
4-97 4.2.2 Marbled Murrelet

4-97 4.2.2.1 Affected Environment

4-106 4.2.2.2 Criteria for Assessing the Alternatives

4-118 4.2.2.3 Environmental Consequences to the Marbled Murrelet

4-135 Cumulative Effects

4.2.2 Marbled Murrelet

This section is subdivided into two sections. The first briefly summarizes the affected environment for the marbled murrelet. The second describes the environmental consequences of implementing the alternatives to the marbled murrelet.

Two action alternatives, Alternatives B and C, are considered in detail along with the No Action alternative, Alternative A. For the OESF, Alternatives 1, 2, and 3 are identical to Alternatives A, B, and C respectively. The alternatives differ in the way they define potential nesting habitat, the methods used to protect occupied sites, the number of occupied sites potentially protected, the operative time lines of each alternative, the amount of information gathered on the species, and the overall conservation strategy used.

A detailed discussion of the environmental consequences of each alternative can be found in Section 4.2.2.2 and a summary of the environmental consequences of each alternative is provided in Table 4.2.34.

4.2.2.1 Affected Environment

This section presents information on the marbled murrelet and its habitat requirements that will be used as the base line against which to measure the impacts of the alternatives. The draft HCP contains a detailed description of the marbled murrelet, including a review of its taxonomy, physical characteristics, geographical distribution, behavior, nesting habitat, and a thorough discussion of habitat status in Washington and threats to the species (see HCP, Chapter III).

An analysis of the amount of murrelet habitat remaining in western Washington completed by DNR for the draft EIS on Forest Practices rule proposals indicated there were 916,611 acres of old-growth and 868,317 acres of mature forests in western Washington below 3,500 feet in elevation and within 66 miles of saltwater (WFPB 1995a). The analysis also indicated that of this habitat, approximately 62,200 acres of old-growth and 64,656 acres of mature forests exists on state-managed lands out of a total of 130,104 acres of old-growth and 165,312 acres of mature forest on state and private ownerships. Therefore, as much as 7 percent of the total potential marbled murrelet habitat in Washington (both federal and nonfederal) exists on state-managed lands. In addition, of the habitat on nonfederal ownerships, approximately 48 percent of the old-growth and 39 percent of mature forests are located on state-managed lands. This habitat represents a significant amount of the old-growth and mature forest nesting habitat available to the marbled murrelet.

Habitat Status in Washington. Estimates of the amount of potential marbled murrelet nesting habitat in Washington have been made using satellite data developed by the Washington Department of Fish and Wildlife (WDFW) and modified by DNR (see Raphael et al. 1995; WFPB 1995a; data developed by Eby and Snyder 1990 and updated by Collins 1993). These estimates were based on broad definitions of old-growth and large-saw forests. The amount of potential nesting habitat by ownership based on these estimates is shown in Table 4.2.28.

Current Habitat Protection

Estimates of the amount of murrelet habitat present on various land ownerships in western Washington were derived from a GIS analysis completed for the draft EIS on Forest Practices rule proposals for the marbled murrelet (WFPB 1995a). This analysis used Landsat data from 1988 that has been updated to reflect remaining habitat as of 1994. Old growth in this study was defined as stands with greater than or equal to eight dominant trees per acre greater than or equal to 32 inches diameter at breast height (dbh) associated with the presence of greater than or equal to 12 co-dominant trees per acre with a diameter greater than 16 inches. The presence of a multi-layered canopy, snags and down logs were also criteria. In addition, to be considered marbled murrelet habitat, old-growth stands had to be located within 66 miles of marine waters and below 3,500 feet in elevation. These limits were chosen because studies in Washington have shown that 99 percent of the breeding sites have been located within these zones (WFPB 1995a).

For all ownerships, old-growth habitat estimated to be present in western Washington from this analysis was 916,611 acres. Potential nesting habitat is protected in Olympic and North Cascades National Parks, wilderness areas, state parks, federal wildlife refuges, and through the President's Forest Plan. Within 66 miles of the coast and below 3,500 feet in elevation in Washington, approximately 342,832 acres of old growth exists within national parks, 440,088 acres in wilderness areas or areas included in the President's Forest Plan, 702 acres in state parks, and 26 acres in federal wildlife refuges (WFPB 1995a). In summary, 783,648 acres of potential nesting habitat in western Washington may receive some protection by these land designations. Some of this habitat may not be protected on tribal lands. Old growth on tribal lands was estimated to be 3,609 acres. A small amount of habitat was also located on other federal and state ownerships where guidelines concerning the protection of this habitat are unknown. These estimates indicate that approximately 86 percent of the old-growth forests in western Washington is located on federal lands with the majority of this habitat receiving protection. Habitat without current regulatory protection includes 62,200 acres of old growth on DNR-managed lands and 67,154 acres of old growth on private lands. Therefore, approximately 7 percent of the old-growth habitat in western Washington is managed by DNR and an additional 7 percent is located on private lands.

President's Forest Plan

The Secretaries of Agriculture and Interior adopted the President's Forest Plan in April 1994 (USDA and USDI 1994a). Marbled murrelets and their habitat on federal lands were specifically considered in this plan. Potential marbled murrelet nesting habitat, defined as stands dominated by conifers that were at least 21 inches dbh and characterized by a multi-story canopy, are specifically considered in this ecosystem approach to the management of late-successional forests (FEMAT 1993). In this plan, it was estimated that approximately 94 percent of the 969,200 acres of potential nesting habitat estimated to be available on federal land in western Washington is protected by the plan's Late-Successional Reserves (304,800 acres), Adaptive Management Areas (56,600 acres), and Riparian Reserves (13,200 acres) or through Congressionally or Administratively Withdrawn Areas (534,100 acres) (FEMAT 1993). These are much higher estimates of habitat protected than those developed by the GIS analysis for the Washington Forest Practices Rules (WFPB 1995a).

Two separate assessments were made by the President's Forest Plan Marbled Murrelet Working Team of the effectiveness of providing protection for marbled murrelets. One assessed only the sufficiency of habitat to provide for a well-distributed population on federal lands for 100 years and resulted in an 80 percent likelihood of such an outcome. The second assessment examined the probability of having a viable population of marbled murrelets on federal lands for 100 years with all factors (such as habitat on state and private lands, at-sea conditions, etc.) influencing murrelets considered and resulted in a 60 percent likelihood.

The analysis team stated that in some parts of the range of the marbled murrelet, nonfederal lands are key to maintaining the existing distribution of marbled murrelets and providing for potential recovery of the species and ... "management and development of murrelet habitat on private and state lands could provide for a higher viability rating and an increased likelihood that the ecosystem plan adopted on federal lands will maintain marbled murrelets for the long-term" (FEMAT 1993).

U.S. Fish and Wildlife Service Critical Habitat

On January 27, 1994, USFWS originally proposed designation of marbled murrelet critical habitat in Washington, Oregon and California (59 Fed. Reg. 3811 (1994)). From the comments received regarding the first designation and additional information available, the service amended the proposed designation of critical habitat on August 10, 1995. Comments from the public on this second proposal were due October 10, 1995.

Critical habitat is defined in section 3(5)(A) of the Endangered Species Act as the specific areas within the geographical area occupied by the species on which are found those physical and biological features essential to the conservation of the species, or which require special management considerations or protection. Critical habitat receives consideration under section 7 of the act with regard to actions carried out, authorized, or funded by a federal agency. As such, designation may affect nonfederal lands only where such a federal nexus exists. Federal agencies must ensure that their actions do not result in the destruction or adverse modification of critical habitat.

Application of the selection criteria in the designation of critical habitat resulted in the proposed designation of many of the mapped Late-Successional Reserves within marbled murrelet zones 1 and 2, as described in the Forest Ecosystem Management Assessment Team report (FEMAT 1993). Application of these criteria also resulted in the designation of nonfederal lands, where federal lands alone were judged to be insufficient in providing suitable nesting habitat for the recovery of the species. A proportion of DNR-managed lands were proposed for critical habitat designation where federal lands were limited or nonexistent. DNR-managed lands in southwest Washington are particularly important. Some private lands were proposed as critical habitat because they also provided essential elements. These designations included areas in the lowlands of northern Washington and land supporting known occupied sites in southwest Washington.

In western Washington, critical habitat designations included Congressionally Withdrawn Areas (1,800 acres), Late-Successional Reserves (1,220,200 acres), DNR-managed lands (426,800 acres) and private lands (2,500 acres). U.S. Fish and Wildlife Service stated that

any lands within critical habitat that are included in a habitat conservation plan that addresses the conservation of the marbled murrelet will be subsequently excluded from critical habitat designation while an HCP approved by USFWS is in effect. According to state regulations, when critical habitat is designated by the federal government, actions within these areas automatically become Class IV-Specials and a SEPA checklist is required. Much of state-managed and private land designated in the USFWS critical habitat rule are also being included in potential habitat conservation plans.

U.S. Fish and Wildlife Service Spotted Owl Proposed 4(d) Special Rule

Restrictions on "take" are currently imposed in all of the northern spotted owl's range. On February 7, 1995, the USFWS proposed a rule using section 4(d) of the Endangered Species Act, to impose "take" prohibitions only where USFWS finds it necessary and advisable. Under the proposed rule, the incidental take of spotted owls in the course of timber harvest and related activities on specified nonfederal lands in Washington and California would not be prohibited. The proposal does not include the marbled murrelet but could result in the loss of some old-growth habitat in areas designated for the rule. A final 4(d) special rule has not been adopted at this time.

U.S. Fish and Wildlife Service Draft Recovery Plan

The marbled murrelet was federally listed as threatened in Washington, Oregon and California on September 28, 1992 (57 Fed. Reg. 45328 (1992)) due to the high rate of nesting habitat loss and fragmentation, plus mortality associated with net fisheries and oil spills (Marbled Murrelet Recovery Team 1995). A Draft Marbled Murrelet Recovery Plan for the marbled murrelet was published by USFWS in July 1995. Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. The plan states that the next 50 years will be the most critical period for marbled murrelet conservation efforts because significant amounts of additional mature/large-saw forest habitat will not develop until after the year 2040 (FEMAT 1993). Populations in the Pacific Northwest are likely to continue to decline as a result of low reproduction and additional factors such as gill net mortality, oil spills, and predation that have increased adult mortality (Marbled Murrelet Recovery Team 1995). The plan states that the weight of evidence indicates the major factors in murrelet population decline are the loss of nesting habitat and poor reproductive success in the habitat that does remain. This poor reproductive success is apparently due in large part to increased vulnerability of nests to predators in highly fragmented landscapes (Marbled Murrelet Recovery Team 1995).

The plan states that there is little opportunity for an increase in marbled murrelet productivity as a result of forest maturation in the near future, and that any further substantial reduction in occupied nesting habitat would hamper efforts to stabilize the population and recover the species (Marbled Murrelet Recovery Team 1995). The plan concludes that: (1) recovery of the marbled murrelet will require additional nonfederal lands, with several key areas occurring on state and private lands (Marbled Murrelet Recovery Team 1995); (2) maintaining a well-dispersed marbled murrelet population is

an important component of recovery; and, (3) each segment of the species range should be managed to maintain viable populations (Marbled Murrelet Recovery Team 1995).

The Marbled Murrelet Recovery Team outlined several interim recovery objectives in the draft recovery plan. The primary objective of the plan is to stabilize population size at near current levels throughout the three-state area while gathering the necessary information to determine specific delisting criteria, such as population size goals and habitat needs for each marbled murrelet conservation zone. To achieve this overall objective, the plan states it would be necessary to achieve the objectives of: (1) maintaining and/or increasing the productivity of the population as reflected by total population size, the adult:juvenile ratio and nesting success; and, (2) removing and/or minimizing threats to survivorship, including mortality from gill net fisheries and oil spills. Actions needed to achieve these goals will be to: (1) secure habitat by designating reserves and critical habitat in both the marine and terrestrial environment, develop habitat conservation plans and protect occupied sites; (2) develop and implement landscape management strategies within marbled murrelet conservation zones to stabilize populations and improve habitat conditions; (3) monitor populations and survey potential breeding habitat to identify nesting areas; (4) implement short-term actions to stabilize and increase the population including maintaining habitat distribution and quality, maintaining suitable habitat in large continuous blocks, maintaining buffer areas, decreasing adult and juvenile mortality, increasing recruitment, and initiating research to determine the impacts of disturbance in both marine and terrestrial environments; (5) implement long-term actions to stop the population decline and increase population growth by increasing the amount, quality and distribution of suitable nesting habitat, decreasing fragmentation, protecting recruitment habitat, providing replacement habitat through silvicultural techniques, and improving marine habitat quality; and, (6) conduct research and monitoring to refine survey and monitoring protocols, examine limiting factors, and gather data necessary to develop specific delisting criteria and appropriate landscape management strategies (Marbled Murrelet Recovery Team 1995).

