monitoring, the current study disagrees with the Kareiva *et al.* (1999) scores indicating the plan's lack of monitoring for absence/ presence and population size/trends is not significant and that the deficiencies in the areas of consumer species and murrelet behavior are of little consequence.

Table 13.--Comparison of Adequacy Ratings by Jordan and Kareiva *et al.* (1999) (NCEAS)

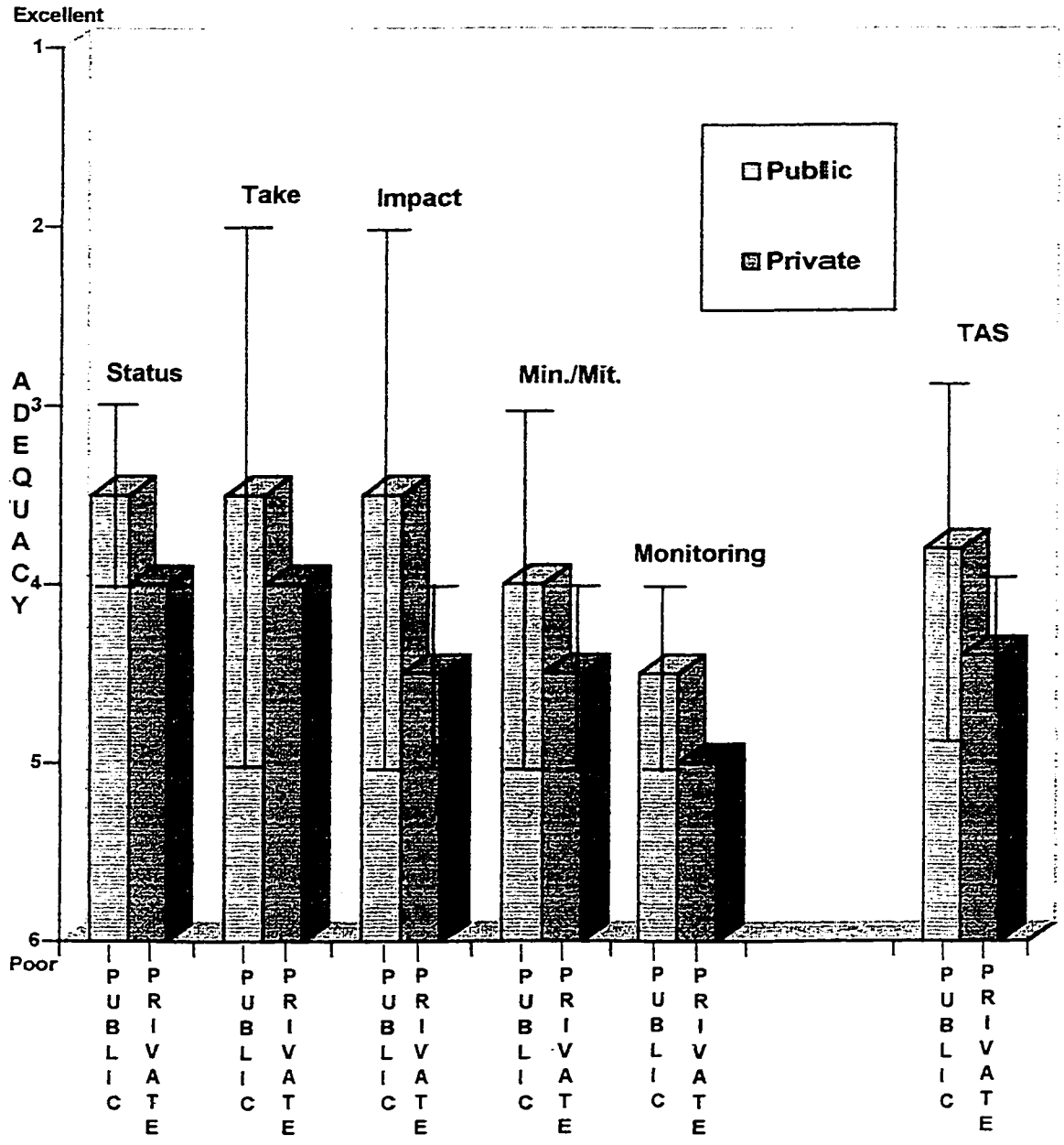
	Status	Take	Impact of Take	Minimization/ Mitigation	Monitoring	TAS
WADNR						
Jordan	4	5	5	5	5	4.8
Kareiva *et al.* (1999)	5	5	5	5	5	5.0
Plum Creek						
Jordan	4	4	4	4	5	4.2
Kareiva *et al.* (1999)	3	4	3	3	4	3.4

Land Ownership

Hypothesis 1) Public entities are more likely than private entities to use adequate scientific information in a Habitat Conservation Plan.

Although only two cases of each category of land ownership were analyzed, it appears that there is some support for this hypothesis in the results of this study (Figure 16). This trend, however, appears to be driven by the Elliott State Forest HCP (Figure 17), given that the WADNR plan was quite weak in several areas of analysis.

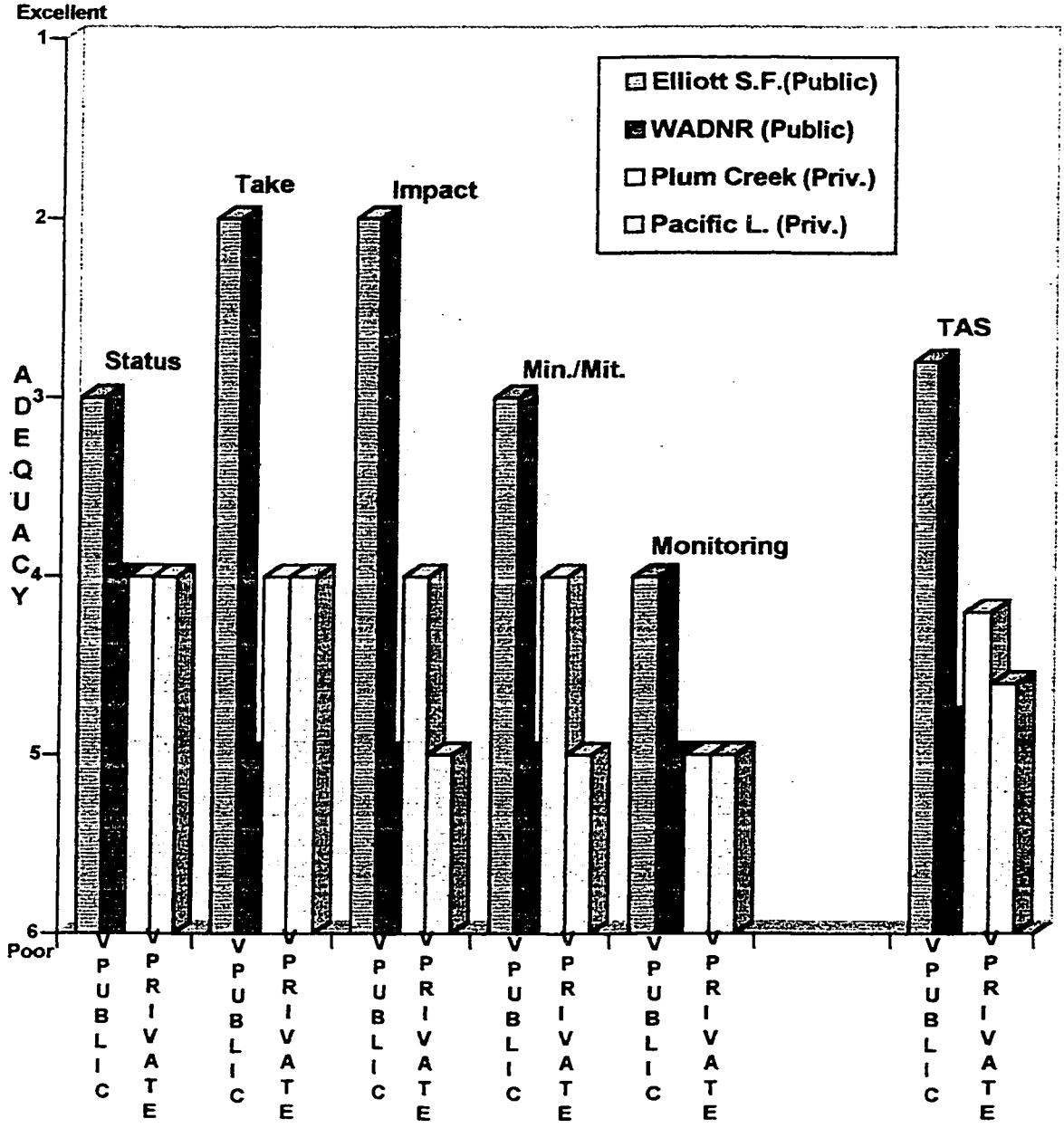
Figure 16.--Mean Case Study Adequacy Scores and Land Ownership



ASSESSMENT AREAS AND TAS FOR LAND OWNERSHIP COMPARISON

Figure 16 groups the adequacy scores from the five areas of analysis by land ownership. The mean scores of the two public ownership HCPs examined by this study, Elliott State Forest and Washington Department of Natural Resources (WADNR), are compared to the mean scores of the two private ownership HCPs examined by this study, Plum Creek Timber Company and Pacific Lumber Company. The Total Adequacy Scores (TASs) are determined by summing the raw scores in all areas of analysis according to ownership and dividing by the number of scores (10). Error bars are given when applicable.

Figure 17.--Case Study Adequacy Scores and Land Ownership



ASSESSMENT AREAS AND TAS FOR LAND OWNERSHIP COMPARISON

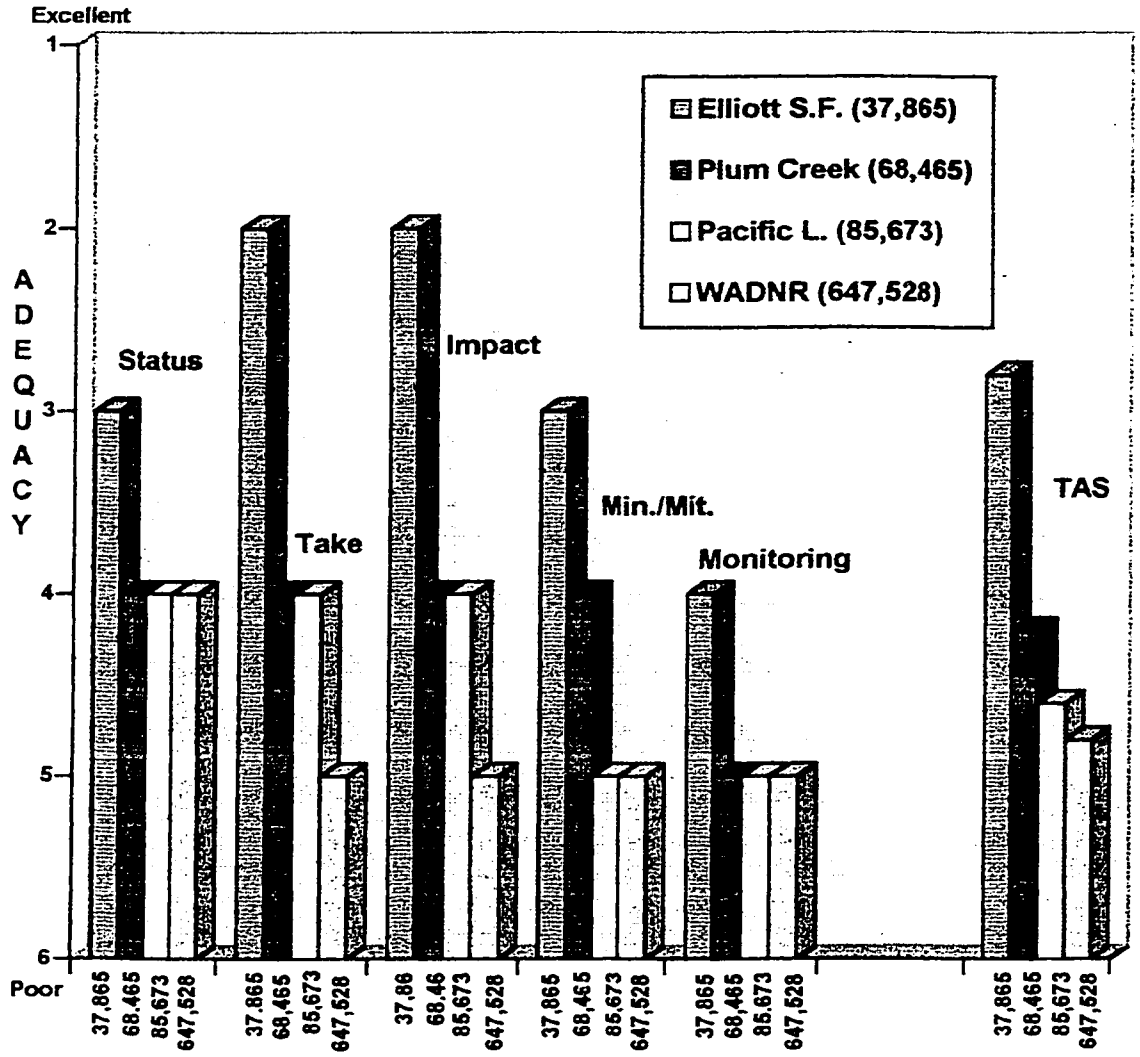
Figure 17 groups the adequacy scores from the five areas of analysis by land ownership. The scores of the two public ownership HCPs examined by this study, Elliott State Forest and Washington Department of Natural Resources (WADNR), are given first; followed by the two private ownership HCPs examined by this study, Plum Creek Timber Company and Pacific Lumber Company. The Total Adequacy Scores (TASs) are determined by summing the raw scores in all areas of analysis and dividing by the number of scores (5).

Area Covered

Hypothesis 2) The larger the area covered by a Habitat Conservation Plan, the more likely the plan will be to use adequate scientific information.

This hypothesis is not supported by the data. In fact, the opposite trend holds (Figure 18). The larger the area covered by a Habitat Conservation Plan, the **less** likely the plan will be to use adequate scientific information. Due to the small number of HCPs analyzed, conclusive evidence is not possible to obtain.

Figure 18.--Case Study Adequacy Scores and Area Covered (Hectares)



ASSESSMENT AREAS AND TAS FOR COMPARISON OF AREA COVERED

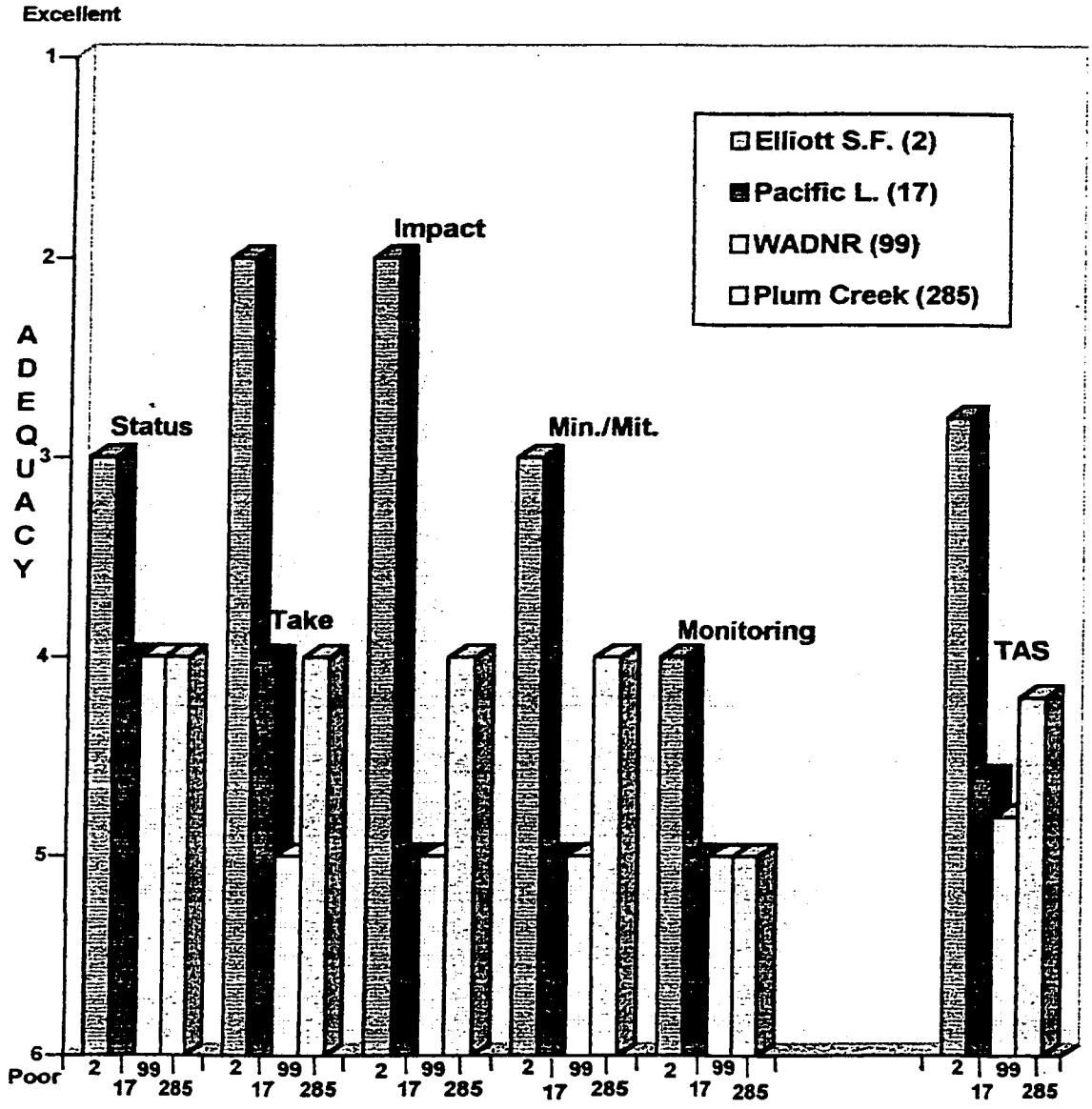
Figure 18 shows the adequacy scores from the five areas of analysis and the area covered by a HCP (in hectares). The results are shown in Figure 18 from smallest area to largest area, in order to analyze results. The physical area covered by these HCPs range from Elliott State Forest at 37,865 hectares, Plum Creek Timber Company at 68,465 hectares, Pacific Lumber at 85,673 hectares, to WADNR at 647,528 hectares. The Total Adequacy Scores (TASs) are determined by summing the raw scores in all areas of analysis and dividing by the number of scores (5).

Species Addressed for Incidental Take Permit

Hypothesis 3) The more species specifically addressed with biological information by a Habitat Conservation Plan (covered by the Incidental Take Permit), the more likely the plan will be to use adequate scientific information.

This hypothesis is not supported by the data. No trend related to number of species addressed is evident in the results of this study (Figure 19). The results undermine the stated hypothesis.

Figure 19.--Case Study Adequacy Scores and Number of Species Addressed



ASSESSMENT AREAS FOR NUMBER OF SPECIES ADDRESSED COMPARISON

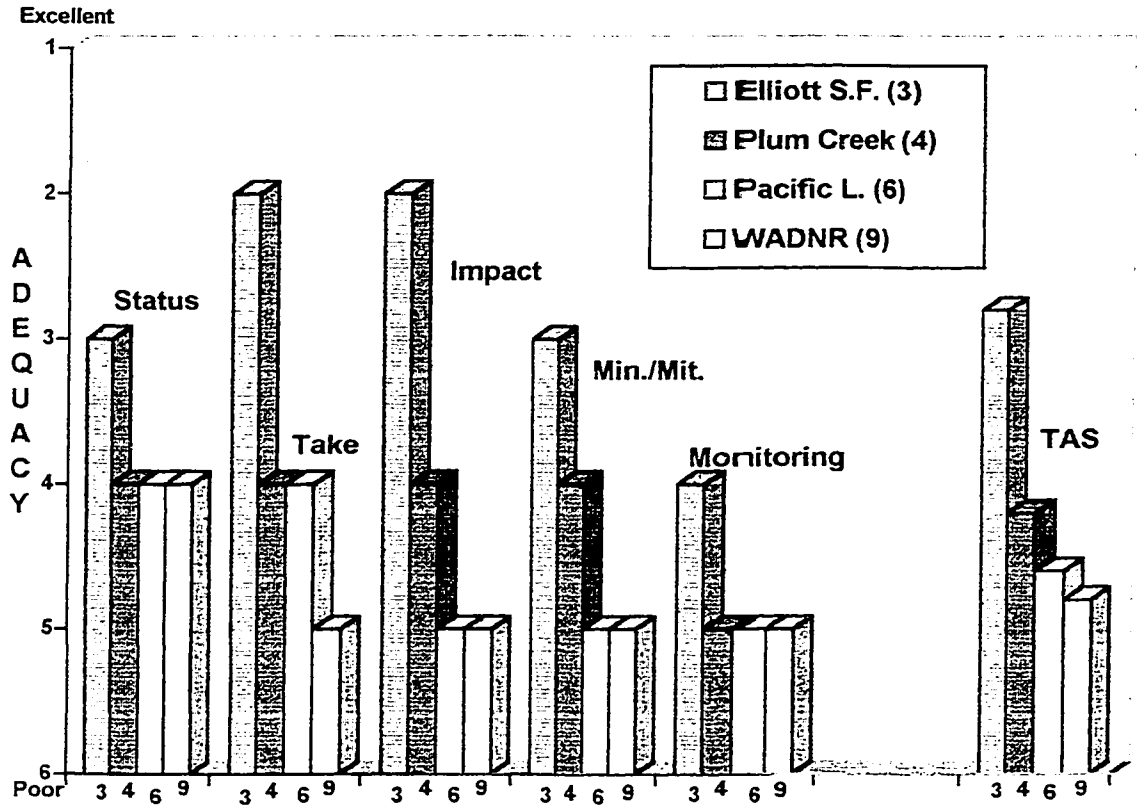
Figure19 shows the adequacy scores from the five areas of analysis and the number of species specifically addressed by each HCP (to be covered by the Incidental Take Permit (ITP)). The plans are given in Figure 19 by increasing number of species covered by the ITP. The number of species covered by the ITP ranges from only 2 for the Elliot State Forest to an unprecedented 285 in the Plum Creek Company plan; Pacific Lumber Company and WADNR are intermediate with 17 and 99, respectively. The Total Adequacy Scores (TASs) are determined by summing the raw scores in all areas of analysis and dividing by the number of scores (5).

Number of Species Listed Under the Endangered Species Act of 1973

Hypothesis 4) Habitat Conservation Plans for areas that are known to contain more species listed as federally threatened or endangered are more likely to use adequate scientific information.

This hypothesis is not supported by the data. In fact, the opposite trend holds (Figure 20). Habitat Conservation Plans for areas that are known to contain more species listed as federally threatened or endangered under the ESA, the **less** likely the plan will be to use adequate scientific information. Due to the small number of HCPs analyzed, conclusive evidence is not possible to obtain.

Figure 20.--Case Study Adequacy Scores and Number of ESA Species



ASSESSMENT AREAS FOR NUMBER OF ESA SPECIES COMPARISON

Figure 20 shows the adequacy scores from the five areas of analysis and the number of species listed under the Endangered Species Act of 1973 (ESA) in each HCP. The plans are shown in Figure 20 by increasing number of species listed under the ESA. The number of species listed under the ESA known to exist in the HCP area ranges from three in the Elliot State Forest, Plum Creek land contains four, Pacific Lumber has six, to WADNR land with nine. The Total Adequacy Scores (TASs) are determined by summing the raw scores in all areas of analysis and dividing by the number of scores (5).

DISCUSSION

Habitat Conservation Plans

This study concludes that Habitat Conservation Plans (HCPs) often:

1) Inadequately use extant scientific knowledge,
2) Lack organization,
3) Fail to demonstrate that the impacts of take are minimized and mitigated to the maximum extent practicable, a violation of Section 10(a)(2)(B) of the ESA (see page 2, #2),
4) Include measures likely to have a profoundly detrimental impact on the likelihood of survival and recovery of species listed under the Endangered Species Act of 1973 (ESA), a violation of Section 10(a)(2)(B) of the ESA (see page 2, #4),
5) Fail to adequately specify the impacts likely to result from the proposed taking of species listed under the ESA, a violation of Section 10(a)(2)(A) of the ESA and Federal Regulation 50 CFR 17.22(b)(1)(iii)(C) (see page 3, #1), and
6) Fail to provide adequate procedures to deal with unforeseen circumstances, a violation of Section 10(a)(2)(A) of the ESA and Federal Regulation 50 CFR 17.22(b)(1)(iii)(C) (see page 3, #2).

Scientific adequacy. The scientific adequacy scores obtained from this study indicate that, in general, HCPs tend to be significantly lacking and inadequate in their use of scientific data and information. Of 20 scores for scientific adequacy (5 for each case study), 8 are Inadequate, 8 are Significantly Lacking in Data or Analysis to Reach Conclusion, two are Sufficient, two are above average, and none are excellent. This demonstrates the existence of a problem in the process as these plans cover a total of 839,531 hectares of land, and numerous species (11 ESA listed, over 300 total). These plans have been approved as has the take of all of the species covered by each plan for the life of the plan. The results of this study confirm that the widespread concern over the biological soundness of HCPs is well founded.

The inadequate use of science in the four HCPs examined by this study is apparent in numerous ways in all five areas of assessment (status, take, impact of take, minimization/mitigation, and monitoring). The HCPs examined lack several types of information and often use the information that is included poorly.

Basic information concerning existing knowledge of the marbled murrelet is absent from the plans. These deficiencies include, but are not limited to, the important aspects of population numbers, habitat affiliations, habitat quality, habitat quantity, and trends associated with the aforementioned areas. A lack of information about plan environment and the extent of the activities that will occur under the plan are serious omissions in the HCPs.

Inadequate use of the science that is included in the plans is evident in several forms. Numbers are not being formulated and checked to measure biological success of

the HCPs. Use of unbiased, third party monitoring is not proposed in the plans for measurement of the often unreliable and unproven mitigation and minimization procedures. Data is sometimes global in perspective, sometimes local, often apparently randomly switching between perspective. Poor statistical analysis, illogical relationships between data and plan conclusions, and the underestimating of effects of plan activities are more examples of the level of scientific inadequacy found in the HCPs examined. See Results, Data sheets/Justification Notes (Appendixes B and F), and Justification Comments (Appendixes C, D, G, and H) for further detail.

Organization. With the notable exception of the Elliott State Forest 1995 HCP, the plans examined by this study were poorly organized. Due to poor organization and often obscure section titles, the detail-driven analysis involved in this study was often difficult. The Pacific Lumber 1999 HCP, for example, is an appendix in the three volume "Final Environmental Impact Statement/Environmental Impact Report and Habitat Conservation Plan/Sustained Yield Plan for the Headwaters Forest project," making analysis of the plan confusing as it contains numerous references to the numerous documents contained elsewhere in the volumes.

Violation of ESA and federal regulation. Several of the inadequacies present in the HCPs examined by this study are violations of federal regulation and ESA (See 3-6 above). The HCPs often failed to meet several of the requirements for issuance of an Incidental Take Permit and HCP substance.

This study indicates that large amounts of take, in the form of habitat and actual numbers of species, may be approved by the regulatory agencies that are not scientifically

defensible and that will potentially have a large negative impact on many of the species' likelihood to survive and/or recover from decline. Instead of clear monitoring goals and putting appropriate processes in place for adaptive management, the HCPs examined tend to ingrain inadequate science in the form of lengthy incidental take permits with "No Surprises" clauses attached.

Consistent Analysis/National Center for Ecological Analysis and Synthesis Study by Kareiva *et al.* (1999)

Having one researcher examine a plan or series of plans may lead to findings that are more consistent in analysis and facilitate further studies. Using more than one researcher may lead to fragmentation of analysis and can make directed further research confusing. This problem was apparent in the coding errors in various sections of the National Center for Ecological Analysis and Synthesis' (NCEAS') analysis of the Plum Creek Timber Company 1996 Multi-Species Habitat Conservation Plan by Kareiva *et al.* (1999). In addition to the mentioned problems of different codation values and analysis by section, having different researchers analyze different sections of a plan can potentially lead to missed information. A researcher analyzing one section of a HCP may not become aware of the presence and location of information pertinent to their analysis, as it might be found in another part of the plan. To accurately comprehend what information is included in a HCP, the entire plan must be studied. The applicability of this conclusion is restricted by the scale of analysis. In the Kareiva *et al.* (1999) case, detailed examination of focus species in 43 HCPs would be prohibitive for a single

researcher. However, changing researchers within the examination of one HCP and one species, as was apparently the case in the Kareiva *et al.* (1999) Plum Creek study, leads to confusion and inconsistency.

The Kareiva *et al.* (1999) questionnaire was found to be thorough and of high quality for HCP analysis. The questionnaire could, however, use some minor changes and additions. Expanding the range of response options in two areas of analysis would aid the examination of a HCP. Question C1: "Overall, was the analysis of take based upon calculations of habitat loss (1), or loss of individuals of the species (2)?" could use a "(3) both" option and Subquestion QD: "Importance of missing information. For this type of information was significant information or analysis THAT DID EXIST missing from the HCP?" would be more descriptive if a fourth response option was added between the existing 1 and 2 that stated: "*Significant* information was missing that would *not* have changed some quantitative conclusions." The Assessment of Minimization and Mitigation being divided into two sections, Assessment of Minimization and Assessment of Mitigation, would allow for more clear dissection of plan strengths and weaknesses. As one area of analysis, plans that are stronger in minimization than mitigation and vice versa are somewhat difficult to interpret.

Relationship to Prior Research

This study's findings support the findings of Hall (1997) that 1) forestland HCPs fail to provide adequate mitigation for old-growth, late successional, and other older and more diverse habitat; and 2) forestland HCPs' minimization and mitigation measures

often lack credibility. Shilling's (1997) assessment that most HCPs are lacking in adequate baseline information on actual habitat use by species is supported by this research, as is the authors finding that when this vital baseline information is available to planners it is not necessarily used in the implementation and mitigation phases of a HCP. Bean *et al.* (1991) found the likelihood that an HCP will benefit a species to be questionable due to unproven biological assumptions and unproven conservation measures; findings identified throughout this study.

The NCEAS study mentioned above, by Kareiva *et al.* (1999), contains several findings that are supported by this research. These are:

1) Large HCPs show no evidence of being more adequate;
2) Little emphasis is placed in HCPs on accurately estimating impact of take;
3) HCPs often contain inadequate assessments for impact of take;
4) The quality of data used to justify mitigation measures in HCPs is often low;
5) Absences of crucial data leading to unproven mitigation measures are being relied on in many HCPs; and
6) Many (50% in NCEAS study) HCPs do not contain clearly outlined monitoring programs.

This study contradicts researchers who have stated that HCPs that cover more area and more species tend to be, or should be, more scientifically adequate (Bean *et al.* 1991; Mann and Plummer 1995; National Research Council 1995).

Hypothesis #1.

Public entities are more likely than private entities to use adequate scientific information in a Habitat Conservation Plan.

The mean adequacy scores for ownership tend to support hypothesis #1. This trend breaks down some what when Total Adequacy Scores and individual HCP findings are considered.

In particular, the Elliott State Forest is publicly owned by the State of Oregon and managed by the Oregon Department of Forestry. Of the case studies, The Elliott State Forest 1995 HCP is the most scientifically adequate in its assessments for the marbled murrelet. The 1997 Washington Department of Natural Resources (WADNR) HCP, for the publicly-owned lands of Washington State, uses the least scientific guidance of the four case studies examined; inadequate in all areas of plan assessment except for one. The divergence of these two public land HCPs weakens Hypothesis #1.

The fact that the mean adequacy scores are higher for HCPs by public entities than for private entities, despite the low scores and lowest Total Adequacy Score of the WADNR HCP, underscores the weakness of HCPs by private entities. This relative weakness of private HCPs is thought to exist due to differing incentives and disincentives. The policies and procedures used by a public entity are, theoretically, a reflection of the public. The public tends to support the Endangered Species Act of 1973 (ESA) and other protections provided for species listed under the act and their habitat. Public entities are not dependent upon the revenue generated from their forestland, in

contrast to private timber companies. The public may have more input into HCPs on public land. For these and other reasons, public entities are also not as motivated as private entities to maximize profits. Maximization of profit for timber companies does not encourage species protections and retention of species habitat; the opposite being true, especially for old-growth dependent species such as the marbled murrelet.

Hypothesis #2

The larger the area covered by a Habitat Conservation Plan, the more likely the plan will be to use adequate scientific information.

Hypothesis #2 is weakened by this study as the opposite trend is observed. This trend may be due to one or more of the following factors:

1) Larger landowners tend to have more influence in politics and, therefore, on regulatory agencies;
2) Lack of information, use of unproven techniques, and poor management create more inadequacies as area increases;
3) All HCPs receive approximately the same amount of time and resources from underfunded regulatory agencies;
4) Larger areas contain more future potential suitable habitat, thus large losses are more accepted due to promised future gain;
5) Loss of habitat and species is considered more acceptable when the area, and perhaps amount of habitat and number of species, increases; and

6) Smaller areas are easier to survey, monitor, and manage.

The implications of this study's findings regarding Hypothesis #2 are reason for concern. The larger the area covered by a HCP:

1) the larger the number of species likely to be affected,
2) the larger the population of a species likely to be affected,
3) the larger the amount of habitats likely to be affected,
4) the larger the amount of a species habitat likely to be affected,
5) the larger the amount of area bordering the plan, and
6) the larger the effort (monetary and otherwise) required to monitor and restore the area.

The implications of larger HCPs being less likely to use adequate scientific information are clear in regard to 1-6 above. The finding of this study, coupled with the finding by USFWS (1996) that HCPs are tending to get larger, creates a strong trend toward scientifically inadequate HCPs and a large percentage of total HCP area being managed without adequate science.

The focus species of this study, the marbled murrelet, is an example of the implications of this finding. While the quality and quantity of current prime habitat (i.e. old-growth, residual old-growth, and late-successional forests with tree deformities, sufficient canopy closure, etc.) vary by forest, all forestland within 80 kilometers of marine waters dominated by conifers is potential suitable habitat and important to the long-term survival of the species. If a majority of the remaining prime habitat (a small amount) is managed in smaller HCPs (more likely to use adequate scientific

information), the future of the species still remains in balance due to the cumulative effects of larger HCPs (less likely to use adequate scientific information; i.e. increased fragmentation, edge, predatory species, young forest conditions) and other threats to survival (oil spills, gill netting, weather fluctuations, etc.).

Numbers 1-4 for larger areas, above, will vary somewhat on a case-by-case basis. If smaller HCPs tended to occur in areas of high endangerment and larger HCPs tended to occur in areas of low endangerment, the trend, at least in the early stages, would not have as significant consequences. Unfortunately, this tenet is not supported by research, including this study (See "Hypothesis #4" below).

Hypothesis #3

> The more species specifically addressed with biological information by a Habitat Conservation Plan (covered by the Incidental Take Permit), the more likely the plan will be to use adequate scientific information.

The results of this study do not support hypothesis #3. No clear trend related to this hypothesis is observed by this study.

Hypothesis #4

> Habitat Conservation Plans for areas that are known to contain more species listed as federally threatened or endangered are more likely to use adequate scientific information.

Hypothesis #4 is undermined by this study as the opposite trend is found to exist in the HCPs examined:

> Habitat Conservation Plans for areas that are known to contain more species listed as federally threatened or endangered are *less* likely to use adequate scientific information.

In this study, the range of number of species listed as federally threatened or endangered (ESA species) known to inhabit plan land directly corresponds to the amount of area covered by a plan; a logical relationship, especially in an endangered ecosystem. The reasons for the observed trend, therefore, may correspond with the reason behind the observed trend for Hypothesis #2 (See Discussion - Hypothesis #2 above). In addition, this observed trend may be due to:

1) Regulatory agencies are more willing to compromise in HCPs for land with more endangered species as more is at stake and HCPs are viewed by these agencies as beneficial to species; and
2) The more species listed under the ESA in an area, the less time and money that can be allocated to each by the regulatory agency and a landowner.

Number 2, above, is not supported by the larger area correlation mentioned above, as larger landowners tend to have more money to spend on plans, species, etc.; although, depending on the number of ESA species using the plan area, perhaps not per capita.

This study's findings in this area of analysis is cause for concern. The standard of scientific adequacy decreasing with the amount of species in danger of extinction throughout all or a significant portion of their range, or likely to become so within the foreseeable future, puts these species at increased risk of extinction. The intent of Congress, reflecting the intent of their constituents, in creating the Endangered Species Act of 1973 and passing the subsequent reauthorizations, was to protect species from becoming extinct in the United States. The trend found by this study calls into question the implementation of this intent.

Limitations

The limitations of this study include, but may not be limited to, the focus on one species and one habitat, the small number of HCPs examined, and potential interaction between factors evaluated in the study. The research only supports conclusions on the adequacy of science used in the Endangered Species Act of 1973 when it complements findings in related areas such as the listing of species, species recovery plans, and designation of critical habitat.

Research focuses on the scientific adequacy of information used for one species, the marbled murrelet (*Brachyramphus marmoratus*), in four extant HCPs. The scientific

adequacy of a plan may be over or under estimated based solely on marbled murrelet data. A plan may be particularly weak or strong in relationship to the science used with other species in the plan, therefore the quality of the entire HCP may not be accurately reflected by the species analysis. To obtain a more accurate reflection of the entire plan, the science used to address all species would need to be analyzed as extensively as this study examines the marbled murrelet.

The number of plans examined in this study, four, is a small proportion of completed plans and the results of analysis cannot be extrapolated to the over 200 in existence. In order to obtain a comprehensive analysis of the science used for the marbled murrelet, all plans containing the species need to be examined. The small number of plans prevents a study-specific statistical analysis to test the measures of adequacy as the error involved is restrictive.

The case studies are for forested areas containing prime habitat for the marbled murrelet, old-growth conifers, in the Pacific Northwest. While the amount of forestland in the Pacific Northwest being affected by HCPs is large, this area of analysis may not be an accurate reflection of the scientific adequacy of HCPs in other regions. The public and private entities and implementing agencies in this region and field of study may create plans differently than in other regions and disciplines due to factors such as politics, economics, and public awareness.

CONCLUSIONS AND RECOMMENDATIONS

This study has several conclusions and recommendations based upon study results. In addition, background research and the study process provided insight reflected in this section. The focus of this study, Habitat Conservation Plans (HCPs) that are issued to landowners for incidental take of species listed under the ESA, will be discussed first. These documents, along with the taking of species listed under the ESA, are a current reality for endangered species and their use is increasing in rate and scope. Recommendations regarding old-growth forest ecosystems, the focal habitat examined by this study, are also made. Research and funding for related areas are also discussed in this section. This study's focal species, the marbled murrelet, is discussed throughout the sections mentioned above.

Habitat Conservation Plans

Based upon study results, this study has several recommendation concerning HCPs. HCPs should:

1) Be scientifically adequate,
2) Cover a limited area,
3) Pay more attention to areas that have a high number of ESA species,
4) Not contain "No Surprises" clauses,
5) Be limited in the number of species that can be covered under an Incidental

Take Permit,

6) Cover a limited time span,

7) Contain a Scientific Database for Each Species Central Depository, and

8) Be organized clearly and in relation to requirements.

1. Scientific adequacy. In order to be scientifically adequate the HCP should be required to present extensive and accurate scientific information and data concerning the environment covered by a plan. The existing scientific literature on all pertinent related research should be included and summarized in a plan. This data should include quantified amounts of habitat types and the quality of the habitat for the species inhabiting the plan area. The HCP should also be required to quantify the anticipated take in amount of habitat and number of species. The impact of the take should be required to contain local, bioregion, and global perspective. All monitoring should be thorough and performed by independent entities to ensure unbiased results.

2. Limited area. HCPs are beginning to cover large expanses of land in the United States. A finding of this study suggests that as area increases, adequacy of HCP science may decrease. In addition, prior research regarding numerous plan flaws was supported by this study. In light of these findings, this study recommends that the area of HCPs be limited until it has been determined that HCPs are using adequate scientific data and analysis and are successfully conserving habitat and species.

3. Attention to areas with high number of ESA species. The finding of this study that as the number of ESA listed species increases, the level of science may decreases is

troubling in many respects, especially concerning the intent of the ESA and associated federal regulations. Areas with a high number of ESA species are likely to be fragile, sensitive ecosystems that need an associated high level of science, protection, and attention.

4. No Surprises. The 'No Surprises' clause found in a large number of HCPs (all four plans examined by this study) states that the regulatory agencies, United States Fish and Wildlife Service and the National Marine Fisheries Service, will not require additional lands, additional funds, or additional restrictions on lands or other natural resources released for development or use, from any permittee who is implementing an approved HCP should "unforeseen circumstances" occur, such as the listing of a species under the ESA. This unscientific clause should not be attached to any HCP as it furthers the risk of extinction of listed species and those that may become listed in the future. The natural world is full of surprises and contains processes and relationships currently not understood by humans. This clause does not address these issues and, as is demonstrated by the findings of this study, can imbed inadequate science for extended periods of time in management plans.

5. Limitation of ITP species. The number of species being locked into inadequate science for long periods of time by HCPs and "No Surprises" clauses is imperiling species that are already on the brink of extinction, as well as the other species inhabiting the HCP area. The number of species that can be covered under an Incidental Take Permit (ITP) should be limited to a small number. This will encourage more extensive planning for the covered species and prevent numerous species from being

covered by plans when little is known or projected concerning status; a status that may likely change over the life of a plan.