Habitat Conservation Plans

Section 10 of the ESA provides owners of nonfederal land with an alternative to the take prohibition. It allows USFWS to issue an "incidental take permit" to any applicant submitting a conservation plan for a listed species when the taking is incidental to, and not the purpose of carrying out of an otherwise lawful activity. USFWS must find that the taking would not appreciably reduce the likelihood of the survival and recovery of the species. No habitat conservation plans have been finalized in Washington State that specifically protect occupied sites of marbled murrelets. Section 10 efforts and cooperative agreements may, in the future, release protection on some portion of occupied sites and unoccupied suitable habitat in Washington.

Washington State Forest Practices Rules

Most of the potential benefits to marbled murrelets resulting from the implementation of Washington State Forest Practices Rules by state and private landowners would be from timber harvesting rules (WAC 222-30) regarding Forest Practices Riparian Management Zones (RMZs), forested wetlands, wildlife reserve tree management (WAC 222-30-020), and shade requirements to maintain stream temperatures (WAC 222-30-040).

Of these rules, the guidelines regarding Forest Practices RMZs would be expected to have the most benefits in providing some degree of marbled murrelet nesting habitat protection because of Forest Practices RMZ widths prescribed for different stream classes.

Additional benefits to murrelets could occur from rules regarding forested wetlands. For forested wetlands, landowners are encouraged to leave a portion (30-70 percent) of the wildlife reserve tree requirement for the harvested area within a wetland. Wildlife reserve tree management may also provide some limited nesting habitat for marbled murrelets. In some cases, where larger trees (greater than 32 inches dbh) are left to provide shade requirements to maintain stream temperatures (WAC 222-30-040), some marbled murrelet nesting habitat may be protected, but these rules do not specify tree sizes to be retained to meet shade requirements. Since all of these rules are not specifically designed to protect marbled murrelet habitat, minimal protection to breeding habitat or the population can be expected from these actions.

Washington State Forest Practices Rule Proposals for Marbled Murrelets

In the "Notice of Intent to Prepare and Request for Comments on Scope of EIS" dated April 8, 1994, the Forest Practices Board indicated that two marbled murrelet rule alternatives were proposed in addition to a No Action alternative. The alternatives under consideration are Alternative 1, the Occupied Stand Approach and Alternative 2, the Watershed Administrative Unit (MM-WAU) Approach. A final rule has not been adopted at this time.

Private Lands

It is estimated that 7 percent of the old-growth habitat in western Washington is available on private lands (WFPB 1995a). Some protection to suitable habitat and occupied sites may occur in the future if some private landowners develop habitat conservation plans that include the marbled murrelet. Demographic support or protection to occupied sites is expected to be minimal over time since most landowners will be harvesting their timber long before it becomes suitable marbled murrelet habitat.

Table 4.2.28: Old-growth, large-saw, and small-saw forests below 3,500 feet and less than 66 miles from marine waters by ownership

Source: DNR GIS, November 1994.

Ownership	Old-growth (acres)	Large-saw (acres)	Small-saw (acres)
Federal	798,231	710,347	352,853
State	62,950	64,656	173,131
Local	1,162	3,227	2,659
Tribal	3,607	1,302	5,614
Private	67,154	100,656	335,232
Total	933,104	880,188	869,489

Status of Habitat on DNR-Managed Lands

From data in Hamer et al. (1994b), DNR derived another estimate of potentially suitable nesting habitat for the lands it manages, assuming that (1) marbled murrelets would use a stand that contains at least eight trees per acre that are greater than or equal to 32 inches dbh; (2) at least 40 percent of such trees are Douglas-fir, western hemlock, western redcedar, or Sitka spruce; and, (3) the stand contains at least two nesting platforms per acre. This definition was derived from minimum conditions of occupied murrelet stands in Washington. Using forest growth models incorporating site index and assumptions of how managed stands versus unmanaged stands grow, DNR estimated the age at which a stand would develop eight trees greater than or equal to 32 inches dbh. Data from Hamer et al. (1994b) indicate that in unmanaged low-elevation stands, three trees per acre that are greater than or equal to 30 inches dbh would produce at least two platforms per acre. The platform per acre criterion is thus captured by the tree size and density criteria. Using this platform density criterion as the primary variable in defining habitat, DNR ran computer models summing the acres of habitat having four trees per acre that were greater than or equal to 32 inches in diameter. Four trees per acre and a 32 inch criterion was used because the information was already available and not expected to be significantly different than the three trees per acre criterion.

DNR's computerized geographic information system database was queried to assess how many acres of DNR-managed land met the minimum definition of murrelet habitat (greater than or equal to four trees per acre greater than or equal to 30 inches dbh) within 52.25 miles of marine water. The estimate was between 55,773 and 63,614 acres, depending on whether growth was assumed to be for a managed stand or a natural stand.

This represents 3.4-3.8 percent of all DNR-managed forest lands in the area covered by the HCP. However, combining old-growth and large-saw estimates from the WDFW results in an estimate of 126,606 acres of potential murrelet habitat on DNR-managed land (WFPB 1995a).

The 2-year murrelet habitat relationship study currently under way on DNR-managed lands will result in the most accurate picture yet of how much actual potential nesting habitat exists.

Habitat trends

The amount of available murrelet nesting habitat has been decreasing. Murrelets nest almost exclusively in low-elevation old-growth and mature forests within 40 miles of marine waters, although they have been observed as far as 66 miles inland. About 10 percent of pre-settlement old growth remains in western Washington (Norse 1990; Booth 1991) but most of this habitat is found at higher elevations and may be unsuitable for marbled murrelets. For example, 45 percent of the old-growth forest on federal lands in western Washington lies above 3,500 feet (WFPB 1995a). Logging, urbanization, and agricultural development have all contributed to the loss of this habitat.

The Forest Ecosystem Management Assessment Team (FEMAT 1993) estimated that management under the President's Forest Plan is expected to result in retention of 97 percent of the remaining 980,000 acres of potential murrelet habitat on federal lands in Washington (USDA and USDI 1994a; Perry 1995). Although there are currently no federal restrictions on logging of murrelet nesting habitat on nonfederal lands, landowners are still liable for take of murrelets under the Endangered Species Act. To avoid risk of taking, DNR began a voluntary deferral of timber harvesting in potential murrelet habitat in 1992. The Forest Practices Board is developing a rule for murrelet habitat on state and private lands under the Washington Forest Practices Act.

Current State and Federal Habitat Protection Measures Considered in the Assessment of the Alternatives

Some potential nesting habitat for the marbled murrelet is protected in Washington on several types of federal and state ownerships. This section describes how these protection measures were used when assessing and comparing the alternatives.

The analysis of the alternatives considered the benefits of habitat protection from the President's Forest Plan, current forest practices rules, reserves, and federal ESA regulations. In the analysis, it was assumed that the President's Forest Plan would protect a maximum of approximately 86 percent (WFPB 1995a) of existing or potential marbled murrelet habitat on federal lands in Washington State within various types of reserves. This estimate is lower than that provided by the Forest Ecosystem Management Assessment Team. The amount of land reserved in the President's Forest Plan within the range of the northern spotted owl was estimated by FEMAT to represent 75 percent of known marbled murrelet nesting habitat in Oregon, Washington, and California.

However, as Perry (1995) states, not all of these lands may be suitable for murrelets because the estimates were largely based on interpretations of satellite imagery that have

not been thoroughly ground-verified. Multiple GIS and Landsat imagery data with different forest classification categories were used from various agencies throughout the three-state-area to develop these estimates. Therefore, the accuracy of the products in estimating the amount of murrelet habitat in each area is unknown. For example, Table IV-27 of FEMAT 1993 reports that 605,600 acres of marbled murrelet habitat is available on the Olympic Peninsula while 562,700 acres of nesting, roosting and foraging (NRF) habitat are estimated to be available for spotted owls, despite the fact that much of NRF habitat for owls is often younger aged forests (Cummins et al. 1993) and unsuitable for murrelet nesting. Therefore, the estimate of marbled murrelet habitat for this area should be much lower than the estimate of NRF habitat available for the owl. Additionally, the estimates refer to quantity of habitat, not quality, which may depend on proximity to the coast, landscape context, stand size, and other factors that are not well understood.

The possible benefits of current Washington Forest Practices Rules (described previously) were considered and analyzed for each criterion. This analysis also assumed that the effect of ESA regulation would be to protect all occupied sites that are currently known in Washington. Presently there is no ESA requirement to survey potential habitat to locate additional sites and no specific guidelines developed to define what constitutes take for marbled murrelets in terms of habitat modification. It is not possible to predict how much habitat ESA regulations may protect in the future. Although DNR may choose to conduct surveys for marbled murrelets because of ESA requirements, it was not possible in the analysis to predict what surveys would be conducted or how extensive or intensive these surveys may be. Therefore, it was assumed that, at a minimum, known occupied sites would be protected by these federal regulations. It was estimated that approximately 1,814 acres of old-growth and 1,633 acres of mature forest would be protected in currently known occupied sites on private and state-managed lands in western Washington as of 1994 (WFPB 1995a). Although known sites may not be equivalent to currently occupied sites, because murrelets appear to exhibit high site fidelity (Divoky and Horton 1995) it is likely that most of these sites are still occupied. Approximately 43 percent of this acreage is located on DNR-managed lands in western Washington.

Although marine influences also affect the population, after assessing the evidence in both environments, the Marbled Murrelet Recovery Team (1995) states that the weight of the evidence indicates that the major factors in murrelet decline from historical levels are loss of nesting habitat and poor reproductive success in the remaining habitat. In addition, in a review of biological and ecological information on the marbled murrelet by Ralph et al. (1995a), they conclude that the ultimate fate of the marbled murrelet is largely tied to the fate of its reproductive habitat, primarily old-growth forests or forests with an older tree component.

Ninety percent of all old growth on DNR-managed lands is located below 3,500 feet in elevation. In addition, 89 percent of old growth on DNR-managed lands is located within 40 miles of the ocean (WFPB 1995a). Because the majority of potential nesting habitat on DNR-managed lands is located low in elevation and close to the ocean, this habitat, in conjunction with federal lands, likely plays an important role in contributing to the maintenance of murrelet populations in western Washington. In addition, old-growth and

mature forests on DNR-managed lands in southwest Washington, the Puget trough, and the near-coastal areas of the Olympic Peninsula often provide the only habitat available in these areas for the marbled murrelets and thus are critical in supporting and maintaining populations in these areas.

The length of time that suitable habitat is protected will also affect marbled murrelet populations. Adult marbled murrelets are thought to be long-lived birds (Beissinger 1995) that show a high fidelity to nesting areas (Divoky and Horton 1995), returning to the same stands to nest year after year. Divoky and Horton (1995) state that the loss or degradation of occupied breeding habitat would likely result in displaced breeders attempting to prospect for alternate breeding sites. In areas with little habitat available, this could result in birds being prevented from breeding, birds attempting to breed in sub-optimal habitat, increased risks of predation, and disruption of breeding activities for an unknown number of years. In areas with little or no alternate habitat available within a reasonable distance of the disturbed site, birds may be unable to locate suitable habitat to successfully reproduce.

Additional habitat from the development of protected recruitment habitat in Late-Successional Reserves in the President's Forest Plan is not expected to yield supplementary marbled murrelet habitat for 50 years or more (Marbled Murrelet Recovery Team 1995). No other source of additional suitable breeding habitat is expected to be available to the marbled murrelet within the next half century. The most optimistic estimate of the age that a typical western hemlock stand on a high quality growing site can be expected to begin producing minimal suitable nesting habitat is 78 years (Table 4.2.29). For poorer growing sites, the age is likely to be 116 years or more. Therefore, the long-term protection of current nesting habitat to help support current populations and prevent further population declines will be important to the short- and long-term persistence of the species.

4.2.2.2 Criteria for Assessing the Alternatives

This section presents the scientific and analytical basis for comparing the alternatives. The discussion is structured around two assessment criteria: the amount of potential nesting habitat protected by each alternative and the likelihood that an alternative would protect or enhance the reproductive potential of the population in conjunction with federal conservation efforts. This section defines these two criteria, outlines what standard measures were used to assess each criteria and reviews the qualitative and quantitative procedures used to measure the effect of each alternative on marbled murrelets. The significance and importance of each criteria and how they can affect the biology and ecology of the marbled murrelet are also discussed.