6. Limited duration. As is demonstrated in this study, HCPs/ITPs are currently covering long periods of time (up to 100 years). This does not make scientific sense as emerging information on a species will not necessarily benefit the species as a landowner with a permit is not required to acknowledge or act upon the information. A limited time duration of HCPs will ensure that new information will be more available to planners and perhaps required by regulatory agencies to be included in HCPs, increasing the adequacy of the documents and the entire process.

7. Species database. A species 'database,' a scientific summary of current species information and research to date, for all species found in the plan area should be required in every HCP. The database should include extensive information on a species, especially as it relates to HCPs. This database could be obtained from an official provider, such as the United States Fish and Wildlife Service or another approved group or agency. A HCP should be required to make clear and relevant assessments based on this database.

8. Organization. This study recommends HCPs be organized according to the Section 10(a) ESA requirements they are being prepared to meet. The following six criteria must be met for the USFWS and National Marine Fisheries (herein "Services") to issue an Incidental Take Permit (ITP) under 10(a)(2)(B) of the ESA:

1) The take will be incidental to otherwise lawful activities and not the purpose of such activities;

2) The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking;
3) The applicant will ensure that adequate funding for the Habitat Conservation Plan and procedures to deal with unforeseen circumstances will be provided;
4) The taking will not appreciable reduce the likelihood of survival and recovery of the species in the wild;
5) The applicant will ensure that other measures that the Services may require as being necessary or appropriate will be provided; and
6) The Services must receive such other assurances as may be required that the HCP will be implemented.

In addition, under section 10(a)(2)(A) and Federal regulations 50 CFR 17.22 (b)(1)(iii)(C), the HCP submitted in support of an ITP must specify the following:

1) Impacts likely to result from the proposed taking of one or more federally listed wildlife species;
2) Measures the applicant will undertake to monitor, minimize, and mitigate such impacts; the funding that will be made available to undertake such measures; and the procedures to deal with unforeseen circumstances;
3) Alternative actions to the proposed taking that were considered but not selected, and the reasons why such alternatives are not being utilized; and
4) Additional measures the Services may require as necessary or appropriate for purposes of the HCP.

In summary of the above and the findings of this study, it is recommended that all HCPs be required to contain the following sections, preferably in order, and all clearly labeled:

1) Scientific Database for Species Covered;
2) Status of Species Covered;
3) Assessment of Take for Species Covered;
4) Impact of Take on Population and Species;
5) Avoidance, Minimization, and Mitigation of Take;
6) Monitoring of Take, Population Health, and Plan Success;
7) Adaptive Management;
8) Other Alternatives Considered; and
9) Analysis of Funding for Plan Management.

This standardized HCP would facilitate the ability of interested and affected persons to read and comprehend the sometimes multi-volumed documents. If HCPs are organized in this clear and scientific manner there will be less confusion and guesswork on the part of a reader regarding plan assessments, decisions, and the sources and reliability of the information and data they were based upon.

Old-Growth Forest Ecosystems

Old-growth forests, characterized by a range of tree ages and sizes (consisting of both rapid-growing and slow-growing individuals), a multilayered canopy, abundant shade-tolerant species, numerous large, standing snags and downed trees of various size and decay classes, and abundant tree cavities, are an endangered ecosystem. The coast redwood ecosystem is an example of the loss that has occurred to these unique ecosystems; 96 percent of the original old-growth redwood forest has been destroyed by logging. This study documents the inadequate level of science contained in HCPs for these ecosystems as well as their continued loss, fragmentation, and degradation.

As the old-growth forest ecosystem has been so detrimentally affected, this study recommends protecting the remaining old-growth forests in whatever manner possible. Once these forests are destroyed they will most likely never recover to their original state. The characteristics of this ecosystem, mentioned above, take hundreds of years to occur, although some land managers believe they can manage forests to this condition faster, a belief that remains yet to be supported by science or by species habitat affiliations.

As the current trend in forestry in the United States and elsewhere is skewed toward young, even-aged stands, this study recommends the protection of residual old-growth forests (forests that have been logged but still retain significant old-growth forest characteristics) and mature forests (late-successional and otherwise). This protection will help to minimize and mitigate the harm done to the ecosystem and the species dependent upon it as well as ensure a net increase in old-growth forests in the future.

As has been determined for the marbled murrelet due to habitat loss (i.e. loss of old-growth, residual, and mature forests with sufficient canopy closure, nesting platforms, etc.), the next 50 years are crucial to the survival of this ecosystem. If the small amount of remaining older forests are not protected from the harmful effects of logging, road building, conversion, etc., the entire old-growth ecosystem and the habitat it supports will decrease further and become more fragmented, significantly increasing the risk of extinction for the marbled murrelet and the numerous other species, known and unknown, that rely upon it.

This study recommends that old-growth, residual old-growth, and mature forests be protected through acquisition. As demonstrated by this study, acquisition by the federal or state government (or by a third party that donates the purchase to such) is more likely to be successful than relying on management plans, including HCPs. Acquisition will be most successful when it is in large amounts in pristine, undamaged areas. The addition to protected old-growth, residual, and mature forest areas through buffer acquisition will help reduce fragmentation and edge and increase the quality of interior conditions in time.

In the absence of protection, this study recommends no further Habitat Conservation Plans or similar management plans be created or approved for ecosystems containing old-growth, residual old-growth, or mature forests. This recommendation is due to the finding of the absence of sufficient scientific standards in such plans. Management of these areas can not continue in the current manner with the expectation that the ecosystem and the species that depend on it will avoid extinction.

The above recommendations for old-growth, residual old-growth, and mature forests will help the numerous species that, through their dependence on these endangered ecosystems, are in danger of extinction themselves. If these recommendations are followed in a timely and sufficient manner, there remains a chance that previous and continuing losses can be overcome and this ecosystem and its inhabitants will avoid extinction.

Research

Through this study's analysis of four HCPs, the need for research in several areas has surfaced. Scientific research for the marbled murrelet is needed, as is continued research on the scientific adequacy of HCPs and other factors of the Endangered Species Act of 1973 (ESA).

Adequate knowledge of a species' background and status is often necessary in order to protect it from becoming extinct due to human actions. The focus of this study, the marbled murrelet, is a small secretive seabird that flies extremely fast. It has taken researchers several decades to learn the small amount of information which now exists for the species. One area that is in need of research for the marbled murrelet is population assessments and trends. Information of this type is intermittent and has a relatively large range.

While the types of habitat the marbled murrelet nests in is widely known, the quantifiable amounts and trends of suitable habitat need to be understood further. The associated levels of species take due to habitat loss needs to be studied. Several aspects

of the marbled murrelet's life that are somewhat understood need further research to clarify data and strengthen or weaken perceived trends; these include nest fidelity, stand dispersal, fecundity, and seasonal visitation.

Further research into these and other areas concerning the marbled murrelet will contribute to the assessments made about status and help to clarify the acceptability of take. The information currently available and future information made available through research should be consolidated into a comprehensive database to be consulted during decisions effecting the species (See Habitat Conservation Plans above).

Further research is necessary concerning the scientific adequacy of HCPs and other areas contributing to the Endangered Species Act of 1973 (ESA). The findings of this study need to be strengthened or weakened by further analysis of HCPs based on land ownership, area covered, number of species addressed (for incidental take), and number of species listed under the ESA. Further research is also recommended for other aspects of HCPs, recovery plans, and the ESA listing and delisting processes. The findings of this study combined with the findings of research into these other areas will help to provide an assessment of the effectiveness of the ESA in general.

Funding

To achieve many of the previously mentioned recommendations, funding must be provided in several areas. This study recommends prioritizing funding as follows:

1) Acquisition of endangered ecosystems, including old-growth, residual old-growth, and mature forests;

2) Creation of scientific databases for all species listed under the Endangered Species Act of 1973 (ESA) to be required for HCPs and other actions affecting these species;
3) Increase of regulatory agencies ability to adequately assess, enforce, and monitor HCPs and other actions affecting ESA species;
4) Acquisition of buffer areas and other important habitat; and
5) Research into the requirements of species listed under the ESA, including potential of meeting the requirements and prioritization of species.

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APPENDIX A

SPECIES-BASED QUESTIONS ASKED OF FOUR CASE STUDY HCPS

Source : Kareiva et al. 1999. Using science in habitat conservation plans. Washington D.C. : American Institute of Biological Sciences.

General guidelines:

FOR ALL QUESTIONS

-1 = Data/info does not exist
-2 = Not applicable
-3 = Could not be determined

FOR RANKED SERIES

-1 = Not used at all
1 = Most important
2 = Next most important
...etc.
When ties exist, subsequent items are "gap ranked."
E.g., if two items receive a ranking of 1, then the next most important item is scored as a 3 (not a 2).

FOR YES/NO QUESTIONS

0= No
1= Yes

SPECIAL CATEGORICAL RESPONSES

In cases where question-specific categorical responses are required, the category codes are indicated beneath the question.

FOR ADEQUACY RATINGS {Used for B43, C33, D47, E45, E47, E49, F80}:

1 = Excellent
2 = Above average
3 = Sufficient
4 = Significantly lacking in data or analysis to reach conclusions
5 = Inadequate
6 = Extremely poor

CODES FOR QA-QN SUBQUESTIONS [Used when indicated in brackets] :

QA: Was this information used in the HCP?

0 = No
1 = Global information was used, but not local
2 = Local information was used
3 = Both global and local information was used

QB: What was the data quality?

1 = Expert opinion
2 = Qualitative data
3 = Quantitative data with limited and/or poor statistical analysis
4 = Quantitative data with clear and relevant analysis
5 = Quantitative data used with good modeling of processes to extrapolate into the future

QC: How was the data used to make the assessment?

0 = Nonexistent; no clear or logical relationship between the information and conclusions
1 = Some connection, but utterly inadequate to base assessments on
2 = Reasonably good
3 = Excellent analysis; conclusions follow clearly and believably from the data and analysis

QD: Importance of missing information. For this type of information was significant information or analysis THAT DID EXIST missing from the HCP?

0 = Nothing significant missing
1 = Some information that was available was missing, but not too important
2 = Significant information was missing that would have changed some quantitative conclusions
3 = Starkly necessary information was missing that would have changed the conclusions qualitatively and substantially

QE: [y/n] Did the HCP consider this as effect?

QF: What did the HCP conclude about this effect?

1 = Not a noticeable effect at all
2 = Some effect, but not of any consequence
3 = A moderately important effect that bears consideration
4 = A serious effect that will significantly impact the population

QG: What is your assessment of this possible effect on the species/population from the planned HCP activities?

1 = Not a noticeable effect at all
2 = Some effect, but not of any consequence
3 = A moderately important effect that bears consideration
4 = A serious effect that will significantly impact the population

QH: [y/n] Was this measure considered in the HCP?

QI: How much reliance is there on this measure in the plan?

0 = None
1 = Very little
2 = Some, but of secondary importance
3 = The, or one of the, major mitigation measures used in the plan

QJ: For this particular mitigation measure, how good is the data to back up its use and reliability?

0 = None
1 = Very little, or quite unreliable
2 = Moderately well-understood and reliable
3 = Proven to work

QK: Is the mitigation to be done mostly on or off the HCP lands?

1 = On
2 = Off

QL: What is the quality of the data to be collected?

0 = Not collected
1 = Expert opinion/assessments
2 = Qualitative data
3 = Quantitative data with limited and/or poor statistical analysis proposed
4 = Quantitative data with clear and relevant analysis
5 = Quantitative data used with good modeling of processes to extrapolate into the future

QM: Is there a clear connection between the data to be collected and monitoring goal?

0 = Nonexistent; no clear or logical relationship between the information and monitoring goals
1 = Some connection, but utterly inadequate to base assessments on
2 = Reasonably good
3 = Excellent analysis; conclusions follow clearly and believably from the data and analysis

QN: For this species and the impacts, mitigation measures, etc. planned, how are the data of this type that are crucial for an effective monitoring program?

0 = Nothing significant missing from planned monitoring
1 = Some information is missing, but mostly the planned efforts are adequate
2 = Some data that are quite important will not be monitored
3 = Starkly necessary information will not be monitored

FOCAL SPECIES QUESTIONS

A. Basic Status and General Information	
A1	HCP landowner
A2	Species Analyzed (MM = *Brachyramphus marmoratus*)
A3	Taxonomic group 1 = mammal 4 = fish 2 = bird 5 = invertebrate 3 = reptile/amphibian 6 = plant
A4	Treated as a " primary " (1) or "secondary" (2) species
A5	[y/n] Is this a 'habitat-based' HCP?
A6	State or Local Legal status (see codes below)
A7	Federal Legal status (see codes below) 1 = Candidate 2 = Threatened 3 = Endangered
A8	[y/n] Is there a recovery plan?
A9	If yes to A8: Year recovery plan was established
A10	[y/n] Has critical habitat been designated?
A11	If yes to A10: Year critical habitat was designated
Ranked Severity of Threats to this Species	
(separate rankings for *on HCP land* and *Globally*) :	
A12	[HCP, Globally] Habitat loss
A13	[HCP, Globally] Habitat degradation
A14	[HCP, Globally] Habitat fragmentation
A15	[HCP, Globally] Direct Human-caused mortality
A16	[HCP, Globally] Pollution
A17	[HCP, Globally] Water diversion/damming
A18	[HCP, Globally] Invasive species
A19	[HCP, Globally] Changes in food species
A20	[HCP, Globally] Changes in predator/parasite/disease species
A21	[HCP, Globally] Natural rarity
A22	[HCP, Globally] Other
A23	[HCP, Globally] Unknown
A24	[HCP, Globally] No known threats at this time
A25	[y/n] Is the species endemic to the counties in which HCP lands occur?
A26	[y/n] Is the species endemic to the state(s) in which the HCP lands occur?
A27	Mean lifespan in years of an individual that makes it through juvenile period
A28	Net reproductive rate (Ro)
A29	Clutch or litter size
A30	Duration of the plan (in years), as a whole

A31	Does the duration of the plan as a whole make sense in light of the species lifespan, life history, etc., plus the knowledge/ignorance of the species and the effects of the plan upon it?
	1 = There is little reason to think that the plan duration accounts for the species biology 2 = There is a plausible match between the species biology and the plan duration 3 = There is an explicit accounting for the species biology; the plan seems well-tailored to the species

B. Assessment of Current Status	
Types of Information Used to Assess Background and Current Status	
B1	[QA-QD] General Habitat affiliations
B2	[QA-QD] Amount and quality of feeding habitat
B3	[QA-QD] Amount and quality of breeding habitat
B4	[QA-QD] Amount and quality of migration habitat
B5	[QA-QD] Trends in habitat qualities
B6	[QA-QD] Trends in habitat amounts
B7	[QA-QD] Habitat fragmentation/habitat isolation
B8	[QA-QD] Population size
B9	[QA-QD] Trends in population sizes
B10	[QA-QD] Population trends by habitat types
B11	[QA-QD] Demographic rates/demographic models
B12	[QA-QD] Basic genetics (e.g. current homozygosity and inbreeding problems)
B13	[QA-QD] Genetic structure and unique value of certain populations
B14	[QA-QD] Movement abilities of individuals
B15	[QA-QD] Effects of future changes in extrinsic factors
B16	[QA-QD] Changes in/interactions with food species
B17	[QA-QD] Changes in/interactions with consumer species
B18	[QA-QD] Less direct species interactions (e.g. trophic cascades)
B19	[QA-QD] Pollution data
B20	[QA-QD] Climate change data
B21	[QA-QD] Succession, predictable disturbance regimes (e.g. fire, flooding)
B22	[QA-QD] Normal Environmental stochasticity (e.g. yearly weather fluctuations)
B23	[QA-QD] Natural or anthropogenic catastrophes
B24	[QA-QD] Cumulative effects (interaction of factors)
B25	[QA-QD] Other
Assessments Made in the HCP about Current Status	
B26	[y/n] In HCP area: Is there currently enough habitat for the species' safety?
B27	[y/n] Globally: Is there currently enough habitat for the species' safety?
	Note: 'Safety' is taken to mean that there is enough habitat to ensure a minimal or no likelihood of extinction of the population of species.

B28	In HCP area: Quality of most remaining habitat
B29	Globally: Quality of most remaining habitat
	1 = Poor; populations are likely to decline through time if isolated 2 = Medium; populations may be self-sustaining, but produce no excess individuals 3 = Excellent; populations can act as sources
B30	In HCP area: Population trends
B31	Globally: Population trends 0 = Declining very rapidly (extinction considered possible within 20 years) 1 = Declining, on the whole 2 = Stable, on the whole 3 = increasing, on the whole
B32	In HCP area: Average rate of changes in populations: (Estimate of lambda)
B33	Globally: Average rate of changes in populations: (Estimate of lambda)
B34	In HCP area: Trends in habitat quantity
B35	Globally: Trends in habitat quantity
	0 = Declining very rapidly (extinction considered possible within 20 years) 1 = Declining, on the whole 2 = Stable, on the whole 3 = Increasing, on the whole
B36	In HCP area: Rate of changes in habitat amounts (estimate of annual multiplication rates)
B37	Globally: Rate of changes in habitat amounts (estimate of annual multiplication rates)
B38	In HCP area: Trends in geographic range
B39	Globally: Trends in geographic range
	0 = Contracting very rapidly 1 = Contracting 2 = Stable 3 = Expanding
B40	In HCP area: Rate of range change (estimate of annual multiplication rates)
B41	Globally: Rate of range change (estimate of annual multiplication rates)
B42	[y/n] Qualitative Assessment: Is there sufficient data on the background to actually determine something clear about status?
B43	Rate overall adequacy (1-6):

C. Assessment and Conclusions about Taking	
C1	Overall, was the analysis of take based upon calculations of habitat loss (1), or loss of individuals of the species (2)?
C2	[QA-QD] General, unspecific expert opinion
C3	[QA-QD] Loss of general habitat for the species
C4	[QA-QD] Loss of habitat accounting for different habitat qualities

C5	[QA-QD] General Population densities
C6	[QA-QD] Habitat-specific densities
C7	[QA-QD] Life history data in relation to take
C8	[QA-QD] Population sizes
C9	[QA-QD] Trends in population sizes
C10	[QA-QD] Demographic rates/demographic models
C11	[QA-QD] Movement abilities of individuals
C12	[QA-QD] Effects of future extrinsic forces (climate change, invasive species)
C13	[QA-QD] Habitat fragmentation/population isolation
C14	[QA-QD] Edge effects
C15	[QA-QD] Changes in/interactions with food species
C16	[QA-QD] Changes in/interactions with consumer species
C17	[QA-QD] Trophic cascades
C18	[QA-QD] Pollution and other indirect impacts
Ranked Relative Importance of the Following as Elements of the Take That Will Occur:	
C19	Loss of adult individuals
C20	Loss of juveniles and propagules
C21	Harassment of individuals
C22	Loss of habitat
C23	Degradation of habitat
C24	Indirect effects
Conclusions in HCP About Take Levels:	
C25	[y/n] Will take occur?
C26	Predicted percentage of the impacted population that will be taken
C27	Total predicted number of individuals that will be taken
C28	Life stage that will primarily be taken 1 = Juveniles 2 = Adults
C29	Duration (in years) of take
C30	[y/n] Are life-stages, sex, etc. of individuals to be taken estimated?
C31	[y/n] Will critical habitat be affected by the activities of the HCP?
C32	[y/n] Qualitative Assessment: Is there sufficient data and analysis to actually determine something clear about take?
C33	Rate overall adequacy (1-6):

D. Assessment of Effects on Population and/or Species	
General Theory:	
D1	[QA-QD] Genetic
D2	[QA-QD] Population ecology
D3	[QA-QD] Behavior and physiology

D4	[QA-QD] Island biogeography
D5	[QA-QD] Community ecology
D6	[QA-QD] Ecosystem ideas
Species Specific Analysis and Data:	
D7	[QA-QD] General Habitat affiliations
D8	[QA-QD] Amount and quality of feeding habitat
D9	[QA-QD] Amount and quality of breeding habitat
D10	[QA-QD] Amount and quality of migration habitat
D11	[QA-QD] Trends in habitat qualities
D12	[QA-QD] Trends in habitat amounts
D13	[QA-QD] Habitat fragmentation/habitat isolation
D14	[QA-QD] Population size
D15	[QA-QD] Trends in population sizes
D16	[QA-QD] Population trends by habitat types
D17	[QA-QD] Demographic rates/demographic models
D18	[QA-QD] Basic genetics(e.g. current homozygosity and inbreeding problems)
D19	[QA-QD] Genetic structure and unique value of certain populations
D20	[QA-QD] Movement abilities of individuals
D21	[QA-QD] Effects of future changes in extrinsic factors
D22	[QA-QD] Changes in/interactions with food species
D23	[QA-QD] Changes in/interactions with consumer species
D24	[QA-QD] Less direct species interactions (e.g. trophic cascades)
D25	[QA-QD] Pollution data
D26	[QA-QD] Climate change data
D27	[QA-QD] Succession, predictable disturbance regimes (e.g. fire, flooding)
D28	[QA-QD] Normal Environmental Stochasticity (e.g. yearly weather fluctuations)
D29	[QA-QD] Natural or anthropogenic catastrophes
D30	[QA-QD] Cumulative effects (interaction of factors)
D31	[QA-QD] Other
Types of Effects Considered Important in HCP:	
D32	[QE-QG] Total Acreage of habitat lost
D33	[QE-QG] Total Individuals killed
D34	[QE-QG] habitat degradation
D35	[QE-QG] % habitat lost
D36	[QE-QG] % Individuals killed
D37	[QE-QG] Fragmentation of habitat
D38	[QE-QG] Reduced movement rates
D39	[QE-QG] Edge effects
D40	[QE-QG] Altered intra-specific interactions
D41	[QE-QG] Altered inter-specific interactions (e.g. disease & exotics)

D42	[QE-QG] Genetic consequences
D43	[QE-GG] Non-point source pollution
D44	[QE-QG] Interactions of factors (i.e. cumulative impacts)
D45	[QE-GG] Other
D46	[y/n] Qualitative Assessment: Is there sufficient data and analysis to actually determine something clear about the impacts of the taking?
D47	Rate overall adequacy (1-6):

E. Assessment of Mitigation/Minimization Measures	
Category of Information Used to Assess General Theory:	
E1	[QA-QD] Genetic
E2	[QA-QD] Population ecology
E3	[QA-QD] Behavior and physiology
E4	[QA-QD] Island biogeography
E5	[QA-QD] Community ecology
E6	[QA-QD] Ecosystem ideas
Species Specific Analysis and Data:	
E7	[QA-QD] General Habitat affiliations?
E8	[QA-QD] Amount and quality of feeding habitat
E9	[QA-QD] Amount and quality of breeding habitat
E10	[QA-QD] Amount and quality of migration habitat
E11	[QA-QD] Trends in habitat qualities
E12	[QA-QD] Trends in habitat amounts
E13	[QA-QD] Habitat fragmentation/habitat isolation
E14	[QA-QD] Population size
E15	[QA-QD] Trends in population sizes
E16	[QA-QD] Population trends by habitat types
E17	[QA-QD] Demographic rates/demographic models
E18	[QA-QD] Basic genetics (e.g. current homozygosity and inbreeding problems)
E19	[QA-QD] Genetic structure and unique value of certain populations
E20	[QA-QD] Movement abilities of individuals
E21	[QA-QD] Effects of future changes in extrinsic factors
E22	[QA-QD] Changes in/interactions with food species
E23	[QA-QD] Changes in/interactions with consumer species
E24	[QA-QD] Less direct species interactions (e.g. trophic cascades)
E25	[QA-QD] Pollution data
E26	[QA-QD] Climate change data
E27	[QA-QD] Succession, predictable disturbance regimes (e.g. fire, flooding)
E28	[QA-QD] Normal environmental stochasticity (e.g.yearly weather fluctuations)
E29	[QA-QD] Natural or anthropogenic catastrophes
E30	[QA-QD] Cumulative effects

E31	[QA-QD] Other
Types of Mitigation/Minimization Measures Considered and Proposed:	
E32	[QH-QK] Avoidance of impacts, while still doing the proposed activity
E33	[QH-QK] Minimization of impacts, while still doing the proposed activity
E34	[QH-QK] Land acquisitions
E35	[QH-QK] Conservation easements
E36	[QH-QK] Habitat banks (exchange rates)
E37	[QH-QK] Translocations
E38	[QH-QK] Restoration of total habitat areas
E39	[QH-QK] Maintain/restore disturbance regimes
E40	[QH-QK] Remove exotics
E41	[QH-QK] Money for research
E42	[QH-QK] Other
Types of Mitigation/Minimization Measures Considered and Proposed:	
E43	[y/n] Is mitigation part of a larger strategy?
E44	[y/n] Does the mitigation plan address the primary threats to the species continued existence?
E45	Rate overall adequacy in addressing primary threats (1-6):
E46	[y/n] Does the plan demonstrate that the impact on the species was minimized to the maximum extent possible, providing economic data to support this?
E47	Rate overall adequacy in demonstrating impact minimization (1-6):
E48	[y/n] Qualitative Assessment: Sufficient data? Determine likely success of the mitigation planned? Use of this mitigation approach justified? Succeed with likelihood? Are the mitigation ratios supported by data?
E49	Rate overall adequacy (1-6):

F. Assessment and Planning of Monitoring Program	
Monitoring of Take Levels:	
F1	Who is monitoring take ? 1 = Private consulting firms 2 = Academic scientists 3 = Employees of land-holder 4 = Employees of local government 5 = State government employees 6 = Federal employees 7 = Committee/consortium with multiple representatives 8 = NGO
F2	[y/n] Is there clear evidence that the monitoring personnel/groups chosen will be competent to carry out the task well?
F3	Duration in years of the planned monitoring [999 = "in perpetuity"]

F4	Frequency (in rounds per year) of monitoring activities
F5	[y/n] Are data to be collected sufficient to determine take levels?
F6	[y/n] Is there an unambiguous plan to change the HCP strategy in response to new monitoring information?
What Data Will be Collected and Analyzed to Monitor Take?	
F7	[QL-QN] Physiological data
F8	[QL-QN] Behavioral data
F9	[QL-QN] Presence/absence data
F10	[QL-QN] Population densities
F11	[QL-QN] Population size
F12	[QL-QN] Population trends
F13	[QL-QN] Survival rates
F14	[QL-QN] Reproductive rates
F15	[QL-QN] Growth rates
F16	[QL-QN] Genetic data
F17	[QL-QN] Movement rates
F18	[QL-QN] Metapopulation dynamics/source-sink, etc.
F19	[QL-QN] Invasive species data
F20	[QL-QN] Effects of climate change data
F21	[QL-QN] Data on food or consumer species
F22	[QL-QN] Inter-specific interactions (e.g. disease) affecting species
F23	[QL-QN] Amount and trends in Habitat quantity
F24	[QL-QN] Amount and trends in Habitat quality
F25	[QL-QN] Pollution and other physical factors
F26	[QL-QN] Data on life history stage duration, numbers, etc.
Monitoring for General Population Health: Assessment of No Net Harm?	
F27	Who is monitoring the population? 1 = Private consulting firms 2 = Academic scientists 3 = Employees of land-holder 4 = Employees of local government 5 = State government employees 6 = Federal employees 7 = Committee/consortium with multiple representatives 8 = NGO
F28	[y/n] Is there clear evidence that the monitoring personnel/groups chosen will be competent to carry out the task well?
F29	Duration (in years) of the planned monitoring [999 = "in perpetuity"]
F30	Frequency (in rounds per year) of monitoring activities
F31	[y/n] Are data to be collected sufficient to determine population status?

F32	[y/n] Is there an unambiguous plan to change the HCP strategy in response to new monitoring information ?
What Data Will be Collected and Analyzed to Monitor Population Status?	
F33	[QL-QN] Physiological data
F34	[QL-QN] Behavioral data
F35	[QL-QN] Presence/absence data
F36	[QL-QN] Population densities
F37	[QL-QN] Population size
F38	[QL-QN] Population trends
F39	[QL-QN] Survival rates
F40	[QL-QN] Reproductive rates
F41	[QL-QN] Growth rates
F42	[QL-QN] Genetic data
F43	[QL-QN] Movement rates
F44	[QL-QN] Metapopulation dynamics/source-sink, etc.
F45	[QL-QN] Invasive species data
F46	[QL-QN] Effects of climate change data
F47	[QL-QN] Data on food or consumer species
F48	[QL-QN] Inter-specific interactions (e.g. disease) affecting species
F49	[QL-QN] Amount and trends in Habitat quantity
F50	[QL-QN] Amount and trends in Habitat quality
F51	[QL-QN] Pollution and other physical factors
F52	[QL-QN] Data on life history stage duration, numbers, etc.
Monitoring of Mitigation Success	
F53	Who is monitoring the mitigation? 1 = Private consulting firms 2 = Academic scientists 3 = Employees of land-holder 4 = Employees of local government 5 = State government employees 6 = Federal employees 7 = Committee/consortium with multiple representatives 8 = NGO
F54	[y/n] Is there clear evidence that the monitoring personnel/groups chosen will be competent to carry out the task well?
F55	Duration (in years) of the planned monitoring [999 = "in perpetuity"]
F56	Frequency (in rounds per year) of monitoring activities
F57	[y/n] Are data to be collected sufficient to determine mitigation success ecologically?

F58	[y/n] Is there an unambiguous plan to change the HCP strategy in response to new monitoring information?
What Data Will be Collected and Analyzed to Monitor Mitigation Success?	
F59	[QL-QN] Physiological data
F60	[QL-QN] Behavioral data
F61	[QL-QN] Presence/absence data
F62	[QL-QN] Population densities
F63	[QL-QN] Population size
F64	[QL-QN] Population trends
F65	[QL-QN] Survival rates
F66	[QL-QN] Reproductive rates
F67	[QL-QN] Growth rates
F68	[QL-QN] Genetic data
F69	[QL-QN] Movement rates
F70	[QL-QN] Metapopulation dynamics/source-sink, etc.
F71	[QL-QN] Invasive species data
F72	[QL-QN] Effects of climate change data
F73	[QL-QN] Data on food or consumer species
F74	[QL-QN] Inter-specific interactions (e.g. disease) affecting species
F75	[QL-QN] Amount and trends in Habitat quantity
F76	[QL-QN] Amount and trends in Habitat quality
F77	[QL-QN] Pollution and other physical factors
F78	[QL-QN] Data on life history stage duration, numbers, etc.
F79	[y/n] Qualitative Assessment: are there sufficient data and analyses proposed to actually determine something clear about the usefulness and the actual use of the monitoring planned?
F80	Rate overall adequacy (1-6):

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	Jordan	Justification	Jordan	Justification
A1	WADNR		Plum Creek	
A2	MM		MM	
A3	2		2	
A4	1		1	
A5	1		1	
A6	2		2	
A7	2		2	
A8	1		1	
A9	1997		1997	
A10	1		1	
A11	1996		1996	
A12HCP	1		1	
A12Glo	1		1	
A13HCP	2		3	
A13Glo	3		3	
A14HCP	3		2	Checkerboard ownership
A14Glo	3		3	
A15HCP	-1		-1	No marine environment
A15Glo	2		2	
A16HCP	-1		-1	
A16Glo	5		5	
A17HCP	-1		-1	
A17Glo	-1		-1	
A18HCP	-1		-1	
A18Glo	8		8	
A19HCP	-1		-1	
A19Glo	7		7	
A20HCP	4		5	Edge
A20Glo	6		6	Edge
A21HCP	-1		4	
A21Glo	-1		-1	
A22HCP	-1		-1	
A22Glo	-1		-1	
A23HCP	-1		-1	
A23Glo	-1		-1	
A24HCP	-2		-2	
A24Glo	-2		-2	
A25	0		0	
A26	0		0	
A27	-1		-1	
A28	-1		-1	
A29	1		1	
A30	70 (100)		100	
A31	-1		-1	
B1QA	3		3	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
B1QB	3		3	
B1QC	1		2	
B1QD	1	Better loss doumentation	1	Lack full perspective
B2QA	3	Global : III.42	0	
B2QB	3		-2	
B2QC	2		-2	
B2QD	0		0	
B3QA	3		3	
B3QB	4		3	
B3QC	1		1	
B3QD	0		2	Only 40 mile inland survey
B4QA	3		0	
B4QB	2		-2	
B4QC	1		-2	
B4QD	0		0	
B5QA	3		3	
B5QB	2		3	
B5QC	1		2	
B5QD	0		0	
B6QA	3		3	
B6QB	3	III.40	5	
B6QC	1		2	
B6QD	1	More quantified	0	
B7QA	3		3	
B7QB	2		5	
B7QC	1		2	
B7QD	0		0	
B8QA	3		3	
B8QB	4		3	
B8QC	2		2	
B8QD	0		0	
B9QA	3	III.36	3	
B9QB	3		3	
B9QC	2		2	
B9QD	0		0	
B10QA	1		0	
B10QB	2		-2	
B10QC	2		-2	
B10QD	0		0	
B11QA	1		0	
B11QB	4		-2	
B11QC	2		-2	
B11QD	0		0	
B12QA	1	III.41	0	
B12QB	2		-2	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
B12QC	1		-2	
B12QD	0		0	
B13QA	0		0	
B13QB	-2		-2	
B13QC	-2		-2	
B13QD	0		0	
B14QA	1		0	
B14QB	3		-2	
B14QC	1		-2	
B14QD	0		1	
B15QA	0		0	
B15QB	-2		-2	
B15QC	-2		-2	
B15QD	0		0	
B16QA	1		0	
B16QB	2		-2	
B16QC	1		-2	
B16QD	0		0	
B17QA	1		0	
B17QB	2		-2	
B17QC	1		-2	
B17QD	0		0	
B18QA	0		0	
B18QB	-2		-2	
B18QC	-2		-2	
B18QD	0		0	
B19QA	3	III.43	0	
B19QB	2		-2	
B19QC	1		-2	
B19QD	0		0	
B20QA	0		0	
B20QB	-2		-2	
B20QC	-2		-2	
B20QD	0		0	
B21QA	0		0	
B21QB	-2		-2	
B21QC	-2		-2	
B21QD	1	Forest succession	1	Decline O-Grwth,windthrw
B22QA	3	Warm years III.37	0	
B22QB	2		-2	
B22QC	2		-2	
B22QD	0		1	El nino, weather
B23QA	3	III.42	0	
B23QB	3		-2	
B23QC	2		-2	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
B23QD	0		1	Oil spills
B24QA	3		0	
B24QB	2		-2	
B24QC	2		-2	
B24QD	0		1	Should use
B25QA	0	None other observed	0	
B25QB	-2		-2	
B25QC	-2		-2	
B25QD	0		0	
B26	-1		-1	This is unknown
B27	-1		-1	
B28	-1		1	
B29	2		2	
B30	1	III.36	-1	Not in HCP
B31	1		1	
B32	-1		-1	
B33	-1		-1	
B34	1		1	
B35	1		1	
B36	-1		-1	Data/Info. does not exist
B37	-1		-1	
B38	-1		-1	
B39	1		1	
B40	-1		-1	
B41	-1		-1	
B42	1	Gen.decline, FESA, etc.	1	
B43	4	Comment #1	4	Comment #1
C1	1		2	
C2QA	0		3	
C2QB	-2		3	
C2QC	-2		2	
C2QD	0		0	
C3QA	3		3	
C3QB	3	III.40	5	
C3QC	1		2	
C3QD	1	Global perspective	2	
C4QA	3		0	
C4QB	3	III.41	-2	
C4QC	1		-2	
C4QD	0		1	Fragmentation; edge
C5QA	0		0	
C5QB	-2		-2	
C5QC	-2		-2	
C5QD	0		0	
C6QA	0		0	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR	Plum Crk	
C6QB	-2	-2	
C6QC	-2	-2	
C6QD	0	2	III.40 & III.41 in WADNR
C7QA	0	0	
C7QB	-2	-2	
C7QC	-2	-2	
C7QD	0	0	III.40 & III.41 in WADNR
C8QA	0	0	
C8QB	-2	-2	
C8QC	-2	-2	
C8QD	0	0	
C9QA	0	0	
C9QB	-2	-2	
C9QC	-2	-2	
C9QD	0	1	
C10QA	0	0	
C10QB	-2	-2	
C10QC	-2	-2	
C10QD	0	1	Wouldn't change analysis
C11QA	3	3	Streams, Rivers: Fragm.
C11QB	2	3	
C11QC	1	1	
C11QD	0	0	
C12QA	0	0	
C12QB	-2	-2	
C12QC	-2	-2	
C12QD	0	0	
C13QA	3	0	
C13QB	3	-2	
C13QC	1	-2	
C13QD	0	2	WADNR 1997 III.41-frag.
C14QA	3	0	
C14QB	3	-2	
C14QC	1	-2	
C14QD	0	2	Serious to survival rate
C15QA	0	0	
C15QB	-2	-2	
C15QC	-2	-2	
C15QD	0	0	
C16QA	3	0	
C16QB	3	-2	
C16QC	1	-2	
C16QD	0	2	Incr. edge = incr. pred.
C17QA	0	0	
C17QB	-2	-2	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Pium Crk	
C17QC	-2		-2	
C17QD	0		0	
C18QA	0	Not used in HCP	0	
C18QB	-2		-2	
C18QC	-2		-2	
C18QD	0		1	
C19	4	Less important than C20	4	
C20	3	More important than C19	3	
C21	5		5	
C22	1		1	
C23	2		2	
C24	6	Least of these 6	6	
C25	1		-3	
C26	-3	Obscure habitat docum.	-3	
C27	-1		-1	
C28	-3		-3	
C29	70 (100)	Duration of plan	-3	
C30	0		0	
C31	1		0	
C32	0		0	
C33	5	Comment #2	4	Comment #2
D1QA	0		0	
D1QB	-2		-2	
D1QC	-2		-2	
D1QD	0		0	
D2QA	3		3	Technical report #2
D2QB	3		3	
D2QC	1		1	
D2QD	0		2	Only 40 mile inland survey
D3QA	3		0	
D3QB	2		-2	
D3QC	1		-2	
D3QD	0		0	
D4QA	0		0	
D4QB	-2		-2	
D4QC	-2		-2	
D4QD	0		0	
D5QA	0		3	
D5QB	-2		3	
D5QC	-2		1	
D5QD	2	III.26 and III.41; Edge	2	Predation due to fragmnt.
D6QA	0		3	
D6QB	-2		3	
D6QC	-2		2	
D6QD	0		0	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
D7QA	0		3	
D7QB	-2		3	
D7QC	-2		2	
D7QD	2	III.24; Interior; Edge	2	
D8QA	0		0	
D8QB	-2		-2	
D8QC	-2		-2	
D8QD	0		0	
D9QA	3		3	
D9QB	2		3	
D9QC	1		1	
D9QD	1	Quantitative data	2	
D10QA	0		0	
D10QB	-2		-2	
D10QC	-2		-2	
D10QD	0		0	
D11QA	0		3	
D11QB	-2		3	
D11QC	-2		1	
D11QD	2	incr. edge = decr. qual	2	PNWest fragmentation
D12QA	0		3	
D12QB	-2		3	
D12QC	-2		2	
D12QD	2	Quant.data:see D11:III.40	0	
D13QA	0		0	
D13QB	-2		-2	
D13QC	-2		-2	
D13QD	2	III.24; Interior; Edge	2	Interior; Edge
D14QA	0		0	
D14QB	-2		-2	
D14QC	-2		-2	
D14QD	0		0	
D15QA	0		0	
D15QB	-2		-2	
D15QC	-2		-2	
D15QD	0		0	
D16QA	0		0	
D16QB	-2		-2	
D16QC	-2		-2	
D16QD	0		0	
D17QA	0		0	
D17QB	-2		-2	
D17QC	-2		-2	
D17QD	0		0	
D18QA	1	III.41	0	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
D18QB	2		-2	
D18QC	1		-2	
D18QD	0		0	
D19QA	0		0	
D19QB	-2		-2	
D19QC	-2		-2	
D19QD	0		0	
D20QA	3		3	
D20QB	1		1	
D20QC	1		1	
D20QD	0	Unproven; Opp. findings	0	
D21QA	0		0	
D21QB	-2		-2	
D21QC	-2		-2	
D21QD	0		0	
D22QA	0		0	
D22QB	-2		-2	
D22QC	-2		-2	
D22QD	0		0	
D23QA	0		0	
D23QB	-2		-2	
D23QC	-2		-2	
D23QD	2	Not using own bkground	2	Edge
D24QA	0		0	
D24QB	-2		-2	
D24QC	-2		-2	
D24QD	0		0	
D25QA	0		0	
D25QB	-2		-2	
D25QC	-2		-2	
D25QD	0		0	
D26QA	0		0	
D26QB	-2		-2	
D26QC	-2		-2	
D26QD	0		0	
D27QA	0		0	
D27QB	-2		-2	
D27QC	-2		-2	
D27QD	0		0	
D28QA	0		0	
D28QB	-2		-2	
D28QC	-2		-2	
D28QD	0		0	
D29QA	0		0	
D29QB	-2		-2	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
D29QC	-2		-2	
D29QD	0		0	
D30QA	3	III.41	0	
D30QB	2		-2	
D30QC	0		-2	
D30QD	0		2	Fragmentation: edge
D31QA	0		0	
D31QB	-2		-2	
D31QC	-2		-2	
D31QD	0		0	
D32QE	0		1	
D32QF	-2		2	
D32QG	4		3	
D33QE	0		1	
D33QF	-2		1	
D33QG	4		1	
D34QE	1		0	
D34QF	3		-2	
D34QG	4		3	Fragmentation: edge
D35QE	1		1	
D35QF	3		1	
D35QG	4		3	Fragmentation: edge
D36QE	0		1	
D36QF	-2		1	
D36QG	4		3	Fragmentation: edge
D37QE	1		0	
D37QF	2		-2	
D37QG	4		3	Predation and #'s
D38QE	0		0	
D38QF	-2		-2	
D38QG	3		3	Rivers, streams, etc.
D39QE	1		0	
D39QF	2		-2	
D39QG	4	III.41	3	Edge
D40QE	0		0	
D40QF	-2		-2	
D40QG	3	See D39	3	See D39
D41QE	1		0	
D41QF	2		-2	
D41QG	4		2	
D42QE	1		0	
D42QF	1		-2	
D42QG	3	No Logic; see D7	2	
D43QE	0		0	
D43QF	-2		-2	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
D43QG	1	Consideration	1	
D44QE	1		0	
D44QF	2		-2	
D44QG	4		3	Fragmentation: edge
D45QE	0		0	
D45QF	-2		-2	
D45QG	-2		-2	No info.
D46	0		1	
D47	5	Comment #3	4	Comment #3
E1QA	0		0	
E1QB	-2		-2	
E1QC	-2		-2	
E1QD	0		0	
E2QA	3		3	
E2QB	3		3	
E2QC	1		1	
E2QD	0		2	Too small survey range
E3QA	3		0	
E3QB	2		-2	
E3QC	1		-2	
E3QD	0		0	
E4QA	0		0	
E4QB	-2		-2	
E4QC	-2		-2	
E4QD	0		0	
E5QA	3	III.41 and III.26	3	Technical report #2
E5QB	3		3	
E5QC	1		1	
E5QD	0		2	Fragmentation: predation
E6QA	0		3	
E6QB	-2		3	
E6QC	-2		2	Reserves and For. growth
E6QD	1		0	
E7QA	3	III.24	3	
E7QB	2		3	
E7QC	1		2	
E7QD	1		0	
E8QA	0		0	
E8QB	-2		-2	
E8QC	-2		-2	
E8QD	0		0	
E9QA	3		3	
E9QB	3		3	
E9QC	1		1	
E9QD	1	Quantitative data	2	Too small survey range