Criterion 1 - Quantitative: Amount of potential nesting habitat protected by each alternative

This criterion makes a quantitative assessment of the amount of habitat included in each alternative, and the time frame that this protection is provided, to determine if enough habitat is available to protect the majority of breeding sites, make a significant long-term contribution to federal conservation strategies, and increase the probability that the population would persist in conjunction with federal conservation efforts.

Measure: Quantitative GIS analysis of the amount of acreage protected by each alternative within each west-side planning unit, by each inland distance zone, and a qualitative assessment of the length of time that the protection would be provided.

Background Information Relevant to All Alternatives

The number of marbled murrelets protected and the health of the population will be directly related to the amount of habitat that is included under each of the alternatives and the length of time that this habitat is retained and available on the landscape for breeding birds. The eventual size, trend, and stability of the population in Washington will likely be affected by the total amount of habitat protected on state-managed lands combined with habitat protected by the President's Forest Plan, current forest practices rules, ESA protection, and other reserves.

The President's Forest Plan, national parks, and Administratively and Congressionally Withdrawn Areas will protect approximately 783,648 acres of potential nesting habitat (WFPB 1995a). The potential release for harvest of the so-called "318 sales" under Public Law (salvage rider bill) could affect the amount of habitat protected by the President's Forest Plan. In Washington State, these 318 sales include 15 sale units in the Olympic National Forest and 20 sale units in the Mt. Baker National Forest that are believed to be occupied by marbled murrelets. At this time, the Service does not expect occupied habitat from these sales to be harvested. A small amount of additional habitat would also be protected by the forest practices rules discussed previously. No habitat is currently protected by the spotted owl proposed 4(d) special rule, as this process is not yet complete. Little habitat has been protected by other HCPs completed to date, although none of the lands covered by these HCPs currently have occupied stands.

The Marbled Murrelet Recovery Team (1995) states that additional habitat essential for the conservation of the marbled murrelet occurs on nonfederal lands in Washington, but that these could be managed for the murrelet without further regulation if surveys for murrelets were required prior to timber harvest and occupied sites were protected from timber harvest operations. When all factors (including at-sea conditions and the condition of nonfederal lands) affecting the species were taken into account in a second assessment of population viability by the Marbled Murrelet Working Group of the President's Forest Plan, the assessment team rated the plan as having a 60 percent likelihood that murrelet populations on federal lands would be stable and well-distributed after 100 years (FEMAT 1993). In addition, they stated that the management and development of murrelet habitat on nonfederal lands could provide for a higher viability rating and an increased likelihood that the ecosystem plan adopted on federal lands would maintain marbled murrelets for the long term (FEMAT 1993). DNR-managed lands contain approximately 43 percent of the old-growth and mature forests found on nonfederal lands in western Washington.

Criterion 2 - Qualitative: Likelihood that the alternative would protect or enhance the reproductive potential of the population in conjunction with federal conservation efforts which would lead to the long-term persistence and adaptation of the species in Washington

This criterion makes a qualitative assessment whether enough protection is provided to the population to increase the likelihood that successful reproduction is maintained or increased, adult survival is maintained or increased, breeding sites are not disturbed during the breeding season and decrease the likelihood of reduced genetic variability and isolation of occupied sites. Criterion 2 also assesses whether a population source for the colonization of future sites in unoccupied suitable habitat would be provided.

Measure: Qualitative assessment of the degree and length of time that occupied sites are protected. The assessment included the degree that occupied sites were protected from disturbances due to forest management activities, further degradation and modification of breeding habitat, further fragmentation of breeding habitat (edge effects), loss of habitat due to windthrow, microclimatic changes to the stand, and nest predation.

Background Information Relative to All Alternatives

Maintaining a threatened or endangered species depends on determining its rate of population change and correcting the factors that limit population growth. Unfortunately, the amount of data available on murrelet population trends, demography, and biology is still limited. Demographic modeling using the best available information on the marbled murrelet can give indications of likely population trends and can indicate which components of the life history are most likely to significantly affect population growth and stability. Once identified, these limiting factors can be used to indicate what management tools would have the greatest benefits to the species.

Demographic models developed by Beissinger (1995) indicate that the marbled murrelet population is likely declining at a rate of approximately 7 percent per year in Washington, Oregon and California based on juvenile ratios from offshore marine counts. Beissinger found population changes were most sensitive to adult survivorship and stated that because of the murrelet's habit of flying long distances inland to nest in old-growth forests, it probably faces higher adult mortality risks than other seabirds. In addition, he noted that all measures of productivity of the population from field data appear to be low and that this poor reproductive success could be due to high nest failure rates due to predation (Nelson and Hamer 1995a) or a low proportion of adults attempting to breed, perhaps because they are unable to find suitable nests. This information indicates that management directed at increasing adult survivorship, nesting success, and the proportion of adults that are breeding in any 1 year would likely substantially improve conditions and increase the stability of the population over time. Therefore, protection of the reproductive potential of the population and reduction of adult mortality should be given a high priority.

Even with no further loss of habitat, the adult population can be expected to equilibrate and will likely stabilize at a smaller population size than present. Increases in juvenile:adult ratios could result from these declines in the after-hatch year portion of the

population, without any actual increase in reproduction or survival. If these non-equilibrium conditions exist, the recent juvenile:adult ratios observed in the marine environment and used in the Beissinger model may be overestimates of the actual reproduction occurring in the population.

The number of breeding sites protected by each alternative (analyzed in Criterion 1) and the silvicultural and wildlife management techniques used to provide protection to occupied sites would likely directly determine the number of pairs of breeding birds protected and the reproductive success of these birds and, therefore, affect the reproductive potential of the whole population. The methods employed to protect and retain these forests would determine the total amount of habitat retained over time, especially in regions prone to loss of older forests by fire and windthrow. If breeding sites are not located and protected using the best knowledge available, the likely result would be continuing population decline.

Once these breeding sites are located, if long-term protection or enhancement measures are not taken to meet the needs of breeding birds, the likely result would be increased risks of nest predation and adult mortality, continued reproductive failures, continued disturbances to breeding sites, and a decreased likelihood of persistence of the population even with the benefits from federal conservation efforts. If the necessary protective measures are not provided to breeding sites on state-managed lands to ensure reproductive success, the likelihood of the success of the President's Forest Plan in maintaining murrelet populations over time would decrease. In addition, the likelihood that USFWS recovery objectives would be attained for each of the conservation zones in Washington would also be lower.

Plans that consider and solve problems in the distribution of habitat on a landscape scale, and provide increased protection for those areas where populations or habitat levels are low, would likely have a better chance of long-term success. Plans that identify areas where the isolation of breeding colonies could be a problem, or that have the flexibility to recommend the development of habitat in areas where little suitable habitat exists, would be more likely to protect populations over time. Strategies that can provide additional habitat over time to replace habitat that may be lost to catastrophic events and fill gaps in the distribution of suitable nesting habitat allowing birds an opportunity to colonize new stands will have a higher likelihood of success. The Draft Marbled Murrelet Recovery Plan identified southwest Washington (southern portion of conservation zone 2) and near-coastal areas of western Washington Puget trough (western portion of conservation zone 1) as areas nearly devoid of suitable habitat and having little or no federal ownerships to offer habitat and population support from federal conservation efforts (Marbled Murrelet Recovery Team 1995). The plan states that habitat remaining in these portions of the conservation zones will be extremely important in maintaining murrelet populations in these areas and maintaining a well-dispersed population. The plan identified maintaining a well-dispersed population as an important component of recovery and that each segment of the species range should be managed to maintain viable murrelet populations within each zone (except zone 5 near Mendocino, California).

Forest fragmentation leading to smaller stand sizes with decreased interior forest conditions can cause indirect changes in intact forests, such as changes in microclimatic conditions, forest structure, and amount of cover. Fragmentation results in increased forest edge (Harris 1984). Interior portions of old-growth forests generally have lower temperatures and higher humidity conditions than those areas closer to the forest edge. This may be an important factor to the marbled murrelet, a thickly plumaged seabird adapted to diving for food in cold waters. Interior forest conditions would also be expected to provide more protection to nests and young from wind and rain storms than locations closer to the forest edge (Ralph et al. 1995a).

Ralph et al. (1995a) concluded that exposure to avian nest predators may be influenced by the size of the stand and the placement of nests relative to the edge of a stand. Paton (1994) reviewed literature on songbirds and found that artificial nests are subject to greater predation within 50 meters (165 feet) of the forest edge, although none of the studies were conducted in western coniferous forests. Working in coniferous forests in British Columbia, Bryant (1994) found artificial nests placed on the ground or in shrubs near the edge of the stand were more frequently preyed upon than those in the center of the stand. He also found corvids on Vancouver Island to be more common along the edge of forests than in the interior. Nelson and Hamer (1995a) found that successful marbled murrelet nests were farther than 55 meters (182 feet) from the forest edge and were better concealed than unsuccessful nests. Increases in corvid abundance (Marzluff 1994) and increased habitat modifications leading to an increase in corvid foraging effectiveness may be leading to a decrease in the nesting success of marbled murrelets (Nelson and Hamer 1995a). Some studies in the Pacific Northwest have not found corvids to be an open- or edge-related species (Carey et al. 1991). Although more work needs to be done, it is likely that predation is a factor limiting this population and influencing the selection of nesting habitat and reproductive success (Ralph et al. 1995a). In addition, since the marbled murrelet is very social at breeding sites and shows colonial or semi-colonial nesting behavior, larger stands can contain more birds overall, although there is no evidence that density changes as a function of stand size (Miller and Ralph 1995).

The Marbled Murrelet Recovery Team (1995) identified decreasing fragmentation by increasing the size of suitable stands to provide a larger area of interior forest condition as a primary recovery action. The team stated that suitable nesting habitat maintained in larger contiguous blocks would provide more nesting and hiding opportunities, provide for multiple nesting sites for individual pairs of birds over time, facilitate nesting for multiple pairs of birds, and promote increased social contact. They also noted that interior forest conditions may be important to reduce nest predation and adult mortality, increase protection of nests from windstorms and environmental changes, and reduce loss of habitat from windthrow and fire.

The Forest Practices Board Science Advisory Group (SAG) on marbled murrelets made recommendations to the Washington Forest Practices Board regarding murrelet protection on nonfederal lands in Washington in 1993 (Cummins et al. 1993). They concluded that the creation of abrupt forest openings adjacent to occupied stands may result in negative impacts to the suitability of marbled murrelet nesting habitat related to changes such as increased wind velocity, solar radiation, temperature, tree mortality, canopy cover and

decreases in humidity near stand edges. One of the selection criteria in the designation of critical habitat by the USFWS was the presence of large contiguous blocks of habitat. The Marbled Murrelet Working Team that drafted the guidelines for protection of marbled murrelets in the President's Forest Plan designated large contiguous blocks of habitat (Late-Successional Reserves) as the primary means of protecting occupied sites and breeding potential on federal lands.

Nest site disturbance from forest management activities should be another important consideration in any alternative designed to protect marbled murrelet nesting habitat. After a review of available information and listening to comments and recommendations from scientists on potential disturbances to marbled murrelets, the Science Advisory Group on marbled murrelets concluded that alcids are particularly susceptible to human disturbances during early incubation due to risks of nest abandonment and during the first few days following hatching, due to increased vulnerabilities to predation. They also noted that some field biologists felt that murrelets may also be more susceptible to disturbance during the first few days prior to fledging (Cummins et al. 1993). Other sensitive periods include the first few days following hatching. The SAG report states that disturbances that would be of major concern, especially to alcids, are noises that are loud, abrupt, and unpredictable in nature, such as blasting. Posing less risk would be low volume, chronic background noises. They noted that disturbances visible to a nesting bird in conjunction with loud noises would be considered a greater risk than a single disturbance event. The combination of sound, volume, topography, and levels of background noise will probably determine the level of disturbance to nesting marbled murrelets.

The Draft Marbled Murrelet Recovery Plan (Marbled Murrelet Recovery Team 1995) identified the need to evaluate the effects of disturbance in more detail in both the marine and terrestrial environments. The team stated that disturbances near murrelet nest sites that flush incubating or brooding adults from the nest may expose adults and young to increased predation, or result in accidental loss of eggs or nestlings by falling or being knocked out of nests. Human activities that result in an increase in the number of predators near nesting areas could also lead to a greater likelihood of nest predation (Marbled Murrelet Recovery Team 1995). Predation rates on alcid nests are often higher in areas where predators have been introduced, habitat has been modified, or where birds are disturbed by human activities (Gaston 1992; Murray et al. 1983; Nettleship and Birkhead 1985). Ralph et al. (1995a) suggests management of occupied sites should include adjusting the timing of human disturbances to avoid disruption of murrelet activity such as courtship, mating, and nesting. They also recognized that additional information was needed which documented the likelihood and kinds of human activities that may have detrimental effects on murrelet nesting success.