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
E10QA	0		0	
E10QB	-2		-2	
E10QC	-2		-2	
E10QD	0		0	
E11QA	3	III.41	0	
E11QB	2		-2	
E11QC	0		-2	
E11QD	1		2	Edge in Pac. Northwest
E12QA	3		0	
E12QB	3		-2	
E12QC	1		-2	
E12QD	0		2	Important: 40 mile surv.
E13QA	3	III.41	0	
E13QB	2		-2	
E13QC	1		-2	
E13QD	0		2	Fragmentation: edge
E14QA	0		0	
E14QB	-2		-2	
E14QC	-2		-2	
E14QD	0		0	
E15QA	0		0	
E15QB	-2		-2	
E15QC	-2		-2	
E15QD	0		0	
E16QA	0		0	
E16QB	-2		-2	
E16QC	-2		-2	
E16QD	0		0	
E17QA	0		0	
E17QB	-2		-2	
E17QC	-2		-2	
E17QD	0		0	
E18QA	0		0	
E18QB	-2		-2	
E18QC	-2		-2	
E18QD	0		0	
E19QA	0		0	
E19QB	-2		-2	
E19QC	-2		-2	
E19QD	0		0	
E20QA	0		0	
E20QB	-2		-2	
E20QC	-2		-2	
E20QD	2	Nest fidelity; Disper.prob.	2	Nest fidelity; Disper.prob.
E21QA	0		0	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
E21QB	-2		-2	
E21QC	-2		-2	
E21QD	0		0	
E22QA	0		0	
E22QB	-2		-2	
E22QC	-2		-2	
E22QD	0		0	
E23QA	0		0	
E23QB	-2		-2	
E23QC	-2		-2	
E23QD	2	Edge:In plan Background	2	Edge
E24QA	0		0	
E24QB	-2		-2	
E24QC	-2		-2	
E24QD	0		0	
E25QA	0		0	
E25QB	-2		-2	
E25QC	-2		-2	
E25QD	0		0	
E26QA	0		0	
E26QB	-2		-2	
E26QC	-2		-2	
E26QD	0		0	
E27QA	0		0	
E27QB	-2		-2	
E27QC	-2		-2	
E27QD	2	Forest characteristics	2	Forest characteristics
E28QA	0		0	
E28QB	-2		-2	
E28QC	-2		-2	
E28QD	0		0	
E29QA	0		0	
E29QB	-2		-2	
E29QC	-2		-2	
E29QD	0		0	
E30QA	0		0	
E30QB	-2		-2	
E30QC	-2		-2	
E30QD	0		0	
E31QA	0		0	
E31QB	-2		-2	
E31QC	-2		-2	
E31QD	0		0	
E32QH	1		1	
E32QI	3		3	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
E32QJ	1		2	
E32QK	1		1	
E33QH	1		1	
E33QI	3		2	
E33QJ	1		1	
E33QK	1		1	
E34QH	0		1	
E34QI	-2		0	
E34QJ	-2		1	
E34QK	-2		1	
E35QH	0		0	
E35QI	-2		-2	
E35QJ	-2		-2	
E35QK	-2		-2	
E36QH	0		0	
E36QI	-2		-2	
E36QJ	-2		-2	
E36QK	-2		-2	
E37QH	0		0	
E37QI	-2		-2	
E37QJ	-2		-2	
E37QK	-2		-2	
E38QH	0		0	
E38QI	-2		-2	
E38QJ	-2		-2	
E38QK	-2		-2	
E39QH	0		0	
E39QI	-2		-2	
E39QJ	-2		-2	
E39QK	-2		-2	
E40QH	0		0	
E40QI	-2		-2	
E40QJ	-2		-2	
E40QK	-2		-2	
E41QH	1		1	Tech. Report #2
E41QI	3		2	
E41QJ	-1	No data	-1	
E41QK	1		1	
E42QH	0		0	
E42QI	-2		-2	
E42QJ	-1		-2	
E42QK	-2		-2	
E43	0		1	
E44	1		0	
E45	4	Weak language	4	Frag., 40 mile survey, etc.

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
E46	0		0	
E47	4	Surveying before project	4	Noise, etc.
E48	0		0	
E49	5	Comment #4	4	Comment #4
F1	3		-1	
F2	1		-1	
F3	70		-1	
F4	1		-1	
F5	0		0	
F6	1		1	
F7QL	0		0	
F7QM	-2		-2	
F7QN	0		0	
F8QL	0		0	
F8QM	-2		-2	
F8QN	3		0	
F9QL	4		0	
F9QM	2		-2	
F9QN	3		3	Nests?
F10QL	0		0	
F10QM	-2		-2	
F10QN	1		1	
F11QL	0		0	
F11QM	-2		-2	
F11QN	0		1	
F12QL	0		0	
F12QM	-2		-2	
F12QN	3	Important	3	40 mile survey insuff.
F13QL	0		0	
F13QM	-2		-2	
F13QN	3		0	
F14QL	0		0	
F14QM	-2		-2	
F14QN	3		0	
F15QL	0		0	
F15QM	-2		-2	
F15QN	0		0	
F16QL	0		0	
F16QM	-2		-2	
F16QN	0		0	
F17QL	0		0	
F17QM	-2		-2	
F17QN	0		0	
F18QL	0		0	
F18QM	-2		-2	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR:		Plum Crk	
F18QN	3		3	Important
F19QL	0		0	
F19QM	-2		-2	
F19QN	0		0	
F20QL	0		0	
F20QM	-2		-2	
F20QN	0		0	
F21QL	0		0	
F21QM	-2		-2	
F21QN	2	Edge; Fragmentation	2	Edge; Frag. predation
F22QL	0		0	
F22QM	-2		-2	
F22QN	0		0	
F23QL	4		0	
F23QM	1		-2	
F23QN	2		3	
F24QL	4		0	
F24QM	1		-2	
F24QN	2		3	
F25QL	0		0	
F25QM	-2		-2	
F25QN	0		0	
F26QL	0		0	
F26QM	-2		-2	
F26QN	0		0	
F27	3		3	
F28	1		1	
F29	70		1	
F30	1		3	
F31	0		0	
F32	1		1	
F33QL	0		0	
F33QM	-2		-2	
F33QN	0		0	
F34QL	0		0	
F34QM	-2		-2	
F34QN	0		0	
F35QL	4		3	
F35QM	2		2	
F35QN	3		3	
F36QL	0		0	
F36QM	-2		-2	
F36QN	3		0	
F37QL	0		0	
F37QM	-2		-2	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
F37QN	3		3	Helpful
F38QL	0		0	
F38QM	-2		-2	
F38QN	3		3	Important
F39QL	0		0	
F39QM	-2		-2	
F39QN	3		3	Important
F40QL	0		0	
F40QM	-2		-2	
F40QN	3		3	Needed
F41QL	0		0	
F41QM	-2		-2	
F41QN	0		0	
F42QL	0		0	
F42QM	-2		-2	
F42QN	0		0	
F43QL	0		0	
F43QM	-2		-2	
F43QN	0		0	
F44QL	0		0	
F44QM	-2		-2	
F44QN	3		3	Need this info.
F45QL	0		0	
F45QM	-2		-2	
F45QN	0		0	
F46QL	0		0	
F46QM	-2		-2	
F46QN	0		0	
F47QL	0		0	
F47QM	-2		-2	
F47QN	2	Edge: Fragmentation	2	Predators, esp. edge
F48QL	0		0	
F48QM	-2		-2	
F48QN	0		0	
F49QL	4		0	
F49QM	3		-2	
F49QN	0		3	Crucial ommission
F50QL	4		0	
F50QM	3		-2	
F50QN	0		3	Crucial ommission
F51QL	0		0	
F51QM	-2		-2	
F51QN	0		0	
F52QL	0		0	
F52QM	-2		-2	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
F52QN	0		0	
F53	3		3	
F54	1		1	
F55	70		5	
F56	1		3	
F57	0		0	
F58	1		1	
F59QL	0		0	
F59QM	-2		-2	
F59QN	0		0	
F60QL	0		0	
F60QM	-2		-2	
F60QN	3	Dispersion; chick aband.	3	Dispersion; chick aband.
F61QL	4		3	
F61QM	2		2	
F61QN	3		3	
F62QL	0		0	
F62QM	-2		-2	
F62QN	0		0	
F63QL	0		0	
F63QM	-2		-2	
F63QN	0		0	
F64QL	0		0	
F64QM	-2		-2	
F64QN	3		3	Important
F65QL	0		0	
F65QM	-2		-2	
F65QN	3		3	Important
F66QL	0		0	
F66QM	-2		-2	
F66QN	3		3	Important
F67QL	0		0	
F67QM	-2		-2	
F67QN	0		0	
F68QL	0		0	
F68QM	-2		-2	
F68QN	0		0	
F69QL	0		0	
F69QM	-2		-2	
F69QN	0		0	
F70QL	0		0	
F70QM	-2		-2	
F70QN	3		3	Important
F71QL	0		0	
F71QM	-2		-2	

APPENDIX B : WADNR and Plum Creek Data Sheet/Justification Notes (continued)

	WADNR		Plum Crk	
F71QN	0		0	
F72QL	0		0	
F72QM	-2		-2	
F72QN	0		0	
F73QL	0		0	
F73QM	-2		-2	
F73QN	3	Edge; Fragmentation	3	Edge; Frag. predation
F74QL	0		0	
F74QM	-2		-2	
F74QN	0		0	
F75QL	4		0	
F75QM	3		-2	
F75QN	2		3	
F76QL	4		0	
F76QM	2		-2	
F76QN	2		3	
F77QL	0		0	
F77QM	-2		-2	
F77QN	0		0	
F78QL	0		0	
F78QM	-2		-2	
F78QN	0		0	
F79	0		0	
F80	5	Comment #5	5	Comment #5

APPENDIX C -- WADNR JUSTIFICATION COMMENTS

COMMENT #	COMMENT
1	Not sufficient quantitative data; inadequate assessments and connections, especially for breeding habitat (B3), habitat quality (B5), habitat amounts (B6), fragmentation (B7) and trends (B6, B10).
2	Mostly qualitative inadequate assessments (C13, C14, C16) and lack of data (C2) especially for the existing suitable habitat in HCP (C3) and scale of projects under HCP (C32).
3	Several inadequate assessments and lack of information, especially habitat affiliations (D7) and breeding habitat (D9). Underestimation of seriousness of most factors (D32-42).
4	Not a major part of plan; only minor minimization/mitigation in interim, mostly unproven (E32, E33). No assurances on key points. Lack of realization of nest fidelity and poor dispersion to new nesting stands (III.40 in HCP) (E13, E23). Not sufficient data (E6, E20, E27) or analysis (E2, E3, E5, E7, E9, E11, E12)
5	Numerous problems, including: not monitoring take (F5) or trends (F12, F23, F24, F37, F38, F65, F66, F75, F76) and own employees conducting monitoring (F1, F27, F53). See also F18, F21, F35, F39, F40, F44, F47, F57, F60, F61, F70, F73.

APPENDIX D -- PLUM CREEK JUSTIFICATION COMMENTS

COMMENT #	COMMENT
1	General lack of biological information. The 0 code (Information was not used) was prevalent for B series question as was -1 (Data/information does not exist). Significant information missing (B3) is crucial as it is breeding habitat, one area that is known and considered extremely important for the marbled murrelet.
2	The information that Plum Creek possessed was used relatively well (C2, C3), although they don't have sufficient information, partially due to their lack of surveying knowledge of land (0 code prevalent again). Also missing available information on edge, fragmentation, and pollution (C4, C13, C14, C15, C18).
3	Several inadequate assessments and lack of information, especially important areas of habitat quality trends (D11), habitat fragmentation (D13), consumer species (D23), breeding habitat (D9) and population ecology (D2) that lead to underestimating seriousness of most factors (D32-42).
4	Plan does not address primary threats for minimization/mitigation (E44). There is no analysis of maximum extent possible (as required). A serious lack of information (external and internal) impaired the plan as did inadequate assessments (E2, E5, E9) and unreliable measures (E33, E34).

APPENDIX D (continued) -- PLUM CREEK JUSTIFICATION COMMENTS

COMMENT #	COMMENT
5	Numerous problems, including : Not monitoring take (F5) or trends (F12, F23, F24, F37, F38, F65, F66, F75, F76). Insufficient collection of data to determine mitigation success (F57) contributes to other serious deficiencies (F18, F21, F35, F39, F40, F44, F47, F57, F60, F61, F70, F73).

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes

	NCEAS	Jordan	NCEAS	Jordan
A1	WADNR	WADNR	Plum Creek	Plum Creek
A2	Marbled Murrelet		Marbled Murrelet	
A3	2		2	
A4	1		1	
A5	1		1	
A6	2		2	
A7	2		2	
A8	1		1	
A9	1997		1997	
A10	1		1	
A11	1996		1996	
A12HCP	1		1	
A12Glo	1		1	
A13HCP	2		3	
A13Glo	3		3	
A14HCP	3		2	
A14Glo	3		3	
A15HCP	-1		6	-1
A15Glo	2		2	
A16HCP	-1		-1	
A16Glo	5		4	5
A17HCP	-1		-1	
A17Glo	-1		-1	
A18HCP	-1		-1	
A18Glo	7	8	6	8
A19HCP	-1		-1	
A19Glo	6	7	5	7
A20HCP	4		-1	5
A20Glo	7	6	6	
A21HCP	-1		4	
A21Glo	-1		-1	
A22HCP	-1		-1	
A22Glo	-1		7	-1
A23HCP	-1		5	-1
A23Glo	-1		-1	
A24HCP	-2		-1	-2
A24Glo	-2		-1	-2
A25	0		0	
A26	0		1	0
A27	-1		-1	
A28	-1		-1	
A29	1		1	
A30	70	70 (100)	100	
A31	-1		-1	
B1QA	3		3	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
B1QB	3		3	
B1QC	1		2	
B1QD	0	1	0	1
B2QA	1	3	0	
B2QB	3		-2	
B2QC	1	2	-2	
B2QD	0		0	
B3QA	3		3	
B3QB	4		3	
B3QC	1		1	
B3QD	0		2	
B4QA	3		0	
B4QB	2		-2	
B4QC	1		-2	
B4QD	0		0	
B5QA	3		3	
B5QB	2		3	
B5QC	1		2	
B5QD	0		0	
B6QA	3		3	
B6QB	2	3	5	
B6QC	1		2	
B6QD	0	1	0	
B7QA	3		3	
B7QB	2		5	
B7QC	1		2	
B7QD	0		0	
B8QA	3		3	
B8QB	4		3	
B8QC	2		2	
B8QD	0		0	
B9QA	1	3	3	
B9QB	3		3	
B9QC	2		2	
B9QD	0		0	
B10QA	1		0	
B10QB	2		-2	
B10QC	2		-2	
B10QD	0		0	
B11QA	1		0	
B11QB	4		-2	
B11QC	2		-2	
B11QD	0		0	
B12QA	0	1	0	
B12QB	-2	2	-2	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
B12QC	-2	1	-2	
B12QD	0		0	
B13QA	0		0	
B13QB	-2		-2	
B13QC	-2		-2	
B13QD	0		0	
B14QA	1		0	
B14QB	3		-2	
B14QC	1		-2	
B14QD	0		1	
B15QA	0		0	
B15QB	-2		-2	
B15QC	-2		-2	
B15QD	0		0	
B16QA	1		0	
B16QB	2		-2	
B16QC	1		-2	
B16QD	0		0	
B17QA	1		0	
B17QB	2		-2	
B17QC	1		-2	
B17QD	0		0	
B18QA	0		0	
B18QB	-2		-2	
B18QC	-2		-2	
B18QD	0		0	
B19QA	0	3	0	
B19QB	-2	2	-2	
B19QC	-2	1	-2	
B19QD	0		0	
B20QA	0		0	
B20QB	-2		-2	
B20QC	-2		-2	
B20QD	0		0	
B21QA	0		0	
B21QB	-2		-2	
B21QC	-2		-2	
B21QD	0	1	1	
B22QA	0	3	0	
B22QB	-2	2	-2	
B22QC	-2	2	-2	
B22QD	0		0	1
B23QA	0	3	0	
B23QB	2	3	-2	
B23QC	-2	2	-2	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
B23QD	0		0	1
B24QA	3		0	
B24QB	2		-2	
B24QC	2		-2	
B24QD	0		0	1
B25QA	1	0	0	
B25QB	4	-2	-2	
B25QC	2	-2	-2	
B25QD	0		0	
B26	-1		0	-1
B27	-1		-1	
B28	-1		1	
B29	2		2	
B30	-1	1	1	-1
B31	1		1	
B32	-1		-3	-1
B33	-1		-1	
B34	1		1	
B35	1		1	
B36	-1		-3	-1
B37	-1		-1	
B38	-1		-1	
B39	1		1	
B40	-1		-1	
B41	-1		-1	
B42	0	1	1	
B43	5	4	3	4
C1	1		2	
C2QA	0		3	
C2QB	-2		3	
C2QC	-2		2	
C2QD	0		0	
C3QA	3		3	
C3QB	2	3	5	
C3QC	1		2	
C3QD	0	1	2	
C4QA	3		0	
C4QB	2	3	-1	-2
C4QC	1		-1	-2
C4QD	0		0	1
C5QA	0		0	
C5QB	-2		-1	-2
C5QC	-2		-1	-2
C5QD	0		0	
C6QA	0		0	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
C6QB	-2		-1	-2
C6QC	-2		-1	-2
C6QD	0		0	2
C7QA	0		0	
C7QB	-2		-1	-2
C7QC	-2		-1	-2
C7QD	0		0	
C8QA	0		0	
C8QB	-2		-1	-2
C8QC	-2		-1	-2
C8QD	0		0	
C9QA	0		0	
C9QB	-2		-1	-2
C9QC	-2		-1	-2
C9QD	0		0	1
C10QA	0		0	
C10QB	-2		-1	-2
C10QC	-2		-1	-2
C10QD	0		0	1
C11QA	3		3	
C11QB	2		3	
C11QC	1		1	
C11QD	0		0	
C12QA	0		0	
C12QB	-2		-1	-2
C12QC	-2		-1	-2
C12QD	0		0	
C13QA	3		0	
C13QB	3		-1	-2
C13QC	1		-1	-2
C13QD	0		-3	2
C14QA	3		0	
C14QB	3		-1	-2
C14QC	1		-1	-2
C14QD	0		0	2
C15QA	0		0	
C15QB	-2		-1	-2
C15QC	-2		-1	-2
C15QD	0		0	
C16QA	3		0	
C16QB	3		-1	-2
C16QC	1		-1	-2
C16QD	0		0	2
C17QA	0		0	
C17QB	-2		-1	-2