Throughout the next sections, "protected" refers to habitat that would fall under a particular alternative (deferral or protection) and "unprotected" refers to habitat that would not be provided for in an alternative.

Procedures Used for the Analysis of Alternatives Under Criterion 1

The first criterion (Criterion 1) used for analysis of the three alternatives for marbled murrelets was defined as the amount of potential nesting habitat protected by each alternative. To measure the acreage of potential nesting habitat protected by each alternative, a geographic information system (GIS) analysis was conducted. A direct measure of potential nest platform abundance and the number of dominant trees per acre for each stand on DNR-managed lands within the range of the marbled murrelet was not available for this analysis. DNR's GIS data does not specifically include the stem density or potential nest platform density information needed to classify whether a stand is potential murrelet habitat. Therefore, another measure (described below) that is directly related to the variable "stems per acre" was used to classify murrelet habitat.

Research results by Hamer et al. (1994b p. 43) indicated that conifer trees with a diameter between 30-39 inches (dominant tree) in unmanaged (fully stocked) low-elevation stands could be expected to have a mean of 0.66 potential nest platforms per tree. Conifer trees below this diameter rarely contained any potential nest platforms. Therefore, on average, a stand containing three trees per acre with a dbh greater than 30 inches would result in a forest structure with a minimum of two platforms per acre. The relationship between tree size and platform density was not available for managed stands but platforms are most likely less abundant in these stands. To derive estimates of murrelet habitat, it was assumed a similar relationship existed for managed stands. This assumption helps prevent an underestimate of the total potential habitat available. Even with this assumption, estimates of the amount of habitat available in each planning unit are very similar to estimates obtained in a GIS analysis estimating the amount of marbled murrelet habitat available on DNR-managed lands (WFPB 1995a) and a GIS analysis using Landsat Thematic Mapper data conducted by DNR for the Olympic Experimental State Forest (OESF).

The ages at which forest stands would likely develop at least three dominant trees per acre were estimated using forest stand inventory data from DNR's Forest Resources Division. Two separate estimates were made: one for stands dominated by Douglas-fir, and one for stands dominated by western hemlock (Tables 1 and 2). If a stand was not dominated by either Douglas-fir or western hemlock, western hemlock estimates were used. By using forest stand inventory data, it was possible to calculate the average age at which stands, for each site index (a measure of site quality and growth potential) and stand type (managed or fully stocked stands), would reach minimum suitable habitat conditions (three dominant trees per acre).

Fully stocked and managed stands represent two different sets of assumptions about stand development. "Managed" is interpreted to mean a stand grown at 50 percent of full stocking from time of crown closure until age 35. Managed stands, because of the lower stocking level and uncrowded conditions for tree growth, would reach suitable habitat conditions at an earlier age than fully stocked stands. Similarly, stands with lower site indexes (poorer growing conditions) would take longer to develop into suitable habitat (Tables 1 and 2). Information on age estimates for each site index and stocking level were only available for four and eight dominant trees per acre. Foresters developing these estimates stated that there would be no significant difference in the stand age estimates

for four stems per acre and the three stems per acre used in the Alternatives B and C definition of suitable habitat as a surrogate for two platforms.

Table 4.2.29: Age (years) when four and eight trees per acre, 32 inches dbh and larger occur in fully stocked and lower stocked managed stands in coastal Douglas-fir stand types

Higher site index values indicate better growing conditions for trees.

Site Index	Full Stock 4 stems/acre	Full Stock 8 stems/acre	Managed 4 stems/acre	Managed 8 stems/acre
150+	72	80	54	64
150	98	108	78	88
140	106	116	89	99
130	144	154	101	110
120	192	202	130	140
110	240	260	160	180

Table 4.2.30: Age (years) when four and eight trees per acre 32 inches dbh and larger occur in fully stocked and lower stocked managed stands of coastal western hemlock stand types

Higher site index values indicate better growing conditions for trees.

Site Index	Full Stock 4 stems/acre	Full Stock 8 stems/acre	Managed 4 stems/acre	Managed 8 stems/acre
140	78	88	58	68
130	88	98	68	78
120	98	108	78	88
110	107	117	88	98
100	116	126	98	108
90	138	148	107	117
80	161	180	116	126

Therefore, the average age that a stand would reach suitable habitat conditions was determined based on when stands developed four trees per acre greater than or equal to 32 inches dbh. At this stocking density and tree size, stands begin to develop a minimum of two potential nest platforms per acre. Because the No Action alternative uses two different inland distance criteria to define habitat, the GIS analysis was partitioned into two inland distance zones. The total amount of marbled murrelet habitat estimated to be available in each inland zone was multiplied by the proportion of habitat that is currently being deferred by DNR to obtain final estimates of habitat available. Under Alternative A, the two zones included stands that were: (1) *0-40 miles inland*: 100 percent of sales are currently deferred by DNR that meet the criterion of having four trees per acre greater than or equal to 32 inches dbh; and, (2) *40-52.25 miles inland*: 33 percent of sales that meet the criterion of having four trees per acre greater than or equal to 32 inches dbh are currently deferred by DNR. Therefore, out of the total acreage of habitat in this zone, 33 percent were calculated to receive deferral.

To estimate the amount of habitat that would be included in Alternatives B and C, the four stems per acre criterion was again used, since the HCP alternatives also use a minimum of two platforms per acre as a criterion in its definition of suitable marbled murrelet habitat. Therefore, the GIS analysis counted the acreage in all stands between 0-50 miles inland that were greater than or equal to 5 acres in size and were greater than or equal to the age at which these stands would have four trees per acre greater than or equal to 32 inches dbh. The total amount of marbled murrelet habitat estimated to be available in each inland zone was multiplied by the current estimates of occupancy rates (percent of stands surveyed and found to be occupied) for each planning unit to obtain final estimates of habitat available. Only one inland distance zone was used to define habitat for the two HCP alternatives: *0-50 miles inland*: Only occupied stands are deferred and protected. These stands would all meet the criterion of having two potential nest platforms per acre and being greater than or equal to 5 acres in size. Current estimates of occupancy rates for each planning unit were used to estimate the amount of habitat expected to be occupied and protected in each planning unit as surveys are conducted.

Estimates of occupancy rates used to calculate the proportion of protected habitat anticipated under Alternative B were obtained from results of marbled murrelet surveys conducted by DNR in four of the six west-side planning units. These planning units were the Olympic Experimental State Forest (OESF), Straits, South Coast, and Columbia planning units. Two years of surveys have been completed by DNR in the OESF and Straits planning units, while only 1 year of surveys were completed in the South Coast and Columbia planning units. A second year of surveys will be conducted in the South Coast and Columbia units in 1996. It is likely that occupancy rates could be expected to increase after the second year of survey are completed in these planning units. Occupancy rates for the North Puget and South Puget planning units were obtained from survey results reported by Hamer et al. (1994b).

Occupancy rates from DNR data were calculated using only survey data from stands where the habitat was defined by DNR as high (old-growth or mature forest with an average density of two or more suitable potential nest platforms per acre) or medium quality (sub-mature forest habitat with an average density of two or more suitable

potential nest platforms per acre). Data from low-quality stands that were surveyed by DNR were not used because they did not meet the criterion of having at least two potential nest platforms per acre. Low-quality habitat was defined by DNR as young forest habitat with at least one suitable potential nest platform present in the stand. In addition, occupancy of a stand was defined according to the current definition used by the Pacific Seabird Group Marbled Murrelet Survey Protocol (Ralph et al. 1994a). This definition only considered stands occupied if birds were observed at or below the forest canopy. The Washington Department of Fish and Wildlife definition of occupancy includes birds observed over the top of the canopy within 1.25 tree heights. A tree height is considered the height of the average dominant tree in the area.

The amount of habitat protected in Alternative C in the near term would include all marginal marbled murrelet habitat identified by the habitat relationship studies and all surveyed unoccupied habitat identified by the intensive surveys. Therefore, the amount of habitat protected by Alternative C is estimated to be similar to the estimate of the total amount of habitat available for Alternative B before occupancy rates are taken into account (Table 4.2.30).

GIS Habitat Analysis Results

The total amount of potential marbled murrelet nesting habitat on DNR-managed lands for each planning unit is shown in Table 4.2.30 before deferral and occupancy rates are taken into account for Alternatives A and B. These estimates may fall below the actual amount of habitat because they are based on the age of the primary tree species in a forest stand and ignore the secondary tree species, which can provide additional trees per acre greater than or equal to 32 inches dbh.

Further, these estimates do not account for stands where a small patch of murrelet habitat may prompt a decision to restrict timber harvest for the entire stand. On the other hand, these estimates may include some hardwood-dominated stands that would not be considered marbled murrelet habitat because murrelets are not known to use hardwoods as nest trees, and some high-elevation conifer stands not typically used by murrelets. Stands dominated by hardwoods may be less likely to contain enough conifer nesting habitat for the marbled murrelet. It was not possible to select and remove these hardwood stands from the analysis. Acreage calculated for the alternatives did not include any elevational limit. Because the analysis only included stands dominated by Douglas-fir or western hemlock, elevation was accounted for by not including stand types located at higher elevations that would be dominated by silver fir or mountain hemlock. The majority of marbled murrelet habitat is found in western hemlock forest types (Table 4.2.30). Very little habitat is available in Douglas-fir forest types for any DNR planning unit.

Table 4.2.31: Estimated acreage of marbled murrelet habitat on DNR-managed lands by stand type and planning unit before deferral and occupancy rates are taken into account for each alternative

Two inland distance zones are shown for the No Action alternative. Estimates were derived using the age at which stands would be expected to produce two potential nest platforms per acre (4 stems per acre ≥ 32 inches dbh) for each stand type and site index (see Tables 4.2.28 and 4.2.29 for age estimates).

Planning Unit	Species	No Action Alternative		Alternatives B and C
		Acres 0-40 mi.	Acres 40-52.25 mi.	Acres 0-50 mi.
OESF	DF	20	0	20
Straits	DF	61	0	61
South Coast	DF	554	0	554
Columbia	DF	487	418	750
North Puget	DF	309	2	312
South Puget	DF	138	0	138
Total Douglas-fir		1569	420	1835
OESF	WH	45642	0	45642
Straits	WH	353	0	353
South Coast	WH	2829	0	2829
Columbia	WH	1559	66	1625
North Puget	WH	6945	208	7153
South Puget	WH	1122	105	1227
Total West. Hemlock		58450	379	58829
Total Acreage Overall		60019	799	60,664

Under the No Action alternative, 60,019 acres of habitat are located between 0-40 miles inland and 799 acres (of which 264 acres or 33 percent are likely to be deferred) are located between 40-52.25 miles inland. After deferral rates are taken into account, No Action would defer the harvest of 60,283 acres of marbled murrelet habitat (Table 4.2.31) for an unknown period of time.

Table 4.2.32: Estimated acres of marbled murrelet habitat on DNR-managed lands for No Action (Alternative A) taking into account deferral rates for each inland zone currently implemented by DNR

Planning Unit	Total Acres 0-40 mi.	Estimated Acres Deferred	Total Acres 40-52.25 mi.	Estimated 33% Deferred	Total Acres Deferred
OESF	45,662	45,662	0	0	0
Straits	414	414	0	0	0
S. Coast	3,383	3,383	0	0	0
Columbia	2,046	2,046	484	160	160
N. Puget	7,254	7,254	210	69	69
S. Puget	1,260	1,260	105	35	35
TOTAL	60,019	60,019	799	264	60,283

Alternatives B and C include 60,664 acres of habitat estimated to be available between 0-50 miles inland (Table 4.2.30). Seventy-five percent of all the marbled murrelet habitat found on state-managed lands for either HCP alternative is located within the OESF Planning Unit and 12 percent is located in the North Puget Planning Unit. After occupancy rates for each planning unit are taken into account, Alternative B is estimated to protect 38,442 acres of marbled murrelet habitat (Table 4.2.32). Alternative C, because it retains all suitable habitat until a long-term conservation plan is developed, would protect approximately 60,664 acres (Table 4.2.30) of habitat for at least a 10-year period. Once the long-term plan is developed it is impossible to predict what proportion of the marginal and suitable unoccupied habitat would be protected over time under Alternative C.