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
C17QC	-2		-1	-2
C17QD	0		0	
C18QA	2	0	0	
C18QB	1	-2	-1	-2
C18QC	1	-2	-1	-2
C18QD	0		0	1
C19	3	4	-1	4
C20	3		-1	3
C21	6	5	-1	5
C22	1		1	
C23	2		-1	2
C24	5	6	-1	6
C25	1		-1	-3
C26	0.35	-3	-1	-3
C27	-1		-1	
C28		-3		-3
C29	68	70 (100)	-1	-3
C30	0		0	
C31	1		0	
C32	0		0	
C33	5		4	
D1QA	0		0	
D1QB	-2		-1	-2
D1QC	-2		-1	-2
D1QD	0		0	
D2QA	3		0	3
D2QB	3		-1	3
D2QC	1		-1	1
D2QD	0		0	2
D3QA	3		0	
D3QB	2		-1	-2
D3QC	1		-1	-2
D3QD	0		0	
D4QA	0		0	
D4QB	-2		-1	-2
D4QC	-2		-1	-2
D4QD	0		0	
D5QA	0		3	
D5QB	-2		3	
D5QC	-2		2	1
D5QD	0	2	0	2
D6QA	0		3	
D6QB	-2		3	
D6QC	-2		2	
D6QD	0		0	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
D7QA	0		3	
D7QB	-2		3	
D7QC	-2		2	
D7QD	0	2	2	
D8QA	0		0	
D8QB	-2		-1	-2
D8QC	-2		-1	-2
D8QD	0		0	
D9QA	3		3	
D9QB	2		3	
D9QC	1		1	
D9QD	0	1	2	
D10QA	0		0	
D10QB	-2		-1	-2
D10QC	-2		-1	-2
D10QD	0		0	
D11QA	0		3	
D11QB	-2		3	
D11QC	-2		2	1
D11QD	0	2	0	2
D12QA	0		3	
D12QB	-2		3	
D12QC	-2		2	
D12QD	0	2	0	
D13QA	0		0	
D13QB	-2		-1	-2
D13QC	-2		-1	-2
D13QD	0	2	0	2
D14QA	0		0	
D14QB	-2		-1	-2
D14QC	-2		-1	-2
D14QD	0		0	
D15QA	0		0	
D15QB	-2		-1	-2
D15QC	-2		-1	-2
D15QD	0		0	
D16QA	0		0	
D16QB	-2		-1	-2
D16QC	-2		-1	-2
D16QD	0		0	
D17QA	0		0	
D17QB	-2		-1	-2
D17QC	-2		-1	-2
D17QD	0		0	
D18QA	0	1	0	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
D18QB	1	2	-1	-2
D18QC	1		-1	-2
D18QD	0		0	
D19QA	0		0	
D19QB	-2		-1	-2
D19QC	-2		-1	-2
D19QD	0		0	
D20QA	3		3	
D20QB	1		1	
D20QC	1		1	
D20QD	0		0	
D21QA	0		0	
D21QB	-2		-1	-2
D21QC	-2		-1	-2
D21QD	0		0	
D22QA	0		0	
D22QB	-2		-1	-2
D22QC	-2		-1	-2
D22QD	0		0	
D23QA	0		0	
D23QB	-2		-1	-2
D23QC	-2		-1	-2
D23QD	0	2	0	2
D24QA	0		0	
D24QB	-2		-1	-2
D24QC	-2		-1	-2
D24QD	0		0	
D25QA	0		0	
D25QB	-2		-1	-2
D25QC	-2		-1	-2
D25QD	0		0	
D26QA	0		0	
D26QB	-2		-1	-2
D26QC	-2		-1	-2
D26QD	0		0	
D27QA	0		0	
D27QB	-2		-1	-2
D27QC	-2		-1	-2
D27QD	0		0	
D28QA	0		0	
D28QB	-2		-1	-2
D28QC	-2		-1	-2
D28QD	0		0	
D29QA	0		0	
D29QB	-2		-1	-2

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
D29QC	-2		-1	-2
D29QD	0		0	
D30QA	0	3	0	
D30QB	-2	2	-1	-2
D30QC	-2	0	-1	-2
D30QD	0		0	2
D31QA	0		0	
D31QB	-2		-1	-2
D31QC	-2		-1	-2
D31QD	0		0	
D32QE	0		1	
D32QF	-2		2	
D32QG	4		2	3
D33QE	0		1	
D33QF	-2		1	
D33QG	4		1	
D34QE	1		0	
D34QF	3		-2	
D34QG	4		1	3
D35QE	1		1	
D35QF	3		1	
D35QG	4		1	3
D36QE	0		1	
D36QF	-2		1	
D36QG	4		1	3
D37QE	1		0	
D37QF	2		-2	
D37QG	4		1	3
D38QE	0		0	
D38QF	-2		-2	
D38QG	2	3	1	3
D39QE	1		0	
D39QF	2		-2	
D39QG	4		1	3
D40QE	0		0	
D40QF	-2		-2	
D40QG	1	3	1	3
D41QE	1		0	
D41QF	2		-2	
D41QG	4		1	2
D42QE	1		0	
D42QF	1		-2	
D42QG	-3	3	1	2
D43QE	0		0	
D43QF	-2		-2	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
D43QG	-2	1	1	
D44QE	1		0	
D44QF	2		-2	
D44QG	4		1	3
D45QE	0		0	
D45QF	-2		-2	
D45QG	-2		1	-2
D46	0		1	
D47	5		3	4
E1QA	0		0	
E1QB	-2		-2	
E1QC	-2		-2	
E1QD	0		0	
E2QA	3		0	3
E2QB	3		-2	3
E2QC	1		-2	1
E2QD	0		1	2
E3QA	3		0	
E3QB	2		-2	
E3QC	1		-2	
E3QD	0		0	
E4QA	0		0	
E4QB	-2		-2	
E4QC	-2		-2	
E4QD	0		0	
E5QA	0	3	0	3
E5QB	-2	3	-2	3
E5QC	-2	1	-2	1
E5QD	0		2	
E6QA	0		0	3
E6QB	-2		-2	3
E6QC	-2		-2	2
E6QD	0	1	0	
E7QA	0	3	3	
E7QB	-2	2	3	
E7QC	-2	1	2	
E7QD	0	1	0	
E8QA	0		0	
E8QB	-2		-2	
E8QC	-2		-2	
E8QD	0		0	
E9QA	3		3	
E9QB	3		3	
E9QC	1		1	
E9QD	0	1	0	2

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
E10QA	0		0	
E10QB	-2		-2	
E10QC	-2		-2	
E10QD	0		0	
E11QA	0	3	0	
E11QB	-2	2	-2	
E11QC	-2	0	-2	
E11QD	0	1	0	2
E12QA	3		0	
E12QB	3		-2	
E12QC	1		-2	
E12QD	0		0	2
E13QA	0	3	0	
E13QB	-2	2	-2	
E13QC	-2	1	-2	
E13QD	0		0	2
E14QA	0		0	
E14QB	-2		-2	
E14QC	-2		-2	
E14QD	0		0	
E15QA	0		0	
E15QB	-2		-2	
E15QC	-2		-2	
E15QD	0		0	
E16QA	0		0	
E16QB	-2		-2	
E16QC	-2		-2	
E16QD	0		0	
E17QA	0		0	
E17QB	-2		-2	
E17QC	-2		-2	
E17QD	0		0	
E18QA	0		0	
E18QB	-2		-2	
E18QC	-2		-2	
E18QD	0		0	
E19QA	0		0	
E19QB	-2		-2	
E19QC	-2		-2	
E19QD	0		0	
E20QA	0		0	
E20QB	-2		-2	
E20QC	-2		-2	
E20QD	0	2	1	2
E21QA	0		0	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
E21QB	-2		-2	
E21QC	-2		-2	
E21QD	0		0	
E22QA	0		0	
E22QB	-2		-2	
E22QC	-2		-2	
E22QD	0		0	
E23QA	0		0	
E23QB	-2		-2	
E23QC	-2		-2	
E23QD	0	2	0	2
E24QA	0		0	
E24QB	-2		-2	
E24QC	-2		-2	
E24QD	0		0	
E25QA	0		0	
E25QB	-2		-2	
E25QC	-2		-2	
E25QD	0		0	
E26QA	0		0	
E26QB	-2		-2	
E26QC	-2		-2	
E26QD	0		0	
E27QA	0		0	
E27QB	-2		-2	
E27QC	-2		-2	
E27QD	0	2	0	2
E28QA	0		0	
E28QB	-2		-2	
E28QC	-2		-2	
E28QD	0		0	
E29QA	0		0	
E29QB	-2		-2	
E29QC	-2		-2	
E29QD	0		0	
E30QA	0		0	
E30QB	-2		-2	
E30QC	-2		-2	
E30QD	0		0	
E31QA	0		0	
E31QB	-2		-2	
E31QC	-2		-2	
E31QD	0		0	
E32QH	1		1	
E32QI	3		3	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
E32QJ	1		2	
E32QK	1		1	
E33QH	1		1	
E33QI	3		2	
E33QJ	1		1	
E33QK	1		1	
E34QH	0		1	
E34QI	-2		0	
E34QJ	-2		1	
E34QK	-2		1	
E35QH	0		0	
E35QI	-2		-2	
E35QJ	-2		-2	
E35QK	-2		-2	
E36QH	0		0	
E36QI	-2		-2	
E36QJ	-2		-2	
E36QK	-2		-2	
E37QH	0		0	
E37QI	-2		-2	
E37QJ	-2		-2	
E37QK	-2		-2	
E38QH	0		0	
E38QI	-2		-2	
E38QJ	-2		-2	
E38QK	-2		-2	
E39QH	0		0	
E39QI	-2		-2	
E39QJ	-2		-2	
E39QK	-2		-2	
E40QH	0		0	
E40QI	-2		-2	
E40QJ	-2		-2	
E40QK	-2		-2	
E41QH	1		0	1
E41QI	3		-2	2
E41QJ	-2	-1	-2	-1
E41QK	1		-2	1
E42QH	0		0	
E42QI	-2		-2	
E42QJ	-2		-2	
E42QK	-2		-2	
E43	0		1	
E44	1		0	
E45	4		4	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
E46	0		0	
E47	-2	4	4	
E48	0		1	0
E49	5		3	4
F1	3		-1	
F2	1		-1	
F3	70		-1	
F4	1		-1	
F5	0		0	
F6	1		1	
F7QL	0		0	
F7QM	-2		-2	
F7QN	0		0	
F8QL	0		0	
F8QM	-2		-2	
F8QN	3		0	
F9QL	4		0	
F9QM	2		-2	
F9QN	3		0	3
F10QL	0		0	
F10QM	-2		-2	
F10QN	0	1	1	
F11QL	0		0	
F11QM	-2		-2	
F11QN	0		1	
F12QL	0		0	
F12QM	-2		-2	
F12QN	3		1	3
F13QL	0		0	
F13QM	-2		-2	
F13QN	3		0	
F14QL	0		0	
F14QM	-2		-2	
F14QN	3		0	
F15QL	0		0	
F15QM	-2		-2	
F15QN	0		0	
F16QL	0		0	
F16QM	-2		-2	
F16QN	0		0	
F17QL	0		0	
F17QM	-2		-2	
F17QN	0		0	
F18QL	0		0	
F18QM	-2		-2	

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
F18QN	3		0	3
F19QL	0		0	
F19QM	-2		-2	
F19QN	0		0	
F20QL	0		0	
F20QM	-2		-2	
F20QN	0		0	
F21QL	0		0	
F21QM	-2		-2	
F21QN	0	2	0	2
F22QL	0		0	
F22QM	-2		-2	
F22QN	0		0	
F23QL	4		0	
F23QM	1		-2	
F23QN	2		3	
F24QL	4		0	
F24QM	1		-2	
F24QN	2		3	
F25QL	0		0	
F25QM	-2		-2	
F25QN	0		0	
F26QL	0		0	
F26QM	-2		-2	
F26QN	0		0	
F27	3		3	
F28	1		1	
F29	70		1	
F30	1		3	
F31	0		0	
F32	1		1	
F33QL	0		0	
F33QM	-2		-1	-2
F33QN	0		0	
F34QL	0		0	
F34QM	-2		-1	-2
F34QN	0		0	
F35QL	4		3	
F35QM	2		2	
F35QN	3		3	
F36QL	0		0	
F36QM	-2		-1	-2
F36QN	3		0	
F37QL	0		0	
F37QM	-2		-1	-2

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
F37QN	3		0	3
F38QL	0		0	
F38QM	-2		-1	-2
F38QN	3		0	3
F39QL	0		0	
F39QM	-2		-1	-2
F39QN	3		0	3
F40QL	0		0	
F40QM	-2		-1	-2
F40QN	3		0	3
F41QL	0		0	
F41QM	-2		-1	-2
F41QN	0		0	
F42QL	0		0	
F42QM	-2		-1	-2
F42QN	0		0	
F43QL	0		0	
F43QM	-2		-1	-2
F43QN	0		0	
F44QL	0		0	
F44QM	-2		-1	-2
F44QN	3		0	3
F45QL	0		0	
F45QM	-2		-1	-2
F45QN	0		0	
F46QL	0		0	
F46QM	-2		-1	-2
F46QN	0		0	
F47QL	0		0	
F47QM	-2		-1	-2
F47QN	0	2	0	2
F48QL	0		0	
F48QM	-2		-1	-2
F48QN	0		0	
F49QL	4		0	
F49QM	3		-1	-2
F49QN	0		3	
F50QL	4		0	
F50QM	3		-1	-2
F50QN	0		3	
F51QL	0		0	
F51QM	-2		-1	-2
F51QN	0		0	
F52QL	0		0	
F52QM	-2		-1	-2

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
F52QN	0		0	
F53	3		3	
F54	1		1	
F55	70		5	
F56	1		3	
F57	0		0	
F58	1		1	
F59QL	0		0	
F59QM	-2		-1	-2
F59QN	0		0	
F60QL	0		0	
F60QM	-2		-1	-2
F60QN	2	3	0	3
F61QL	4		3	
F61QM	2		2	
F61QN	3		3	
F62QL	0		0	
F62QM	-2		-1	-2
F62QN	0		0	
F63QL	0		0	
F63QM	-2		-1	-2
F63QN	0		0	
F64QL	0		0	
F64QM	-2		-1	-2
F64QN	3		0	3
F65QL	0		0	
F65QM	-2		-1	-2
F65QN	3		0	3
F66QL	0		0	
F66QM	-2		-1	-2
F66QN	3		0	3
F67QL	0		0	
F67QM	-2		-1	-2
F67QN	0		0	
F68QL	0		0	
F68QM	-2		-1	-2
F68QN	0		0	
F69QL	0		0	
F69QM	-2		-1	-2
F69QN	0		0	
F70QL	0		0	
F70QM	-2		-1	-2
F70QN	3		0	3
F71QL	0		0	
F71QM	-2		-1	-2

APPENDIX E : NCEAS Comparison Data Sheet/Justification Notes (continued)

	WADNR	Jordan	Plum Crk	Jordan
F71QN	0		0	
F72QL	0		0	
F72QM	-2		-1	-2
F72QN	0		0	
F73QL	0		0	
F73QM	-2		-1	-2
F73QN	0	3	0	3
F74QL	0		0	
F74QM	-2		-1	-2
F74QN	0		0	
F75QL	4		0	
F75QM		3	-1	-2
F75QN	2		3	
F76QL	4		0	
F76QM		2	-1	-2
F76QN	2		3	
F77QL	0		0	
F77QM	-2		-1	-2
F77QN	0		0	
F78QL	0		0	
F78QM	-2		-1	-2
F78QN	0		0	
F79	0		0	
F80	5		4	5

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes

	Jordan	Justification	Jordan	Justification
A1	Elliott S.F.		Pacific L.	
A2	MM		MM	
A3	2		2	
A4	1		1	
A5	1		1	
A6	2		3	
A7	2		2	
A8	1		1	
A9	1997		1997	
A10	1		1	
A11	1996		1996	
A12HCP	1		1	
A12Glo	1		1	
A13HCP	2		2	
A13Glo	3		3	
A14HCP	3		3	
A14Glo	3		3	
A15HCP	-1		-1	
A15Glo	2		2	
A16HCP	-1		-1	
A16Glo	5		5	
A17HCP	-1		-1	
A17Glo	-1		-1	
A18HCP	5	Hardwoods	5	
A18Glo	8		8	
A19HCP	-1		-1	
A19Glo	7		7	
A20HCP	4		4	
A20Glo	6		6	
A21HCP	-1		-1	
A21Glo	-1		-1	
A22HCP	-1		-1	
A22Glo	-1		-1	
A23HCP	-1		-1	
A23Glo	-1		-1	
A24HCP	-2		-2	
A24Glo	-2		-2	
A25	0		0	
A26	0		0	
A27	-1		-1	
A28	-1		-1	
A29	1		1	
A30	6 (60)	6yr. ITP for MM(60yr.plan)	50	
A31	-1		-1	
B1QA	3		3	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
B1QB	3		3	
B1QC	2		2	
B1QD	1	More O-G correspond.	1	More quant. (esp.global);O-G corr.
B2QA	1		1	
B2QB	3		1	
B2QC	2		2	
B2QD	0		1	Distribution;numbers;prey;etc.
B3QA	3		3	
B3QB	5		4	Some good info.
B3QC	3		3	Some good info.
B3QD	1	Document O-grwth amnt.	1	More on global & CA quality
B4QA	3		3	Serious ommission of trends
B4QB	4		3	
B4QC	2		2	
B4QD	1	Document O-grwth amnt.	1	
B5QA	3		1	
B5QB	4		1	
B5QC	3		2	
B5QD	0		3	Needs to be put in perspective
B6QA	1		1	Serious ommission
B6QB	3		1	
B6QC	2		2	
B6QD	1	% of O-grwth; declines	3	Serious lack of perspective
B7QA	3		3	
B7QB	4		3	
B7QC	2		2	
B7QD	1	More on fragmentation	1	More quantification
B8QA	3		2	Switches to local info. for this
B8QB	3		3	
B8QC	2		3	
B8QD	0		3	Global perspctve imp. (like habitat)
B9QA	1		3	
B9QB	3		3	
B9QC	2		2	
B9QD	1	Historic OR #s	1	Global #s?; lack of avail. info
B10QA	3		3	
B10QB	2		3	
B10QC	2		2	
B10QD	1	More extensive	1	Similar to B9
B11QA	1		3	
B11QB	3		3	
B11QC	2		2	
B11QD	1	Rates of decline	1	Some good data,not extensive
B12QA	0		0	
B12QB	-2		-2	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
B12QC	-2		-2	
B12QD	1	Isolation	1	Isolation
B13QA	0		2	
B13QB	-2		3	
B13QC	-2		2	
B13QD	0		2	Very imp.; perspective?;analysis?
B14QA	3		3	
B14QB	3		2	
B14QC	2		1	Too much focus off property.
B14QD	0		2	Too much focus off property.
B15QA	0		0	
B15QB	-2		-2	
B15QC	-2		-2	
B15QD	0		0	
B16QA	0		0	
B16QB	-2		-2	
B16QC	-2		-2	
B16QD	0		0	
B17QA	3		3	
B17QB	4		4	
B17QC	2		2	
B17QD	1	Could cite more studies	1	Observed rates of pred.?glbl&local
B18QA	0		0	
B18QB	-2		-2	
B18QC	-2		-2	
B18QD	0		0	
B19QA	0		0	
B19QB	-2		-2	
B19QC	-2		-2	
B19QD	0		0	
B20QA	0		0	
B20QB	-2		-2	
B20QC	-2		-2	
B20QD	0		0	
B21QA	3		3	
B21QB	5		2	
B21QC	3		1	
B21QD	1	Global data	1	Needs global
B22QA	0		0	
B22QB	-2		-2	
B22QC	-2		-2	
B22QD	1	El nino, etc. important	1	El nino, etc. important
B23QA	1		0	
B23QB	3		-2	
B23QC	2		-2	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
B23QD	1	Local oil spills, threats	2	Susceptability of pop. to catast.
B24QA	0		0	
B24QB	-2		-2	
B24QC	-2		-2	
B24QD	1	Important	1	Important, wouldn't change anlys.
B25QA	0		0	
B25QB	-2		-2	
B25QC	-2		-2	
B25QD	0		0	
B26	-1		-1	
B27	-1		-1	
B28	2		2	Trends don't ind. incr., other hab.
B29	2		2	
B30	1		1	3.10-42 in HCP
B31	1		1	
B32	-1		-1	3.10-42 in HCP
B33	-1		-1	
B34	1		1	
B35	1		1	
B36	-1		-1	
B37	-1		-1	
B38	-1		-1	
B39	1		1	
B40	-1		-1	
B41	-1		-1	
B42	1		1	
B43	3	Comment #1	4	Comment #1
C1	1		1	
C2QA	0		3	
C2QB	-2		2	
C2QC	-2		2	
C2QD	0		0	
C3QA	3		2	All local
C3QB	5		5	
C3QC	3		3	
C3QD	0		2	Property data? Suitable, not occ.
C4QA	3		3	
C4QB	5		2	
C4QC	2		2	
C4QD	1	Frag.; edge = cum incr., ta	2	Frag.; edge = cum incr., take incr.
C5QA	0		2	
C5QB	-2		4	
C5QC	-2		2	1:1 ratio? Habitat cumulative...
C5QD	0		0	
C6QA	3		3	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
C6QB	4		5	
C6QC	3		2	
C6QD	0		0	
C7QA	0		0	
C7QB	-2		-2	
C7QC	-2		-2	
C7QD	0		0	
C8QA	0		3	
C8QB	-2		4	
C8QC	-2		2	
C8QD	0		0	
C9QA	0		0	Limited; N1.19 in HCP
C9QB	-2		-2	
C9QC	-2		-2	
C9QD	0		0	
C10QA	0		0	
C10QB	-2		-2	
C10QC	-2		-2	
C10QD	0		0	
C11QA	3		3	
C11QB	2		2	
C11QC	2		2	
C11QD	2	Studies to support?	2	Studies to support?
C12QA	0		0	
C12QB	-2		-2	
C12QC	-2		-2	
C12QD	0		0	
C13QA	3		3	Fragmentation
C13QB	4		2	
C13QC	2		0	
C13QD	0		2	This will be effect; effect 1:1 ratio
C14QA	3		3	
C14QB	4		2	
C14QC	0		0	
C14QD	2	No mention in take	2	Will effect numbers
C15QA	0		0	
C15QB	-2		-2	
C15QC	-2		-2	
C15QD	0		0	
C16QA	3		1	
C16QB	4		2	
C16QC	0		0	
C16QD	2	w/C14	2	No predation studies cited
C17QA	0		0	
C17QB	-2		-2	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
C17QC	-2		-2	
C17QD	0		0	
C18QA	0		0	
C18QB	-2		-2	
C18QC	-2		-2	
C18QD	0		0	
C19	4		4	
C20	3		3	
C21	5		5	
C22	1		1	
C23	2		2	
C24	6		6	
C25	1		1	
C26	2%	6 % of hab. @ 33% occ.	24%	This is "reasonable" est.; huge
C27	-1		246|355	1:1 w.3.10-12 HCP|Suitable N1-B
C28	-3		-3	
C29	6		50	
C30	0		0	
C31	0	HCP land excluded from	1	
C32	1		1	
C33	2	Comment #2	4	Comment #2
D1QA	0		0	
D1QB	-2		-2	
D1QC	-2		-2	
D1QD	0		1	
D2QA	3		3	
D2QB	5		4	
D2QC	3		1	Liter
D2QD	0		1	Liter
D3QA	3		3	
D3QB	5		2	
D3QC	3		1	
D3QD	0		2	Nest fidelity, etc.
D4QA	0		0	
D4QB	-2		-2	
D4QC	-2		-2	
D4QD	0		0	
D5QA	0		1	
D5QB	-2		2	
D5QC	-2		1	
D5QD	1	Edge on take	2	Incr. predation due to frag./edge
D6QA	3		3	
D6QB	5		4	
D6QC	2		2	
D6QD	0	Needs surveying	0	Needs surveying