Table 4.2.33: Estimated acres of marbled murrelet habitat protected on DNR-managed lands for Alternative B taking into account the expected stand occupancy rates (percent of stands surveyed and found to be occupied) for each planning unit

Occupancy rates were obtained from actual surveys conducted on state-managed lands or rates were obtained from research conducted by Hamer et al. (1994b).

Planning Unit	Total Acres 0-50 miles	Percent Occupancy	Total Acres Protected
OESF	45,662	72.5	33,105
Straits	414	2.9	12
South Coast	3,383	60	2,030
Columbia	2,375	7.3	173
North Puget	7,465	40	2,986
South Puget	1,365	10	137
Total	60,664		38,442

4.2.2.3 Environmental Consequences to the Marbled Murrelet

This section describes the probable consequences to the marbled murrelet and its habitat of implementing the three alternatives presented in this DEIS. This discussion includes descriptions of the direct physical and biological consequences of each alternative and the cumulative effects of these actions.

No population viability model has been constructed for the marbled murrelet; therefore, accurate population size estimates and specific information regarding the amount of habitat needed to support or maintain various population levels is lacking. For the purpose of this DEIS, precise quantitative effects of the alternatives on the murrelet population cannot be specified. This evaluation should not be viewed as precise analyses of likelihoods of persistence; rather, it provides the decision makers and the public with the best assessment of the potential consequences of the alternatives. This assessment should provide enough information for the USFWS to predict whether the alternatives (two of which include permission to incidentally take the marbled murrelet) provide sufficient habitat conditions and management considerations to support the Washington population in conjunction with expected conditions on federal lands.

Assessment of Criterion 1 - Quantitative: Amount of potential nesting habitat protected by each alternative

This criterion makes a quantitative assessment of the amount of habitat included in each alternative, and the time frame that this protection is provided, to determine if enough habitat is available to protect the majority of breeding sites, make a significant long-term contribution to federal conservation strategies, and increase the probability that the population would persist in conjunction with federal conservation efforts.

Measure: Quantitative GIS analysis of the amount of acreage protected by each alternative within each west-side planning unit, by each inland distance zone, and a qualitative assessment of the length of time that the protection would be provided.

ALTERNATIVE A

Under the No Action alternative, currently known occupied sites on DNR-managed lands would be protected in compliance with the ESA requirements. As of 1993, the area of nonfederal lands under ESA restrictions due to presence of known occupancy included approximately 1,814 acres of old-growth and 1,633 acres of mature forest habitat (WFPB 1995a). However, known sites involve only a fraction of the potential suitable habitat that DNR and other land managers must consider in order to avoid a possible violation of the ESA. ESA compliance under the No Action alternative is achieved through the Board of Natural Resources take-avoidance policy, which, at present approximates a "no take" approach. However, the No Action alternative contains no permanent provisions that would ensure that a take-avoidance policy would continue, or that plans for the management of suitable but unoccupied habitat for the benefit of the marbled murrelet would be developed.

An estimated 60,283 acres of habitat on DNR-managed lands in western Washington would be deferred by this alternative for an unknown period of time (Table 4.2.31). Approximately 60,019 acres would be deferred between 0-40 miles inland and 264 acres would be deferred between 40-52.25 miles inland. One hundred percent of the suitable habitat on DNR-managed lands in the 0-40 mile inland distance zone and 33 percent of the suitable habitat in the 40-52.25 inland distance zone would be deferred based on current DNR habitat protection guidelines. If this deferral were to continue through time, the No Action alternative would defer a large amount of suitable habitat that could be used to develop future conservation plans for the marbled murrelet. This approach could have tremendous benefits to marbled murrelets if some provisions could be made to guarantee the long-term deferral would continue. Long-term deferral would keep all future options available for the species' protection.

In the near term under this alternative, DNR would conduct habitat relationship studies to assist the Board of Natural Resources in assessing the risk of take. These studies would provide more precise information to determine what constitutes high quality habitat for marbled murrelets in each planning unit. These studies would help minimize the harvest of occupied sites and further define the areas that are likely to contain additional breeding sites. It is likely that these studies would identify some marginal habitat types that could be made available for harvest while deferring higher quality habitat. However, there is no guarantee that the Board would not change their risk-aversion policy and allow harvest in

higher quality habitats at some time in the future. It is unknown what level of risk the Board may choose once these studies are completed.

Although the amount of habitat estimated to be deferred by this alternative appears high, because of the uncertainties regarding future decisions to be made by the Board, there are no guarantees that marbled murrelet habitat would continue to be deferred and protected over time under the No Action alternative. Under this alternative, DNR would not attempt to locate additional murrelet breeding sites once the habitat relationship studies are completed in each planning unit. The surveys conducted in the study make up only a small sample of stands within each planning unit. Although identified occupied sites would be protected by ESA requirements, the location of the majority of other breeding sites on the landscape in each planning unit would not be known. No intensive surveys designed to cover all suitable habitat within each planning unit would be conducted. Therefore, even if desired, there would be little opportunity to protect these sites from disturbances due to forest management activities occurring on the adjacent landscape and no opportunity to enhance or increase the level of habitat protection of breeding sites since their locations are unknown.

Even for occupied sites that are located and protected by the ESA, the No Action alternative has no short- or long-term provisions to clearly delineate or protect these breeding areas. No site-specific management plans or protection guidelines exist for occupied sites. Loss and degradation of suitable habitat due to windthrow, fire, and riparian protection strategies that are not designed to protect murrelet habitat would be expected to continue. The No Action alternative contains no provisions to minimize or reduce disturbances to breeding areas from road maintenance and forest management activities, especially since the locations of the majority of occupied sites are unknown. This alternative does not develop a long-term conservation and monitoring plan designed specifically for marbled murrelet habitat to ensure its persistence on DNR-managed lands over time.

There is no certainty that any protection or habitat improvement measures would be provided to occupied sites except those sites that are already located and protected by ESA. This alternative would not ensure the protection of sufficient amounts of suitable nesting habitat to marbled murrelet populations over time, since it does not include provisions to: (1) survey for occupied sites; (2) develop a long-term protection plan; or, (3) continue deferral of harvesting suitable murrelet habitat. This lack of certainty leads to a lower likelihood that the No Action alternative would provide and retain enough suitable nesting habitat to maintain viable marbled murrelet populations on DNR-managed lands in western Washington. Over time, this alternative is likely to lead to increased disturbance of breeding sites, and a decrease in interior forest conditions resulting in reduced protection of nests from windstorms and environmental changes, increased loss of habitat due to windthrow, and an increase in the number of nest predators and nest predation due to forest fragmentation. It is possible that a reduction in the range of the marbled murrelet could occur with impacts most severe in southwest Washington and the near-coastal areas of the Olympic Peninsula. Under this alternative, marbled murrelets would have a high likelihood of being extirpated from DNR-managed lands.

If a large percentage of the occupied sites on DNR-managed lands are not located and protected over time under the No Action alternative and these sites are degraded or lost, this could lead to the majority of the population being primarily dependent on federal habitat. In the short term, such dependency would likely lead to lowered reproductive success, decreased adult survivorship, and population declines of the marbled murrelet in western Washington.

There would be a higher risk that USFWS recovery goals for conservation zones in western Washington may not be achieved. It is likely that larger gaps in the distribution of the species habitat would develop. There is no certainty provided by the No Action alternative that sufficient protection would be provided to breeding habitat to make a significant long-term contribution to federal conservation strategies (President's Forest Plan). Instead, this alternative would likely decrease the probability that the President's Forest Plan would provide for sufficiency of habitat to sustain a viable well-distributed population of marbled murrelets on federal lands over a 100-year period.

ALTERNATIVE B

Under Alternative B, DNR would protect all occupied sites located by the habitat relationship studies conducted in each planning unit, and conduct intensive surveys on all the acres within each planning unit that are expected to contain 95 percent of the remaining occupied sites with the highest probabilities of occupancy. All take would be avoided during the 2-year habitat relationship studies. The planning unit-by-planning unit approach is intended to minimize the amount of nesting habitat that might be lost. Five percent of all the potential occupied sites on DNR-managed lands does not equate to 5 percent of all sites, nor to 5 percent of the population. Where federal lands are present, only a fraction of the existing sites might be located on DNR-managed land. Additionally, since any take of occupied sites would occur in habitat with the lowest probabilities of occupancy (lowest habitat quality), these sites would likely contain a lower density of nesting sites than high quality stands identified and intensively surveyed for occupancy.

It is estimated that DNR may manage 7 percent of the old-growth habitat in western Washington. If it is assumed that this habitat supports 7 percent of the population in Washington, and that 5 percent of the occupied sites on DNR-managed lands may be taken over time, it is possible to roughly estimate the proportion of the population likely to be affected by Alternative B. Multiplying these percentages together, it is estimated that the population could be reduced by a maximum of four-tenths of 1 percent (0.35 percent) under Alternative B in the short term. However, all occupied sites found during the habitat relationship studies and those currently known will also be protected. In addition, the alternative places all the impact of habitat removal in the lower quality habitat expected to contain fewer birds and lower reproductive success. Therefore, the percent of the population affected is expected to be less than four-tenths of 1 percent.

The sites lost would be those located in the lower quality habitat that would not be surveyed intensively under Alternative B. This lower quality habitat would be a part of the future harvest plan. For all remaining occupied sites known or located during the

implementation of the alternative, a management plan would be developed for each occupied site that will be designed to protect remaining habitat from fire, windthrow and disturbances. These plans would design management strategies to improve habitat conditions at these sites to increase nest success and decrease adult and juvenile mortality. The information base to develop these management strategies will be derived from a cooperative research program that will take place over a 7-10 year period. At the end of this period, when the habitat relationship studies and intensive surveys are completed, a long-term conservation plan would be developed to protect all occupied sites. This plan may include provisions for protecting unoccupied suitable habitat or some occupied sites in marginal habitat when needed to meet biological objectives for the population or landscape-level planning needs described in the plan (more uniform distribution of habitat or breeding sites, prevention of isolation). Although provisions for maintaining unoccupied suitable habitat are not specifically described in the long-term plan, there is a high likelihood that a significant amount of suitable unoccupied mature and old-growth habitat will be available and protected due to the HCP conservation strategies planned for the northern spotted owl and riparian ecosystem. For example, the OESF HCP has plans to protect as much as 25 percent of the landscape in riparian zones and 20 percent of the landscape will be retained in an old-growth condition for spotted owls.

All the higher quality murrelet habitat that is found to be occupied by marbled murrelets would be protected by Alternative B over a 10-year period. After the 10-year period, a long-term conservation plan will be developed that implements a strategy to protect and improve the conditions at all occupied sites located. The time frame for this long-term plan is not specified but will likely be a period of 50-100 years to attain the objectives of a landscape approach.

As noted above, the amount of suitable unoccupied habitat that would be protected specifically for marbled murrelets after the long-term plan is developed in 10 years is not specified, but may be significant. An estimated 38,442 acres of occupied habitat located 0-50 miles inland would be protected under Alternative B. Because a small percentage of occupied sites may be taken when harvest of marginal habitat occurs, the actual amount of habitat protected may be somewhat less than this figure. Assuming 5 percent of the occupied sites taken under Alternative B would include 5 percent of the 38,442 acres of occupied habitat on DNR-managed land, then approximately 1,922 acres of occupied habitat may be harvested under Alternative B. This assumes that 5 percent of the occupied sites would equal 5 percent of the occupied habitat area. If stand size is found in the habitat relationship studies to be positively related to stand occupancy, then any occupied sites taken may include stands of smaller size. This would result in a lower harvest level.

Most of the harvest would likely occur in the OESF Planning Unit (1,655 acres), where the majority of habitat on DNR-managed lands remains. This area has a higher percentage of potential nesting habitat still available on USFS and national park lands than anywhere else in Washington. This area includes 60 percent more nesting habitat on federal ownerships than in the western Cascades (FEMAT 1993). The harvest estimate for the OESF is likely an overestimate considering that many stands of suitable unoccupied

murrelet habitat would not be harvested because of the protection provided to riparian ecosystems and the spotted owl within the scope of the HCP. In many cases interior and exterior buffers planned along streams in the OESF will help protect additional murrelet habitat. These buffers will range in width from 150-300 feet (each side) depending on stream type and whether one or both buffers are applied. The exterior buffer is open to the harvest of one-third of the volume present and thus has less value to marbled murrelets over time. It is estimated that up to 25 percent of the forested areas of the OESF may be managed as riparian buffers over the long term. The OESF owl protection strategy objectives are to attain or maintain 20 percent of DNR-managed lands in old-growth forests and 40 percent in young forests in each of 11 landscape planning units. After 100 years, it is estimated that an average of 34 percent of the DNR-managed landscape may consist of old-growth forest at any one time. Therefore, the riparian and owl protection strategies may provide a significant amount of additional suitable but unoccupied habitat and replacement nesting habitat for marbled murrelets over time.

The next highest harvest of occupied habitat would occur in the North Puget Planning Unit, where it is estimated there would be a potential loss of 149 acres of occupied habitat (5 percent of 2,986 acres). This area also includes riparian protection and owl protection strategies within the scope of this HCP that will protect additional areas of unoccupied suitable marbled murrelet habitat.

Alternative B would protect approximately 54 percent less habitat than the No Action alternative. The difference in the inland distance criteria used by these two alternatives (52.25 versus 50 miles) results in approximately 154 fewer acres of habitat being protected under Alternative B compared to the No Action alternative. More importantly, most of the protection provided by Alternative B remains throughout the life of the proposed long-term plan, approximately 100 years. Long-term protection provides more certainty that breeding habitat would be available for breeding birds through time.

Some future options for the protection of habitat would be lost under Alternative B as some marginal habitat as defined by the habitat relationship study is harvested (including some occupied sites), and as some suitable unoccupied habitat is harvested in planning units outside of southwest Washington before the long-term plan is developed. These actions would reduce the options available for consideration in developing the long-term conservation plan. Harvest under this alternative could result in the loss of some occupied sites that may have been important in maintaining a more uniform distribution of occupied sites on the landscape, preventing the isolation of some breeding sites, and providing potential replacement habitat for breeding sites lost to natural disturbance events.

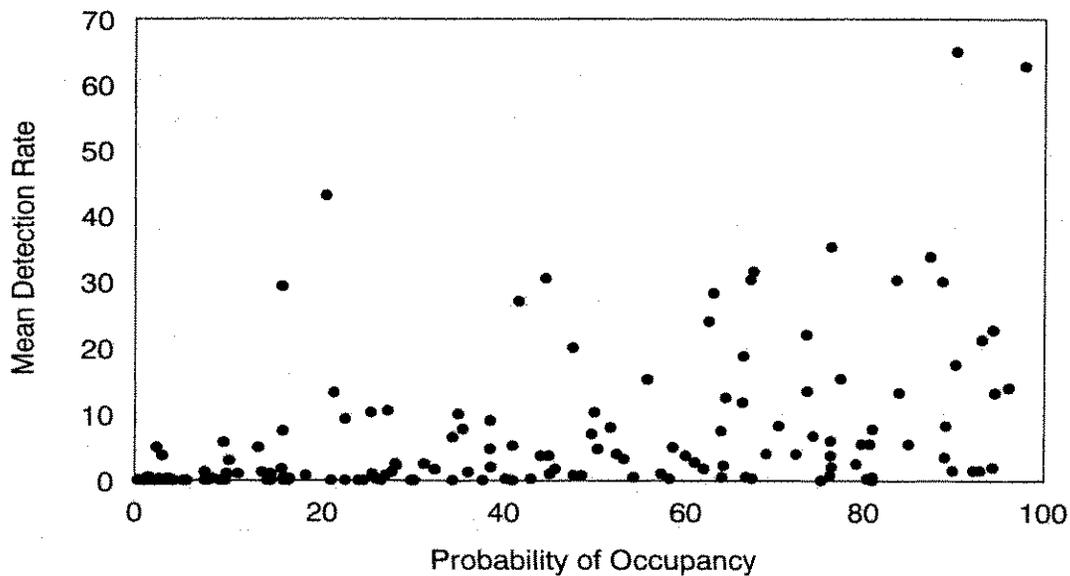
Loss of some occupied sites in marginal habitat may be significant in some areas such as southwest Washington and near-coastal areas of the Olympic Peninsula where very few breeding sites remain to support local populations. Survival of populations in these areas may be completely dependent on a few remaining patches of suitable habitat. Harvest of any of these remaining sites may greatly reduce the likelihood that local populations would persist over time in these areas. Alternative B's long-term plan should address the issue of providing suitable but unoccupied habitat to replace habitat loss to natural

disturbances or specifically plan to develop suitable habitat in areas specified in the Draft Recovery Plan. A worst case analysis would indicate it is possible that Alternative B would result in the harvest of a maximum of 5 percent of the occupied sites, thus potentially eliminating nesting habitat for 5 percent of the population on DNR-managed lands. In addition, there is some risk that any habitat models developed could result in some error so that more than 5 percent of the occupied sites are taken over time. Significant effects on populations would only be expected to occur in planning units with higher occupancy rates (larger numbers of occupied sites) such as the OESF, South Coast and North Puget planning units.

Alternative B proposes to minimize the impact to marbled murrelet populations through the loss of potential nesting habitat in two important ways. First, the habitat relationship studies employed to identify the small percentage of occupied sites in marginal habitat that may be taken under this alternative use a statistical model that calculates the probability that a site may be occupied by marbled murrelets. Only sites with the lowest probabilities of occupancy would be available for harvest. Hamer et al. (1994b) found that the probability of occupancy of a site is directly related to the number of murrelet detections recorded at a site, with a higher number of detections more likely to be recorded at sites with higher probabilities of occupancy (Figure 4.2.10). This model may not fully capture the relationship between the number of detections and probability of occupancy. For example, anecdotal evidence suggests that murrelets may be less likely to vocalize when entering or leaving a stand with low numbers of murrelets, making detection less likely (K. Flotlin, personal communication). Although the exact relationship between the number of murrelet detections recorded at a site and the numbers of birds using a site is unknown, it is generally accepted that a higher number of detections indicate that a larger number of birds are using an area. Therefore, by only harvesting stands with the lowest probability of occupancy, Alternative B minimizes the effect on the population by concentrating the protection given to occupied sites to those sites that support the majority of the population. Although a maximum of 5 percent of the occupied sites may be taken in marginal habitat, the actual percentage of the population affected is likely to be much smaller.

Figure 4.2.10: Mean detection rates (number of birds detected per survey morning) of marbled murrelets at 151 sites surveyed in western Washington compared to the calculated probability that each site is occupied by marbled murrelets

The probability of occupancy for each site was derived using a logistic regression model which predicts occupancy based on the vegetation characteristics of the forest that were measured at each site.



Second, specific guidelines outlined for the development of a long-term conservation plan (see draft HCP for more details) and protection strategies for occupied sites would include the objectives of examining the entire landscape within a planning unit. This would help determine which sites are in most need of protection and enable land managers to consider landscape-level problems in distribution. Landscape-level planning would prevent the isolation of breeding colonies, help maintain a well-distributed population, and could lead to the protection of all occupied sites in certain critical planning units with low populations and little remaining habitat. These primary conservation plan objectives should ensure that any reduction in breeding habitat or population size is minimized to the greatest extent practicable. They would also help ensure that all population-level factors such as isolation and genetic diversity are considered, and that full consideration is given to the protection of sites important in maintaining a population on DNR-managed lands in conjunction with expected habitat conditions on federal lands.

The two most significant benefits of Alternative B are the certainty of protection of occupied sites over time, and the objective of locating up to 95 percent of the breeding sites in each planning unit. Once the locations of these sites are known, specific management plans and recommendations can be made for each site to improve habitat conditions over time. These habitat improvements would be designed to stabilize or increase reproduction and decrease adult and juvenile mortality at breeding sites. In addition, management plans would be designed to reduce the additional loss of murrelet habitat through fire and windthrow. Riparian protection strategies that were not developed specifically to benefit murrelets could be modified in these plans under certain circumstances to improve habitat conditions at occupied sites. Once these occupied sites are located, protection from the disturbance of adjacent timber and road management activities can be provided. Management plans may include designs to reduce gaps in the distribution of habitat through the retention of unoccupied but suitable habitat or through plans to develop new habitat. With all these protective actions and planning efforts, it is expected that the population would increase over the long term.

The long-term conservation plan developed by DNR would include information on the location of occupied sites, the distribution of habitat in each planning unit, current research results, landscape-level analysis and considerations, and the site-specific management plans developed by DNR. This process should result in a comprehensive, detailed landscape-level plan that would help meet the recovery objectives of the USFWS, contribute to the conservation efforts of the President's Forest Plan, and make a significant contribution to maintaining and protecting marbled murrelet populations in western Washington over the life of the HCP. The development of this type of plan would not be possible without conducting the intensive surveys to locate the majority of occupied sites and the research being conducted under Alternative B.

Because Alternative B locates and protects the majority of occupied sites on DNR-managed lands, this alternative has a higher likelihood, when compared to the No Action alternative, of ensuring: (1) a population size adequate to prevent extinction from random population fluctuations and marine influences; (2) prevention of extinction in some regions by locating and providing immediate protection to these sites; and, (3) buffering

against catastrophic events through the development of a long-term landscape-level conservation plan. This is especially true for those areas where significant additional support is provided by federal conservation plans. Under Alternative B, areas such as southwest Washington will have a higher likelihood of maintaining murrelet populations compared to the No Action alternative, but will likely experience difficulties in maintaining viable populations over time unless additional efforts and specific strategies are developed in a long-term plan that addresses these areas. Although some small reduction in the population of marbled murrelets on DNR-managed lands can be expected under Alternative B, this reduction would be minimized with full consideration given to population-level concerns. This small reduction in population size would be offset by the significant benefits of locating and providing long-term protection to the majority of occupied sites and helping conduct research to determine how to protect the breeding potential of the population.

The information gained in the near term under Alternative B would result in less risk of isolating nesting colonies and less disruption to annual breeding cycles and reproductive success than under the No Action alternative. Alternative B would provide significant support to the President's Forest Plan and benefit federal recovery efforts. Under Alternative B, all six of the actions listed by the Draft Marbled Murrelet Recovery Plan (Marbled Murrelet Recovery Team 1995) to achieve recovery of the species would be implemented. Alternative B would likely lead to a higher probability compared to the No Action alternative that the President's Forest Plan would provide for sufficiency of habitat to sustain a viable well-distributed population of marbled murrelets on federal lands over a 100-year period.

ALTERNATIVE C

The conservation strategy for the marbled murrelet proposed under Alternative C is similar to Alternative B except that all suitable habitat, even marginal habitat or habitat known to be unoccupied, is retained until a long-term conservation plan is developed. Approximately 60,664 acres of occupied nesting habitat and suitable unoccupied habitat would be protected by Alternative C over a 10-year period. The amount of suitable unoccupied habitat that would be protected after the long-term plan is developed in 10 years is not specified.

The retention of this habitat would benefit the development of a long-term plan, possibly provide for future nesting habitat for the murrelet and keep all conservation options open for the species. No occupied sites would be lost in the interim during the development of the long-term plan. The uniformity in the distribution of habitat on the landscape would be maximized and the potential for isolating breeding colonies minimized. Alternative C has an even higher chance than Alternative B of ensuring that as habitat is lost to natural events and potential catastrophic influences, sufficient habitat is available to support remaining populations. Therefore, Alternative C has the highest likelihood of protecting the majority of breeding sites and more certainty in maintaining an adequate amount of habitat over time to make a significant contribution to federal recovery and conservation efforts. Alternative C has the greatest chance of increasing the probability that the President's Forest Plan would provide for sufficient habitat to sustain a viable well-distributed population of marbled murrelets on federal lands over a 100-year period. This

alternative has the highest likelihood that the population would persist for the long term on DNR-managed lands and in western Washington in conjunction with federal conservation strategies.

Assessment of Criterion 2 - Qualitative: Likelihood that the alternative would protect or enhance the reproductive potential of the population in conjunction with federal conservation efforts which would lead to the long-term persistence and adaptation of the species in Washington

This criterion makes a qualitative assessment whether enough protection is provided to the population to increase the likelihood that successful reproduction is maintained or increased, adult survival is maintained or increased, breeding sites are not disturbed during the breeding season and decrease the likelihood of reduced genetic variability and isolation of occupied sites. Criterion 2 also assesses qualitatively whether a population source for the colonization of future sites in unoccupied suitable habitat would be provided.

Measure: Qualitative assessment of the degree and length of time that occupied sites are protected. The assessment includes the degree that occupied sites were protected from disturbances due to forest management activities, further degradation and modification of breeding habitat, further fragmentation of breeding habitat (edge effects), loss of habitat due to windthrow, microclimatic changes to the stand, and nest predation.