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
D7QA	3		3	
D7QB	5		3	Only counting O-G and residual
D7QC	3		1	
D7QD	0		0	Need better knowldge of plan area
D8QA	0		0	
D8QB	-2		-2	
D8QC	-2		-2	
D8QD	0		0	
D9QA	3		3	
D9QB	5		4	
D9QC	3		2	
D9QD	0		2	D7 above
D10QA	0		0	
D10QB	-2		-2	
D10QC	-2		-2	
D10QD	0		0	
D11QA	0		0	
D11QB	-2		-2	
D11QC	-2		-2	
D11QD	2	Incr. edge = decr. qual.	2	Edge vs. qual.; fragmentation
D12QA	2		3	
D12QB	5		4	
D12QC	3		3	
D12QD	0		0	Using only occup. and 1:1 unfndd.
D13QA	0		3	
D13QB	-2		2	
D13QC	-2		1	
D13QD	2	Incr. edge = incr. take	2	Needs quantification
D14QA	0		3	
D14QB	-2		4	
D14QC	-2		2	
D14QD	1	More descriptive	0	1:1 of occup. only not proven
D15QA	0		0	
D15QB	-2		-2	
D15QC	-2		-2	
D15QD	2	Perspective	3	No trde off shrt trm(USFWS 1997)
D16QA	3		3	
D16QB	5		4	
D16QC	3		2	
D16QD	0		2	Deformities? Only O-G & resid.?
D17QA	0		0	
D17QB	-2		-2	
D17QC	-2		-2	
D17QD	1	More descriptive	1	
D18QA	0		0	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
D18QB	-2		-2	
D18QC	-2		-2	
D18QD	1	Possible effect	1	Possible effect
D19QA	0		0	
D19QB	-2		-2	
D19QC	-2		-2	
D19QD	0		3	Discussion for presence,not take
D20QA	2		0	
D20QB	5		-2	
D20QC	2		-2	
D20QD	1	Against conv. wis.; proof?	2	Poor dispersion? Nest fidelity?
D21QA	0		0	
D21QB	-2		-2	
D21QC	-2		-2	
D21QD	0		0	
D22QA	0		0	
D22QB	-2		-2	
D22QC	-2		-2	
D22QD	0		0	
D23QA	0		0	
D23QB	-2		-2	
D23QC	-2		-2	
D23QD	2	Incr. edge = incr. pred.	2	Incr. edge = incr. pred.
D24QA	0		0	
D24QB	-2		-2	
D24QC	-2		-2	
D24QD	0		0	
D25QA	0		0	
D25QB	-2		-2	
D25QC	-2		-2	
D25QD	0		0	
D26QA	0		0	
D26QB	-2		-2	
D26QC	-2		-2	
D26QD	0		0	
D27QA	0		0	
D27QB	-2		-2	
D27QC	-2		-2	
D27QD	0		0	
D28QA	0		0	
D28QB	-2		-2	
D28QC	-2		-2	
D28QD	1	Possible factor	2	Huge level of take makes factor
D29QA	0		0	
D29QB	-2		-2	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
D29QC	-2		-2	
D29QD	1	Possible factor	2	Take level makes imp. factor
D30QA	0		0	
D30QB	-2		-2	
D30QC	-2		-2	
D30QD	2	Incr. edge = incr. take	2	Incr. edge = incr. take;esp.level
D31QA	0		0	
D31QB	-2		-2	
D31QC	-2		-2	
D31QD	0		0	
D32QE	1		1	
D32QF	4		4	
D32QG	4		4	
D33QE	0		1	
D33QF	-2		3	
D33QG	4	Loss will likely occur	4	More serious than presented
D34QE	1		1	
D34QF	3		3	
D34QG	3		4	More serious than presented
D35QE	1		1	
D35QF	4		4	
D35QG	4		4	
D36QE	0		1	
D36QF	-2		3	
D36QG	4		4	
D37QE	0		1	
D37QF	-2		3	
D37QG	4		4	This is serious
D38QE	0		1	
D38QF	-2		2	Reliance on surrounding areas
D38QG	3		4	Sea corridor?
D39QE	0		1	
D39QF	-2		3	
D39QG	4	Cum. w/D37 above	4	Increased predation
D40QE	0		0	
D40QF	-2		-2	
D40QG	4	W/D39 above	4	W/D39 above
D41QE	0		0	
D41QF	-2		-2	
D41QG	3	Hardwoods in area	2	
D42QE	0		0	
D42QF	-2		-2	
D42QG	3	Inbreeding, etc.	3	Inbreeding, etc.
D43QE	0		0	
D43QF	-2		-2	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
D43QG	1		0	
D44QE	0		1	
D44QF	-2		2	
D44QG	4	W/D40 above, etc.	4	W/D40 above, etc.
D45QE	0		0	
D45QF	-2		-2	
D45QG	-2		-2	
D46	1		1	
D47	2	Comment #3	5	Comment #3
E1QA	0		0	
E1QB	-2		-2	
E1QC	-2		-2	
E1QD	0		0	
E2QA	3		3	
E2QB	5		4	
E2QC	2		1	
E2QD	0		2	Impact vs. MMCAs
E3QA	3		3	
E3QB	5		3	
E3QC	3		1	
E3QD	0		2	Nest fidelity, poor dispersion
E4QA	0		0	
E4QB	-2		-2	
E4QC	-2		-2	
E4QD	1	Inbreed; increase size	2	Creating islands
E5QA	3		3	
E5QB	5		3	
E5QC	3		1	
E5QD	0		0	Needs surveys, etc.
E6QA	3		3	
E6QB	5		3	
E6QC	3		1	
E6QD	0		0	Needs surveys, etc.
E7QA	3		3	
E7QB	5		3	
E7QC	3		1	
E7QD	0		0	Suitable habitat? Not just best
E8QA	0		0	
E8QB	-2		-2	
E8QC	-2		-2	
E8QD	0		0	
E9QA	3		3	
E9QB	5		3	
E9QC	3		1	
E9QD	0		0	w/E7 above

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L,	Justification
E10QA	0		2	
E10QB	-2		3	
E10QC	-2		1	
E10QD	0		0	Unfounded dispersion
E11QA	3		2	
E11QB	5		2	
E11QC	3		1	
E11QD	0		0	Lack of information
E12QA	3		3	
E12QB	5		4	
E12QC	3		2	
E12QD	0		0	Questionable success
E13QA	3		2	
E13QB	4		3	
E13QC	2		1	
E13QD	0	Studies needed	0	Studies needed
E14QA	0		0	
E14QB	-2		-2	
E14QC	-2		-2	
E14QD	0	Lacking	0	Not used
E15QA	3		0	
E15QB	2		-2	
E15QC	2		-2	
E15QD	0		2	Important to habitat use
E16QA	3		3	
E16QB	2		2	
E16QC	2		2	
E16QD	0		0	
E17QA	0		0	
E17QB	-2		-2	
E17QC	-2		-2	
E17QD	0		0	
E18QA	0		0	
E18QB	-2		-2	
E18QC	-2		-2	
E18QD	2	Size of reserves (packing)	2	Packing consequences
E19QA	0		3	
E19QB	-2		2	
E19QC	-2		0	Does not follow
E19QD	0		0	
E20QA	2		2	
E20QB	3		3	
E20QC	2		1	
E20QD	0		2	Nest fidelity, poor dispersion?
E21QA	0		0	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
E21QB	-2		-2	
E21QC	-2		-2	
E21QD	0		0	
E22QA	0		0	
E22QB	-2		-2	
E22QC	-2		-2	
E22QD	0		0	
E23QA	3		3	
E23QB	4		2	
E23QC	2		1	MMCAs good, others not good
E23QD	0		1	Interior condition better
E24QA	0		0	
E24QB	-2		-2	
E24QC	-2		-2	
E24QD	0		0	
E25QA	0		0	
E25QB	-2		-2	
E25QC	-2		-2	
E25QD	0		0	
E26QA	0		0	
E26QB	-2		-2	
E26QC	-2		-2	
E26QD	0		0	
E27QA	3		0	
E27QB	5		-2	
E27QC	3		-2	
E27QD	0	Needs to be tested	2	Succession?
E28QA	0		0	
E28QB	-2		-2	
E28QC	-2		-2	
E28QD	1	More prot. in El nino, etc.	2	W/take level very imp.;pack/rebnd
E29QA	0		0	
E29QB	-2		-2	
E29QC	-2		-2	
E29QD	0		0	W/take level very imp.;pack/rebnd
E30QA	3		2	
E30QB	3		2	
E30QC	2		0	Guided by Federal; 3.10-158 HCP
E30QD	0		2	Significant
E31QA	0		0	
E31QB	-2		-2	
E31QC	-2		-2	
E31QD	0		0	
E32QH	1		1	
E32QI	3	MMMA, buffer, seasonal	3	MMCA, buffer, seasonal

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
E32QJ	1		1	
E32QK	1		1	
E33QH	1		1	
E33QI	3		3	
E33QJ	1		1	
E33QK	1		1	
E34QH	0		1	Trades/Park land
E34QI	-2		3	
E34QJ	-2		2	
E34QK	-2		2	Selling to U.S./California
E35QH	0		0	
E35QI	-2		-2	
E35QJ	-2		-2	
E35QK	-2		-2	
E36QH	0		0	
E36QI	-2		-2	
E36QJ	-2		-2	
E36QK	-2		-2	
E37QH	0		0	
E37QI	-2		-2	
E37QJ	-2		-2	
E37QK	-2		-2	
E38QH	0		0	
E38QI	-2		-2	
E38QJ	-2		-2	
E38QK	-2		-2	
E39QH	1	Creating late-succ.	1	Minimal
E39QI	3		1	
E39QJ	1	Not proven	1	Not proven
E39QK	1		1	
E40QH	0		0	
E40QI	-2		-2	
E40QJ	-2		-2	
E40QK	-2		-2	
E41QH	1	$500,000	1	$30,000/yr. 5 yrs.+Research Fund
E41QI	3	In lieu of surveys	1	
E41QJ	3		3	
E41QK	1		1	
E42QH	1	Habitat ranking	1	Prioritizing old-growth to be cut
E42QI	3		2	
E42QJ	0	Testing w/ USFWS	0	
E42QK	1		1	
E43	1		1	
E44	1		1	
E45	2		3	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
E46	0		0	
E47	4	No surveying before sales	5	No survey;unproven;reliance outsd
E48	1		0	
E49	3	Comment #4	5	Comment #4
F1	3		3 (1)	(or 1)
F2	1		1	
F3	60		50	
F4	1 (1/5)	(+5 year comprehensive)	-1	
F5	1		0	
F6	1		0	
F7QL	0		0	
F7QM	-2		-2	
F7QN	0		0	
F8QL	0		3	
F8QM	-2		2	
F8QN	1	Notice behavior? Nest	3	Only in MMCA/at sea
F9QL	0		3	
F9QM	-2		2	
F9QN	3	No pre-activity surveys	3	Only in MMCA/at sea
F10QL	0		3	
F10QM	-2		2	
F10QN	1	Would help	3	Only in MMCA/at sea
F11QL	0		4	
F11QM	-2		2	
F11QN	1		3	Only in MMCA/at sea
F12QL	0		4	
F12QM	-2		2	
F12QN	3	Crucial	3	Only at sea established method
F13QL	0		0	
F13QM	-2		-2	
F13QN	3	Important	3	No inland outside MMCAs
F14QL	0		0	
F14QM	-2		-2	
F14QN	3	Important;predation/edge	3	No inland outside MMCAs
F15QL	0		4	
F15QM	-2		2	
F15QN	0		2	Only in MMCA/at sea
F16QL	0		0	
F16QM	-2		-2	
F16QN	0		0	
F17QL	0		0	
F17QM	-2		-2	
F17QN	0		0	
F18QL	0		0	
F18QM	-2		-2	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
F18QN	3	Important	3	Only in MMCA/at sea
F19QL	0		0	
F19QM	-2		-2	
F19QN	0		0	
F20QL	0		0	
F20QM	-2		-2	
F20QN	0		0	
F21QL	0		4	Not stated
F21QM	-2		2	
F21QN	2	Prey species	3	Only in MMCA/at sea
F22QL	0		0	
F22QM	-2		-2	
F22QN	0		0	
F23QL	5		4	
F23QM	3		2	
F23QN	0		1	Extent?
F24QL	5		4	
F24QM	3		2	
F24QN	0		1	Extent?
F25QL	0		0	
F25QM	-2		-2	
F25QN	0		0	
F26QL	0		0	
F26QM	-2		-2	
F26QN	0		0	
F27	3		3 (1)	(possibly 1)
F28	1		1	
F29	60		50	
F30	1(1/5)	(5 year comprehen sive)	-1	
F31	0	Active Sites, Prese nce	0	
F32	1		0	
F33QL	0		0	
F33QM	-2		-2	
F33QN	0		0	
F34QL	0		3	
F34QM	-2		2	
F34QN	1	Nest location?	3	Only in MMCA/at sea
F35QL	0		3	
F35QM	-2		2	
F35QN	3	Important ommissio n	3	Only in MMCA/at sea
F36QL	0		3	
F36QM	-2		2	
F36QN	1	Would help	3	Only in MMCA/at sea
F37QL	0		4	
F37QM	-2		2	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
F37QN	3	Difficult	3	
F38QL	0		4	
F38QM	-2		2	
F38QN	3	Crucial	3	Only in MMCA/at sea
F39QL	0		0	
F39QM	-2		-2	
F39QN	3	Important	3	
F40QL	0		0	
F40QM	-2		-2	
F40QN	3	Helpful information	3	
F41QL	0		4	
F41QM	-2		2	
F41QN	0		2	Only in MMCA/at sea
F42QL	0		0	
F42QM	-2		-2	
F42QN	0		0	
F43QL	0		0	
F43QM	-2		-2	
F43QN	0		0	
F44QL	0		0	
F44QM	-2		-2	
F44QN	3	Important	3	Only in MMCA/at sea
F45QL	0		4	Possibly
F45QM	-2		2	
F45QN	0		3	Only in MMCA/at sea
F46QL	0		0	
F46QM	-2		-2	
F46QN	0		0	
F47QL	0		4	Not stated
F47QM	-2		2	
F47QN	3	Prey population	3	Only in MMCA/at sea
F48QL	0		0	
F48QM	-2		-2	
F48QN	0		0	
F49QL	5		4	
F49QM	3		2	
F49QN	0		3	Only in MMCA/at sea
F50QL	5		4	
F50QM	3		2	
F50QN	0		3	Only in MMCA/at sea
F51QL	0		0	
F51QM	-2		-2	
F51QN	0		0	
F52QL	0		0	
F52QM	-2		-2	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
F52QN	0		0	
F53	3		3 (1)	(possibly 1)
F54	1		1	
F55	60		50	
F56	1 (+1/5)	(5 year comprehensive)	-1	
F57	0		0	Not explicit
F58	1		0	
F59QL	0		0	
F59QM	-2		-2	
F59QN	0		0	
F60QL	0		3	
F60QM	-2		2	
F60QN	1	Would be helpful	3	Only in MMCA/at sea
F61QL	0		3	
F61QM	-2		2	
F61QN	3	Crucial	3	Only in MMCA/at sea
F62QL	0		3	
F62QM	-2		2	
F62QN	1	Would be helpful	3	Only in MMCA/at sea
F63QL	0		4	
F63QM	-2		2	
F63QN	3	Difficult	3	Only in MMCA/at sea
F64QL	0		4	
F64QM	-2		2	
F64QN	3	Need to know	3	Only in MMCA/at sea
F65QL	0		4	
F65QM	-2		2	
F65QN	3	Important	3	Only in MMCA/at sea
F66QL	0		4	
F66QM	-2		2	
F66QN	3		3	Only in MMCA/at sea
F67QL	0		4	
F67QM	-2		2	
F67QN	0		3	Only in MMCA/at sea
F68QL	0		0	
F68QM	-2		-2	
F68QN	0		0	
F69QL	0		0	
F69QM	-2		-2	
F69QN	0		0	
F70QL	0		4	
F70QM	-2		2	
F70QN	3	Important	3	Only in MMCA/at sea
F71QL	0		4	
F71QM	-2		2	

APPENDIX F : Elliott S.F. and Pacific Lumber Data Sheet/Justificaton Notes (continued)

	Elliott S.F.	Justification	Pacific L.	Justification
F71QN	0		3	
F72QL	0		0	
F72QM	-2		-2	
F72QN	0		0	
F73QL	0		4	Not stated
F73QM	-2		2	
F73QN	3	Indicates edges bad	3	Only in MMCA/at sea
F74QL	0		0	
F74QM	-2		-2	
F74QN	0		0	
F75QL	5		4	
F75QM	3		2	
F75QN	0		3	Only in MMCA/at sea
F76QL	5		4	
F76QM	3		2	
F76QN	0		3	Only in MMCA/at sea
F77QL	0		0	
F77QM	-2		-2	
F77QN	0		0	
F78QL	0		0	
F78QM	-2		-2	
F78QN	0		0	
F79	1	Useful, but incomplete	1	Some benefit
F80	4	Comment #5	5	Comment #5

APPENDIX G -- ELLIOTT STATE FOREST JUSTIFICATION COMMENTS

COMMENT #	COMMENT
1	Not much information missing. More analysis of documented loss of old-growth (B3, B4), old-growth remaining (B6), more on fragmentation (B7), threats (B12, B22, B23) would have improved analysis.
2	A lack of full information exists. Using 100+ feet tree heighth as take with the minimal loss of suitable habitat is well documented in plan (C3, C4).
3	Missing only some available information/analysis, mainly fragmentation/ edge/predation (D5, D11, D13, D23, D30).
4	Some strong analyses/info. : Population ecology (E2), behavior (E3), community ecology (E5), ecosystem ideas (E6), habitat (E7,E9, E11, E12). Some weaker analyses/information include : Packing/inbreeding (E18) and lack of surveying (E41).
5	Weakest area of plan. Will protect marbled murrelet management areas (MMMAs) and then not monitor important aspects such as : Behavior (F8, F34, F60), presence (F9, F35, F61), population trends (F12, F38, F64), and survival (F13, F39, F65). Plan will monitor habitat well (F23, F24, F49, F50, F75, F76), maybe in excess considering lack of other monitoring.