ALTERNATIVE A

A significant advantage of the No Action alternative is the deferral of harvest of the majority of suitable marbled murrelet habitat to 52.25 miles inland. These deferrals in the early stages of this alternative contain a significant amount of habitat that could help protect breeding sites from disturbances due to forest management activities, prevent further degradation and fragmentation of breeding sites, help prevent the isolation of breeding sites and possibly reduce predation effects on adults and young.

If these deferrals of habitat were continued through time, there would be more certainty that the No Action alternative would help protect the reproductive potential of the population. Although the majority of timber harvest of suitable marbled murrelet habitat is currently deferred under the No Action alternative, there is no certainty that the Board of Natural Resources would continue with this mode of operation. The Board could choose to change their current take-avoidance/risk-management approach and allow harvest of some proportion of this habitat at any time. In addition, because this alternative does not include provisions to locate additional breeding sites or identify the location of the majority of these sites once the habitat relationship studies are completed, it is not able to afford protection to these sites from disturbance, provide habitat enhancement measures, reduce fragmentation, assess the isolation of occupied sites, or protect specific breeding sites from the risks of windthrow and fire. Information regarding the location of breeding sites would not be available for managers to attempt to reduce predation affects through habitat enhancement or through the use of more direct methods.

Implementation of the No Action alternative has the potential to reduce potential murrelet population because this alternative contains no provisions for protection of future breeding sites in the event potential breeding habitat should be lost. Under the No Action

alternative, DNR would not actively locate additional occupied sites after the habitat relationship studies are completed. This alternative does not contain plans to develop methods to delineate the boundaries of occupied sites once they are located. Therefore, the location of only a small sample of occupied sites would be known and the actual areas used by murrelets within these stands would be difficult or impossible to determine. The No Action alternative contains no additional protection to known occupied sites other than the minimal protection afforded by the Endangered Species Act (ESA) and current Washington Forest Practices Rules. As discussed in the section under "Current Habitat Protection," current forest practices rules regarding the protection of riparian and wetland areas and wildlife trees are not designed to directly address marbled murrelets and may actually be detrimental depending on how these rules are applied in the field.

Since the majority of locations of occupied sites would remain unknown under this alternative, no opportunities exist for providing needed protection to these sites. No habitat improvement or habitat enhancement is planned for any occupied site. There are no strategies to reduce the fragmentation level at occupied sites over time or to speed the development of suitable habitat adjacent to, or within, fragmented occupied sites. There are no considerations or plans for the provision of interior forest conditions at known occupied sites over time.

Because the locations of the majority of occupied sites on the landscape would likely not be known under the No Action alternative, no opportunities are available to locate important gaps in the distribution of occupied sites and work toward eliminating these distribution problems or reducing the isolation of breeding colonies. The Draft Marbled Murrelet Recovery Plan recommends that viable populations be maintained within each segment of the species' range and identifies southwest Washington (southern end of conservation zone 2) and the Puget trough (western portion of conservation zone 1) as areas important to recovery efforts because they contain small amounts of suitable habitat and contain little or no federal ownership to offer support from federal conservation efforts (Marbled Murrelet Recovery Team 1995). The No Action alternative does not attempt to specifically locate or improve the habitat conditions at these important remaining breeding sites and offers no longer term strategy to replace or increase the amount of available habitat within these areas as recommended in the recovery plan. DNR manages significant amounts of land within these areas that have the potential to provide substantial short- and long-term benefits and support to these remaining populations.

More support from federal conservation efforts will be provided in the northeastern portion of recovery zone 2 (western Olympic Peninsula) and eastern portion of conservation zone 1 (north Cascade Range) because of the presence of large areas of USFS and national park lands. It is expected that the amount of suitable habitat on USFS-managed lands will actually increase over time (replacement habitat) as managed under the President's Forest Plan.

The No Action alternative does not include provisions to reduce predation at breeding sites, reduce adult and juvenile mortality at inland sites, increase breeding habitat and

nesting opportunities, maintain the microclimate of nesting habitat, prevent disturbances to occupied sites, or reduce losses of suitable habitat to windthrow or fire.

Some disturbance protection to known occupied sites could be expected from adoption of a final forest practices rule on marbled murrelets, but currently no final rule has been chosen. It is not known how the final rule may be modified and the locations of many sites might not be known. Reduction of disturbance to occupied sites that are located by the habitat relationship studies could be expected because of ESA regulations. However, since the locations of the majority of breeding sites will not be known under this alternative, harvest of unsuitable habitat adjacent to deferred habitat could be expected to occur over time, potentially disturbing a large number of breeding sites.

This alternative has no provisions to encourage cooperative research projects on the marbled murrelet to collect the information necessary to develop protection strategies and enhancement measures for breeding sites. Without such information, protective areas might be established around breeding sites with no assurance that reproductive success, adult survivorship, or the proportion of adults breeding in any year would be maintained or enhanced. Populations could continue to decline if managers simply delineated breeding sites without an understanding of the needs of the population or how reproductive success and adult mortality relate to habitat conditions.

The No Action alternative, when compared to Alternatives B and C, has the lowest likelihood of protecting or enhancing the reproductive potential of the population to a level that would lead to the long-term persistence and adaptation of the species in Washington in conjunction with federal conservation strategies. Operating under the No Action alternative would decrease the likelihood that successful reproduction and adult survival are maintained or increased. The No Action alternative would continue practices which create a higher risk of isolating occupied sites, and contain no long-term plan for providing suitable unoccupied habitat or marginal habitat as a source of habitat for future populations. No special considerations or protection strategies are provided to those portions of conservation zones specifically designated as important to recovery efforts by the Draft Marbled Murrelet Recovery Plan. It has a low likelihood of contributing significantly to federal conservation efforts since recovery plan objectives and the protection guidelines developed for the President's Forest Plan are not used to protect or enhance occupied sites. No landscape-level considerations are made to protect the population and any protection afforded to the population may only be short term.

ALTERNATIVE B

Alternative B differs significantly from the No Action alternative in that its short-term purpose is to maintain options while collecting information needed to develop a long-term management plan with a goal to protect 95 percent of the breeding sites located on DNR-managed lands. After completion of the habitat relationship study within a planning unit, DNR would initiate an intensive survey effort. Concentration of the occupancy survey effort in the highest quality habitat would ensure the most efficient and cost-effective survey effort, and increase the chance of locating the majority of breeding sites. Alternative B would lead to location and protection of the majority of the breeding sites within this higher quality habitat. Five percent of the occupied sites with the lowest

probability of occupancy (lowest habitat quality) would probably not be protected. All occupied sites currently known or located during the habitat relationship study would be protected regardless of the habitat quality.

Under Alternative B, on-site management plans would be developed for each breeding site found. Management plans would identify the specific needs for each breeding site, such as high risk for loss of habitat due to windthrow potential or fire, fragmentation, disturbance, or lack of interior forest conditions. Management plans would help reduce or eliminate these problems and suggest ways to enhance habitat conditions. Management plans developed for each occupied site would include provisions to protect or enhance interior forest conditions to reduce predation at the nest sites and maintain forest microclimate and structure. Silvicultural methods would be employed to speed the development of suitable habitat and increase the amount of suitable habitat while reducing fragmentation. Recruitment habitat found within occupied stands would be maintained and developed to decrease fragmentation and increase the size of breeding sites. In areas where few breeding sites exist and the longer term outlook for murrelet is poor, habitat areas could be recommended for development to increase the amount of suitable habitat to support local populations. In southwest Washington, options for the future will be preserved by retaining high quality suitable, but unoccupied habitat.

Management plans may utilize buffers to minimize edge effects and maintain interior forest conditions by minimizing windthrow and microclimatic changes in the stand interior. Interior forest conditions may help reduce predation of adults and nestlings by providing camouflage and cover for the nest and for adults visiting the nest site. Some nest predators may not be as numerous in interior forest conditions as they are in edge-related habitat. These buffers may give additional protection that would lead to reduced predation of adults and young at the nest sites and maintenance of the microclimatic conditions which maximize nesting success and suitable nesting habitat conditions.

Once the breeding sites within each planning unit are known, a long-term plan would be drafted for the entire planning unit that would then have the ability to take into consideration the entire landscape condition and juxtaposition of occupied sites to each other. Under Alternative B, after the 10-year interim period, DNR would assemble a team of scientists with expertise in conservation biology and ornithology to develop a long-term landscape-level conservation plan. This landscape-level planning ability would allow an analysis and consideration of ways to avoid the isolation of breeding sites, identify areas with suitable unoccupied habitat, identify gaps in murrelet distribution, and allow long-range planning. Breeding populations would have a higher likelihood of being maintained in southwest Washington, the Puget trough, and near the coast on the Olympic Peninsula due to efforts to locate and protect occupied sites in these areas within a reasonable time frame. Alternative B would better enable biologists to assess and maximize the degree of habitat protection overlap between the marbled murrelet and other old-growth-dependent species such as the spotted owl and assess the degree of added protection provided by riparian protection plans. This strategy would likely reduce the total amount of habitat needed for old-growth-dependent species.

The long-term planning provided in Alternative B should create conditions with a higher likelihood that displaced breeding birds could locate additional suitable nesting habitat within the same watershed or adjacent watershed unit, within a shorter time period after loss from timber harvest, fire, or other catastrophic event. A shorter time period would likely result in less disruption to the breeding cycle and, possibly, better reproductive performance. Alternative B attempts to accomplish this goal with a long-term conservation plan. Alternative B would also help prevent isolation of occupied stands because attempts would be made to survey other suitable habitat within the same planning unit within a short period of time to determine occupancy.

Alternative B would allow and encourage cooperative research on the marbled murrelet to collect information over the interim period to better provide substantial and verifiable protective measures to occupied sites. Such research would not be prioritized under the No Action alternative. With this information, DNR could assess the potential for breeding and survival success of marbled murrelets, allowing more efficient planning and habitat conservation. The resulting research information could then be used to develop new methods and techniques to: (1) protect occupied sites from disturbance and harmful habitat modifications; (2) use silvicultural methods to increase the quality of nesting habitat; and, (3) reduce predation of juveniles and adults at breeding. This research will allow managers to understand more clearly the needs of the population or how reproductive success and adult mortality relate to habitat conditions thus providing them with tools to improve breeding conditions and breeding success for these birds over time.

The proposed actions under Alternative B are more consistent with recovery actions outlined in the Draft Marbled Murrelet Recovery Plan (Marbled Murrelet Recovery Team 1995) than those of the No Action alternative. Recovery actions to protect breeding sites were discussed earlier under possible methods used by DNR to protect occupied sites. Alternative B's near-term strategy to locate and protect occupied sites may greatly benefit the species since the recovery team has stated that the next 50 years will be a critical time for the marbled murrelet since little additional suitable habitat is expected to develop within LSRs (Late-Successional Reserves) before that time.

Because the locations of the majority of occupied sites on the landscape would be known under this alternative, opportunities will exist to identify important gaps in the distribution of occupied sites and work toward eliminating these distribution problems and reduce the isolation of breeding colonies as recommended by the Draft Marbled Murrelet Recovery Plan (Marbled Murrelet Recovery Team 1995). The draft recovery plan also recommended that viable populations be maintained within each segment of the species range and identifies southwest Washington (southern end of conservation zone 2) and the Puget trough (western portion of conservation zone 1) as areas important to recovery efforts because they contain small amounts of suitable habitat and contain little or no federal ownership that will offer support from federal conservation efforts (Marbled Murrelet Recovery Team 1995). Alternative B attempts to specifically locate, protect, and improve habitat conditions at these important remaining breeding sites. The long-term plan to be developed in Alternative B includes objectives of protecting all occupied sites in certain critical planning units with low populations and little remaining habitat and preventing the isolation of breeding colonies. Although not specifically stated in the

description of the long-term plan, plans may include developing habitat to replace or increase the amount of available habitat within these critical areas to attain the long-term plan objectives. Increasing the amount of habitat available and providing replacement habitat are both recommended recovery objectives. DNR manages significant amounts of land within these areas that have the potential to provide substantial short- and long-term benefits and support to these remaining populations.

More support from federal conservation efforts will be provided in the northeastern portion of recovery zone 2 (western Olympic Peninsula) and eastern portion of conservation zone 1 (north Cascade Range) because of the presence of large areas of USFS and national park lands. It is expected that the amount of suitable habitat on USFS-managed lands will actually increase over time (replacement habitat) as managed under the President's Forest Plan.

Alternative B has a high likelihood of providing significant support to the interior forest conditions being planned and managed for on federal lands under the President's Forest Plan. It would also better provide for the interior forest conditions being sought by the Draft Marbled Murrelet Recovery Plan.

The amount of disturbance protection provided under Alternative B would be greater than under the No Action alternative because more occupied sites would be located within a short period of time and because DNR would develop management plans for these sites. Management plans would be designed to minimize disturbances to breeding sites. Therefore, this alternative has a high likelihood of offering sufficient protection to breeding birds from nest-site disturbances.

Compared to the No Action alternative, Alternative B has: (1) a higher likelihood of preventing population declines and maintaining or enhancing reproductive potential of the population; (2) higher likelihood of protecting breeding sites from disturbances; and, (3) a higher likelihood of making a significant contribution and support to the President's Forest Plan and federal recovery efforts which would increase the likelihood of the long-term persistence and adaptation of the species in Washington. Alternative B would also decrease the likelihood that catastrophic events would eliminate remaining breeding in areas with few existing breeding sites because the majority of occupied sites would be located and protected.

ALTERNATIVE C

Alternative C would provide similar enhancement of breeding potential to Alternative B, except that under Alternative C there would be no harvest of suitable unoccupied murrelet habitat in any planning unit (as compared to just southwest Washington for Alternative B) or marginal habitat within a planning unit until a long-term conservation plan is developed for the unit. This approach would reserve all options for the final planning team to develop a long-term conservation plan that can utilize all available habitat options and have the best likelihood of success. These considerations may specifically include replacement habitat for marbled murrelets in areas where gaps in the distribution of breeding sites exist or in areas near a breeding site that has the potential of being isolated on the landscape as recommended for certain conservation zones

delineated by the USFWS in the Draft Marbled Murrelet Recovery Plan (Marbled Murrelet Recovery Team 1995). If an area was to lose the only remaining breeding sites to windthrow, fire, or other environmental effects, providing replacement habitat in these areas would help prevent the risk of a complete absence of suitable nesting habitat over time. These areas of concern include southwest Washington (southern end of conservation zone 2) and the Puget trough (western portion of conservation zone 1). These areas are considered important to recovery efforts because they contain small amounts of suitable habitat and contain little or no federal ownership.

The proposed actions under Alternative C are even more consistent with recovery actions outlined in the Draft Marbled Murrelet Recovery Plan (Marbled Murrelet Recovery Team 1995) than those of Alternative B because of the provisions for suitable unoccupied habitat as replacement habitat and objectives to develop suitable habitat in critical areas over time. Except for southwest Washington where the expected results of Alternatives B and C are similar, Alternative C has a higher likelihood than Alternative B of protecting the reproductive potential of the population because there will be an increased likelihood of providing for interior forest conditions due to the additional suitable unoccupied habitat that would be available and maintenance of marginal habitat. In addition, Alternative C has a higher likelihood that displaced breeding birds could locate additional suitable nesting habitat within the same watershed or adjacent watershed, within a shorter time frame than Alternative B due to the retention of marginal or suitable unoccupied habitat for long-term planning.

Therefore, Alternative C has the highest likelihood that the reproductive potential of the population would be maintained or increased in conjunction with federal conservation efforts which would lead to the long-term persistence and adaptation of the species in Washington. Alternative C has the highest likelihood that adult survival would be maintained or increased, breeding sites are not disturbed during the breeding season, and that population sources are provided for the colonization of future habitat. Alternative C has the lowest likelihood of reducing genetic variability of the population and contributing to the isolation of occupied sites.

The provisions under Alternative C to replace murrelet habitat over time and reserve suitable but unoccupied habitat as part of a landscape-level long-term conservation plan would significantly support federal recovery for this species.

Summary of Environmental Consequences of Alternatives

Table 4.2.34: Summary of the environmental consequences of the No Action and Habitat Conservation Plan alternatives according to the two biological criteria

Criteria	Alternative A No Action	Alternative B Proposed HCP	Alternative C
Amount of nesting habitat protected by each alternative in near term	60,283 acres of potential nesting habitat deferred over an unknown time period.	38,442 acres of occupied nesting habitat protected over a 10 year period. Suitable, unoccupied habitat protected in southwest Washington.	60,664 acres of occupied nesting habitat and suitable unoccupied habitat protected over a 10-year period.
Likelihood of long-term protection	No certainty that sufficient habitat is available to maintain populations over time, protect breeding sites, or contribute to federal conservation efforts.	High likelihood that sufficient habitat and protection is provided to support a viable population and assist with federal conservation efforts over the long term.	Highest likelihood that sufficient habitat and protection is provided to support a viable population and assist with federal conservation efforts over the long term.
Likelihood that the alternative would protect or enhance the reproductive potential of the population	Lowest likelihood of protecting or enhancing the reproductive potential of the population at a level leading to long-term persistence of the population.	High likelihood of protecting or enhancing the reproductive potential of the population leading to long-term persistence of the population.	Highest likelihood of protecting or enhancing the reproductive potential of the population leading to long-term persistence of the population.

Cumulative Effects

This analysis of the alternatives considered for conservation of marbled murrelet habitat on DNR-managed lands includes a brief review of the context of this action regarding other state and federal regulations and conservation efforts that may also provide protection to the species. A review of these actions will provide the necessary information to discuss the cumulative effects of this action within this region. The region analyzed for this discussion includes conservation zones 1 and 2 as defined in the Draft Marbled Murrelet Recovery Plan (Marbled Murrelet Recovery Team 1995). The Puget Sound Zone (zone 1) extends south from the U.S.-Canadian border along the east shore of Puget

Sound to Port Townsend, there turning westward along the north shore of the Olympic Peninsula to a point west of Port Angeles near Lake Crescent. The zone extends inland a distance of 50 miles. This zone bisects the Olympic Peninsula. The Western Washington Coast Range Zone (zone 2) extends from a point west of Port Angeles near Lake Crescent west to Cape Flattery, and south to the Columbia River. The zone extends inland a distance of 50 miles from the Pacific Ocean shoreline. The region within these zones includes lands managed by the U.S. Forest Service, U.S. Department of the Interior, private entities, tribal ownership and state-managed lands.

ALTERNATIVE A

Appreciable differences exist between the No Action alternative (Alternative A) and Alternatives B and C in the cumulative effects on the regional population of marbled murrelets. Assuming continued implementation of the President's Forest Plan, significant impacts to the regional population are likely to occur from the implementation of Alternative A because:

(1) Although 60,283 acres of potential nesting habitat is deferred, this deferral occurs over an unknown time period and is subject to change according to future decisions made by the Board of Natural Resources. There is no certainty that long-term protection will be provided to habitat or populations over time. Therefore, the likelihood of specific long-term protection being given to the marbled murrelet is the lowest of all three alternatives considered. Given that DNR manages as much as 7 percent of the total potential marbled murrelet habitat in Washington State (including federal and nonfederal ownerships). Of the habitat on nonfederal ownerships, approximately 48 percent of the old-growth and 39 percent of mature forests are located on state-managed lands. This habitat represents a significant amount of the old-growth and mature forest nesting habitat available to the marbled murrelet and, if not protected, would likely have significant negative impacts to the regional population. This is especially true for the southern portion of conservation zone 2 (southwest Washington) where a substantial amount of DNR-managed lands exist but federal lands are absent, suitable habitat is extremely limited and populations are low.

(2) Occupied sites are not specifically located. Therefore, little or no protection is afforded these sites since the majority of the breeding locations are unknown. It will be difficult or impossible to provide any protection to these areas unless they are located and mapped.

(3) Efforts to protect and enhance the reproductive potential of the population and improve habitat quality and distribution (habitat enhancement) are not a part of the alternatives objectives. This alternative has the lowest likelihood of protecting or enhancing the reproductive potential of the population.

(4) No research is conducted to determine how best to protect habitat and breeding sites, maintain or increase the reproductive potential of the population, or reduce adult and juvenile mortality. Because the level of biological knowledge on the murrelet is still minimal, research is considered one of the highest priorities by the Marbled Murrelet Recovery Team (1995). It will be impossible to protect a species unless specific management strategies can be developed to provide this protection. These management strategies will be impossible to develop without additional research.

(5) No considerations are planned for providing replacement habitat over time or developing new habitat in areas with significant gaps in the distribution of breeding sites. Because Alternative A does not attempt to locate the majority of occupied sites or plan to implement a landscape-level protection strategy for these areas, this alternative has the lowest likelihood of maintaining viable populations over time in western Washington. This would be especially true in southwest Washington.

(6) Although, in the long term, federal conservation efforts would result in a larger amount of suitable high quality habitat (interior forest conditions) than currently available, it is not known how long Alternative A would continue to provide protection to habitat to help sustain populations until this federal habitat is available. The recovery team estimated it would take a minimum of 50 years before any of this federal habitat began to be suitable.

(7) Alternative A has a low likelihood of contributing significantly to federal conservation efforts since recovery plan objectives and the protection guidelines developed for the President's Forest Plan are not used to protect or enhance occupied sites.

Protection provided by the spotted owl proposed 4(d) special rule, additional habitat conservation plans, and from the proposed Washington State Forest Practices rule proposals for marbled murrelets is not yet known since these plans and processes have yet to be finalized. Therefore, the cumulative effects of these processes could not be analyzed. It is unknown if the results of these plans or rules will significantly add to the protection of the regional marbled murrelet population or not. USFWS critical habitat designations (61 Fed. Reg. 26256 (1996)) became final in May, 1996. Federal lands in reserve status under the President's Northwest Forest Plan provide the majority of lands that fall under critical habitat considerations. DNR-managed lands are currently designated to provide over 99 percent of the nonfederal critical habitat. The Service will conduct an assessment of the effects of DNR's proposed HCP on the critical habitat designation in its Biological Opinion. Additional protection to marbled murrelet populations from current forest practices rules and private land management policies is expected to be minimal. In addition, implementation of the Salvage Rider may result in a loss of 15 occupied sites on the Olympic Peninsula and 20 sites on the Mt. Baker National Forest, reducing the number of nesting opportunities for the marbled murrelet and further impacting the regional population. However, at this time, the Service does not expect harvesting in occupied habitat to occur as a result of the Salvage Rider. More detailed descriptions of these state, federal and private actions or plans are provided below.

ALTERNATIVES B AND C

The differences between the implementation of Alternative B and C in the cumulative effects on the regional population of marbled murrelets is expected to be similar. Therefore, they have been analyzed together in the following discussion. Assuming continued implementation of the President's Forest Plan, significant impacts to the regional population are not expected from the implementation of Alternative B or C because:

-
- (1) the majority of habitat removal occurs in the area where there is the highest acreage of potential nesting habitat on federal lands;
 - (2) all *known* occupied sites are protected;
 - (3) impacts to the population are minimized by harvesting those potential occupied sites with the lowest probabilities of occupancy (marginal habitat) expected to contain the least number of individuals;
 - (4) it is estimated that only four-tenths of 1 percent of the Washington population may be affected;
 - (5) efforts to protect and enhance the reproductive potential of the population and improve habitat quality and distribution (habitat enhancement) are made high priorities;
 - (6) research on the marbled murrelet is made a high priority as called for in the Draft Marbled Murrelet Recovery Plan. This research will be used to develop specific management strategies that can be used to further protect and enhance breeding habitat and the reproductive capability of the population, reduce mortality to juveniles and adults, protect habitat from windthrow and fire, and develop silvicultural prescriptions to develop new habitat;
 - (7) additional suitable but unoccupied marbled murrelet habitat will be available from the implementation of protection strategies in the HCP for the northern spotted owl and riparian ecosystem;
 - (8) in the long term, federal conservation efforts would result in a larger amount of suitable high quality (interior forest conditions) than currently available. These two alternatives provide certainty that current populations will be protected during the interim until this habitat is available. The recovery team estimated it would take a minimum of 50 years before any of this federal habitat began to be suitable; and,
 - (9) both alternatives contribute significantly to federal conservation efforts since recovery plan objectives and the protection guidelines developed for the President's Forest Plan are used to protect or enhance occupied sites.

In addition, locating the majority of occupied sites and implementing landscape-level protection strategies for these areas would result in a higher likelihood of maintaining viable populations over time in western Washington. Alternative B provides interim protection to suitable but unoccupied habitat in southwest Washington. Alternative C provides additional interim protection to suitable unoccupied habitat in all planning units and the long-term plan will include provisions for developing new habitat over time.

Therefore, range-wide impacts of the proposed actions (Alternatives B and C) are not expected. The net effect of the issuance of an incidental take permit and the implementation of Alternative B or C on the regional marbled murrelet population is expected to be minimal and significantly lower than under the No Action alternative.