APPENDIX H -- PACIFIC LUMBER JUSTIFICATION COMMENTS

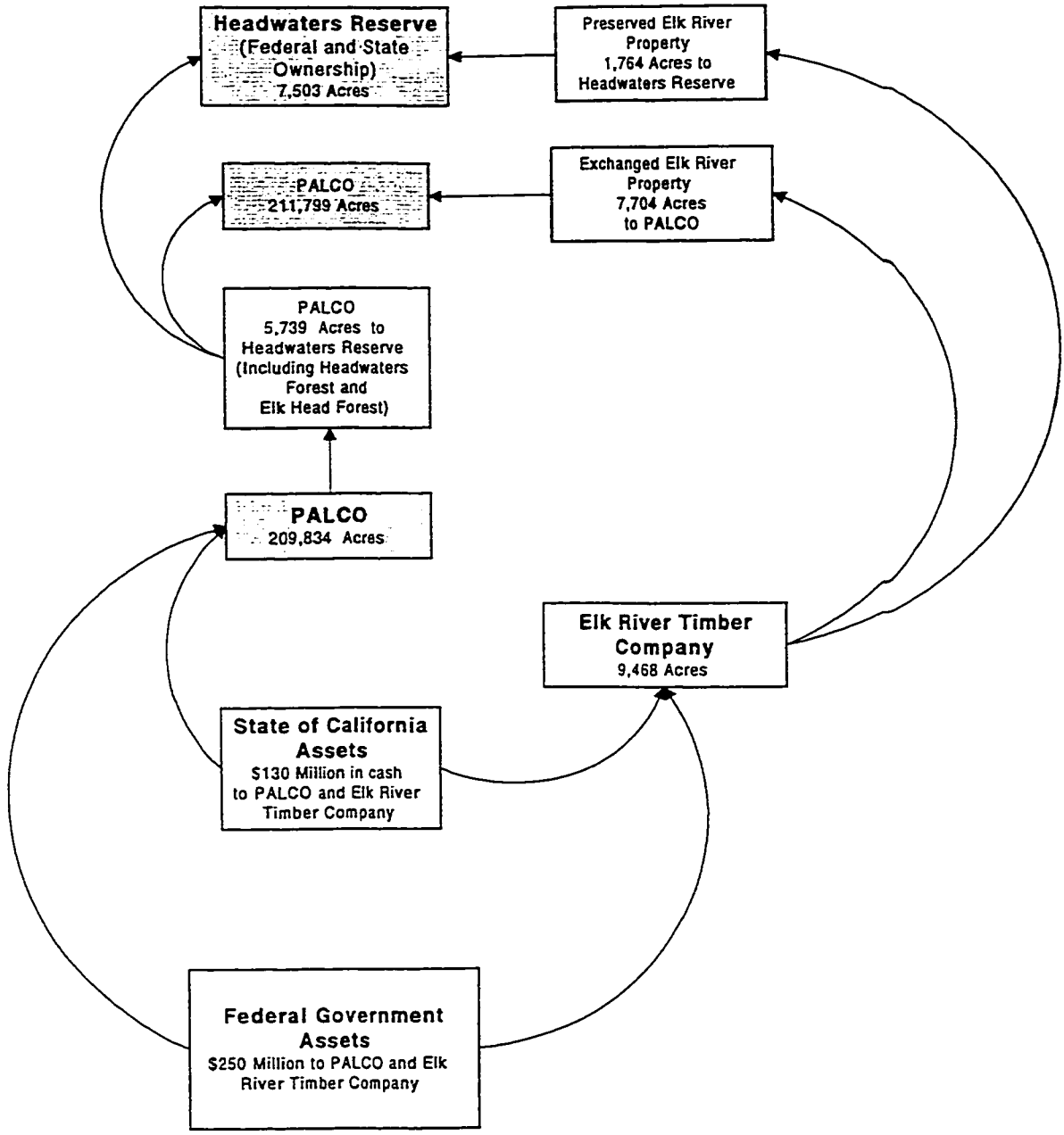
COMMENT #	COMMENT
1	Serious lack of trends (B5, B6). No global population perspective (B8) or extensive discussion about unique value of population (B13), both very important. Serious problems with movement of individuals (B14) and a general lack of available information.
2	Serious flaws exist. Does not use 1:1 ratio with suitable habitat (C5, C26, C27), only best habitat (old-growth and residual). Lack of fragmentation/ edge/cumulative accounting (C4, C5, C13, C16).
3	Not well analyzed. Downplay of several serious factors such as: nest fidelity/poor dispersion (D3, D20) and fragmentation/edge/predation (D5, D11, D30, D39). Only using occupied stands and best habitat to draw 1:1 conclusions is unfounded and most likely underestimates effect (D7, D9, D12, D14, D16). Diverges from own background saying no excessive takings in short term (D15) should occur. Reliance on outside land (D38).
4	Serious deficiencies including : No surveys (E5, E6) and reliance on set-asides while large take occurs in other areas (E2, E23). Lack of accounting for nest fidelity and poor dispersal to new stands (E3, E10, E20) adds to a lack of knowledge/analysis of suitable habitat (E7, E9,E11, E12) and island biogeography (E4, E18, E28, E29)

APPENDIX H (continued) -- PACIFIC LUMBER JUSTIFICATION COMMENTS

COMMENT #	COMMENT
5	Serious lack of information and analysis of existing information. Monitoring of habitat (F23, F24, F49, F50, F75, F76) is a problem as only the best is considered and most is done in marbled murrelet conservation areas (MMCAs). Not monitoring outside MMCAs except at-sea creates problems in sufficiency (F8-F15, F34-F38, F44-F48, F60-F67).

APPENDIX J: PACIFIC LUMBER 1999 HCP INFORMATION

J.1.—Land Acquisition and Asset Exchange



Source: United States Fish and Wildlife Service and California Department of Forestry and Fire Protection. 1999. Final environmental impact statement/environmental impact report and habitat conservation plan/sustained yield plan for the Headwaters Forest project.

APPENDIX J: PACIFIC LUMBER 1999 HCP INFORMATION

J.2.—Various Landscape Scales of Marbled Murrelet Nesting Habitat

Region/Unit		Acres
Pacific Lumber Company Lands [1/]		
	Headwaters/Elk Head Springs	3,117
	Other High Quality [2/]	2,022
	Low/Moderate Quality [3/]	7,250
	TOTAL	**12,389**
Southern Humboldt Bioregion (Bioregion)		
	Pacific Lumber	12,389
	Humboldt Redwoods State Park [4/]	4,095
	Grizzly State Park [5/]	388
	TOTAL	**16,872**
Marbled Murrelet Conservation Zone 4 (MMCZ4) [6/]		
	Bioregion	16,872
	Simpson	608
	Stimson	91
	Yurok	250
	Six Rivers National Forest	3,719
	Arcata BLM	568
	Redwood National and State Parks	38,982
	Oregon	64,727
	TOTAL	**125,817**
California [7/]		
	MMCZ4(CA)	61,090
	MMCZ5	430
	MMCZ6	7,250
	TOTAL	**68,770**
3 State (Washington, Oregon and California) [8/]		
	WA [9/]	373,875
	OR [9/]	254,869
	CA	68,770
	TOTAL	**697,514**

1/ Habitat estimation method on Pacific Lumber Company lands: contiguous occupied old growth/residual habitat within 0.5-mile radius of occupied survey stations on Pacific Lumber Company lands (excluding Headwaters)

2/ High quality indicates unentered old growth redwood outside Headwaters; assumes remaining inadequately surveyed is 100% occupied

3/ Low/moderate quality indicates residual redwood and inland Douglas-fir; assumes remaining inadequately surveyed is 25% occupied

4/ Habitat estimation method in state park: contiguous occupied old growth/residual habitat within 0.5-mile radius of occupied survey stations

5/ Includes all uncut old-growth within the state park

6/ Habitat estimation method in MMCZ4: Bioregion total plus estimates made for lands listed; estimates based on draft HCPs and personal communications with local biologists (OR total explained below)

7/ Habitat estimation method in California: MMCZ4 minus Oregon habitat plus totals for MMCZ5 and MMCZ6. MMCZ5 and MMCZ6 estimates based on L. Roberts (FWS), E. Burkett (CDFG), pers. comm.

8/ WA = 1.5 million potential suitable acres (T. Young, FWS-GIS, pers. comm.) x 0.25 occupancy index (WDNR HCP, Hamer, pers. comm.) excluding 1,125 acres for Quinault
OR = 2 conservation zones, MMCZ3 and MMCZ4 (Total = 254, 869 likely occupied acres)
MMCZ4 = (1) 20,000 acres, Siskiyou National Forest, Rogue National Forest, and Medford BLM (USFS GIS, 80,000 acres x 0.25 occupancy index; index derived from Dillingham et al. (1995), Meyers 1995, ODFW marbled murrelet survey database, and S. Livingston, pers. comm.)
(2) 44,727 acres in Coos Bay BLM (J. Heaney, BLM, pers. comm.)
MMCZ3 = (1) 137,500 acres, Suislaw National Forest (C. Froupfelker, USFS, pers. comm.)
(2) 5,567 acres, Eugene BLM (D. Huber, BLM, pers. comm.)
(3) 30,075 acres, Coos Bay BLM (J. Heaney, BLM, pers. comm.)
(4) 4,000 acres, northwest Oregon (N. Bentivoglio, FWS, pers. comm.)
(5) 13,000 acres, Elliott State Forest HCP
(6) Private lands unknown but likely very small amount

9/ Habitat in Oregon and Washington generally lower quality than California redwood forests, with lower murrelet densities

Source: United States Fish and Wildlife Service and California Department of Forestry and Fire Protection. 1999. Final environmental impact statement/environmental impact report and habitat conservation plan/sustained yield plan for the Headwaters Forest project.

APPENDIX J: PACIFIC LUMBER 1999 HCP INFORMATION

J.3.—Acreage of Suitable and Possibly Suitable Marbled Murrelet Habitat

PALCO Lands	Total Uncut Old Growth Redwood	Total Residual Old Growth Redwood	Total Old Growth Redwood	Other Habitats	Total Old Growth Douglas-Fir	Total Area
Available for Complete Harvest [1/]	501	8,321	8,822	176,225	8,304	193,351
Available for Partial Harvest						
Buffer Zones [2/]						
buf1320	0	205	205	1,632		1,837
buf300	0	90	90	331		421
Not Available for Harvest						
MMCA Options [3/]						
Preserve Grizzly Creek MMCA	117	530	647	410		1,057
Preserve Owl Creek MMCA	317	240	557	350	19	926
MMCA Reserves						
Allen Creek	394	595	989	740		1,729
B Road 7 & 9	21	238	259	232		491
Bell Lawrence	339	107	446	187		633
Booths Run	0	216	216	403	166	785
Cooper Mill	0	396	396	307		703
Elkhead Residual	0	65	65	286		351
LNF Elk	0	237	237	214		451
Road 3	0	374	374	189		563
Rt Road 9	77	112	189	128		317
Shaw Gift	256	54	310	162	31	503
MMCA Reserve Subtotal	1,087	2,394	3,481	2,848	197	6,526
All HCP (Preserve Grizzly Creek MMCA)	1,204	2,927	4,131	5,221	197	9,841
All HCP (Preserve Owl Creek MMCA)	1,404	2,636	4,040	5,161	216	9,710
Headwaters	3,117	665	3,782	1,927		5,709
PALCO Total	5,139	12,445	17,584	183,723	8,520	209,827
Elk River Timber Company Lands				9,469		9,469
All HCP and Purchase Conservation [3/]						
Preserve Grizzly Creek MMCA	4,321	3,592	7,913	8,943	197	17,345
Preserve Owl Creek MMCA	4,521	3,301	7,822	8,883	216	17,214

1/ Available for harvest = available for harvest planning, not taking into account watercourse protection.

2/ Buffer Zones = restricted harvest to protect adjacent old-growth habitat; buf 1,320 = within 1/4 mile of Humboldt/Redwoods State Park buf300 = within 300 feet of old-growth off-site.

3/ MMCA Options = Owl Creek MMCA would be preserved for the life of the permit with the option to purchase. Harvest in the Grizzly Creek MMCA would be deferred for 5 years with the possibility of purchase.

Source: Table I.A, Thomas Reid Associates, 1998. See Appendix N.

Source: United States Fish and Wildlife Service and California Department of Forestry and Fire Protection. 1999. Final environmental impact statement/environmental impact report and habitat conservation plan/sustained yield plan for the Headwaters Forest project.

APPENDIX J: PACIFIC LUMBER 1999 HCP INFORMATION
J.4.—Harvest of Marbled Murrelet Nesting Habitat Under HCP

	Uncut Old Growth Presumed Occupied*	Uncut Old Growth Low/No Survey	Total Uncut	Residual Presumed Occupied*	Residual Low/ No Survey	Total Residual	Total Old Growth
Option: Cut Grizzly	213	406	619	2485	6661	9146	9765
Option: Cut Owl	449	369	818	2306	6549	8856	9674
AB 1986: Cut Neither	150	351	501	2083	6533	8616	9117

*Presumed occupied is contiguous habitat within one-half mile of occupied survey station
(Based on TRA Table 5 A, Appendix N, Part 2)

Source: United States Fish and Wildlife Service and California Department of Forestry and Fire Protection. 1999. Final environmental impact statement/environmental impact report and habitat conservation plan/sustained yield plan for the Headwaters Forest project.

APPENDIX J: PACIFIC LUMBER 1999 HCP INFORMATION
J.5.—Marbled Murrelet Habitat in Southern Humboldt County

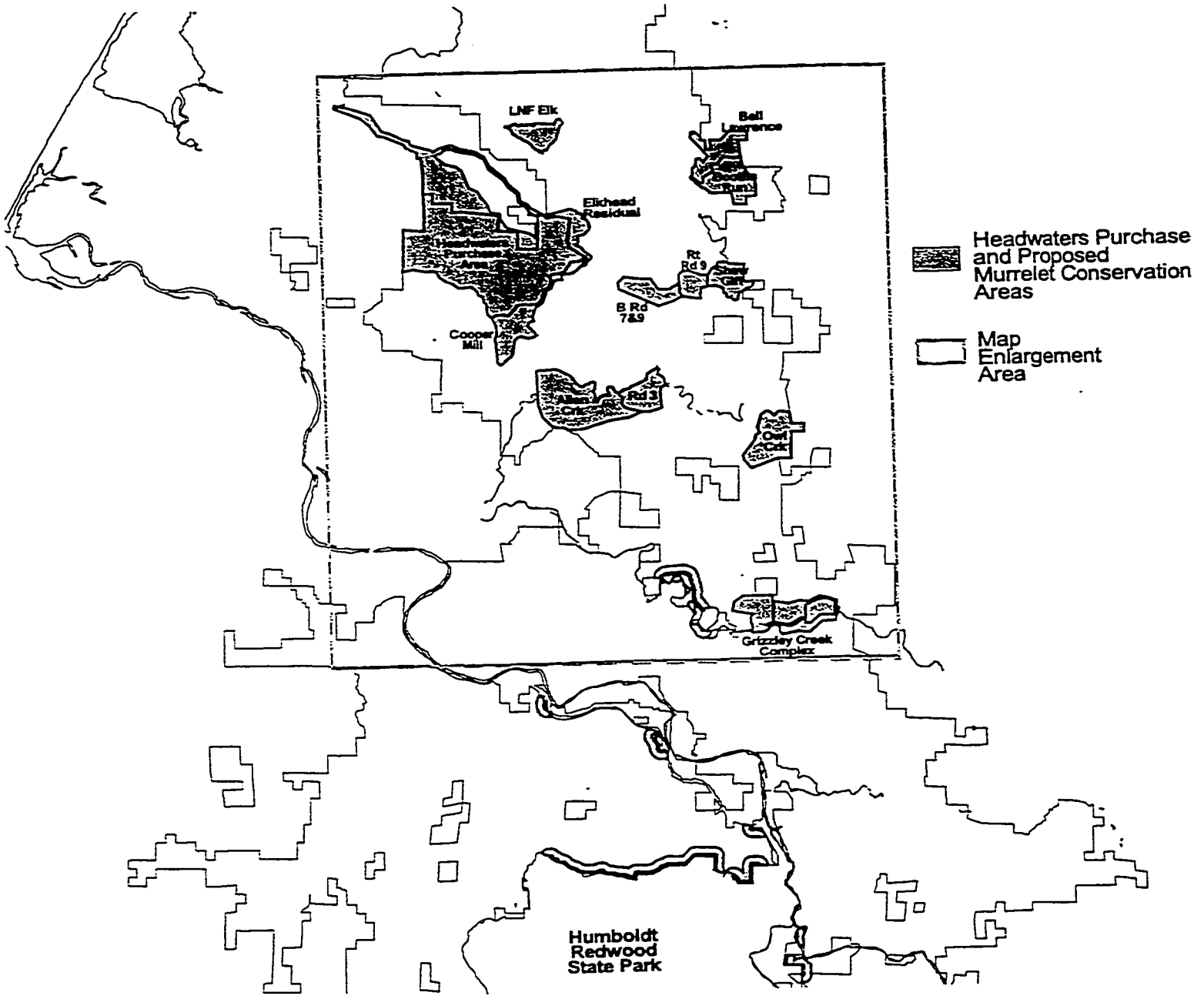
	Uncut Old Growth Presumed Occupied *	Uncut Old Growth Low/No Survey	Total Uncut	Residual Presumed Occupied *	Residual Low/No Survey	Total Residual	Total Old Growth
PALCO Headwaters	2643	474	3117	610	55	665	3782
PALCO Not Headwaters	1587	436	2023	4907	6875	11,782	13,804
PALCO Subtotal	4230	910	5140	5517	6930	12,447	17,586
State Parks	4250	16,059	20,310	122	3232	3354	23,663
Total S Humboldt	8480	16,969	25,449	5867	9933	15,800	41,249

* Presumed occupied is contiguous habitat within ½ mile of occupied survey station

Source: United States Fish and Wildlife Service and California Department of Forestry and Fire Protection. 1999. Final environmental impact statement/environmental impact report and habitat conservation plan/sustained yield plan for the Headwaters Forest project.

APPENDIX J: PACIFIC LUMBER 1999 HCP INFORMATION

J.6.—Marbled Murrelet Conservation Areas



Source: United States Fish and Wildlife Service and California Department of Forestry and Fire Protection. 1999. Final environmental impact statement/environmental impact report and habitat conservation plan/sustained yield plan for the Headwaters Forest project.

APPENDIX J: PACIFIC LUMBER 1999 HCP INFORMATION
J.7.—Marbled Murrelet Conservation Areas Habitat Types

Habitat Type	1 2/ Lower North Fork Elk	2 Bell Lawrence	3 Booth's Run	4 Elk Head Residual	5 Road 7 & 9 North	6 Right Road 9	7 Shaw Gift	8 Cooper Mill	9 Allen Creek & Extension	10 Road 3	11 Owl Creek	12 Grizzly Creek West/Center	Total
Uncut Old-growth Redwood		339			21	78	255		393		318	118	1,522
Uncut Old-growth Douglas-fir			158				31				13		202
Residual Old-growth Redwood	237	107	216	65	239	112	54	397	595	374	247	530	3,174
Residual Old-growth Douglas-fir			8								6		14
Late Seral	159	0	0	0	14			16	150	38	20	64	462
Mid-successional	46	23	78		98		32	136	445	111	18	265	1,251
Young Forest	8	156	199	286	100	69	103	155	37	0	211	14	1,339
Open Forest	1	6	126		0	59	27				70		288
Hardwood													0
Open, Non-timber					20				109	40		65	234
Grassland/Prairie		1									22	2	24
Total	451	633	784	352	492	318	503	704	1,729	564	925	1,057	8,510
Total without Grizzly Creek West/Center													7,453
Total without Owl Creek													7,585

1/ Owl Creek would be protected for the life of the permit with an option to purchase. Grizzly Creek would be protected for the first five years, after which it may be purchased or harvested.

2/ Numbers above correspond to those identifying the MMCAs in Figure 2.5-4.

Source: Foster Wheeler Environmental Corporation

Source: United States Fish and Wildlife Service and California Department of Forestry and Fire Protection. 1999. Final environmental impact statement/environmental impact report and habitat conservation plan/sustained yield plan for the Headwaters Forest project.